



MERCEDES-BENZ

20163

Operation and
Maintenance

OM 636



MERCEDES-BENZ

**Operation and
Maintenance**
TG-1442 B-E

OM 636

DAIMLER-BENZ AKTIENGESELLSCHAFT

Stuttgart - Untertuerkheim

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General

Expert operation and maintenance will influence to a high degree the life and availability of your engine. It is therefore to your own interest to closely follow the indications of this brochure on Operation and Maintenance and to carry out in due time the prescribed maintenance work in the correct intervals. In doing so, please attend to the conditions of the engine application when there are departures from standard operating conditions. It is only in this manner that your guarantee claim is maintained. As a matter of principle, do not break lead seals at the injection pump and at the speed governor.

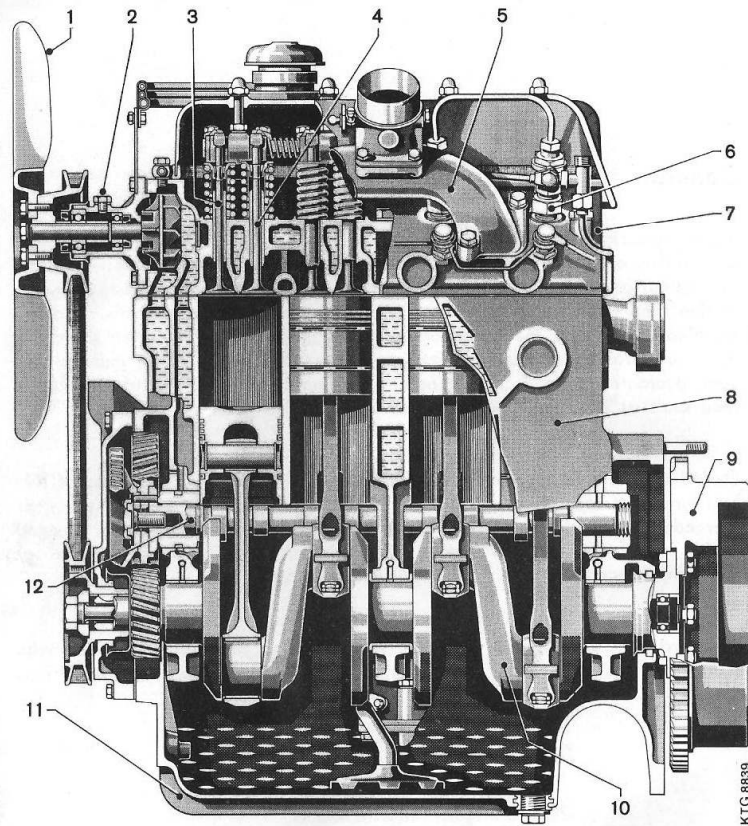
Should there be the desire for an information exceeding the compass of this brochure, the supplier of the unit or of the installation as well as the next Mercedes-Benz Service station are prepared to readily fulfill your demand within the frame of their possibilities. This will also hold true in case of questions concerning repair or supply of spare parts.

In regard to general Service problems, the supplier organization, Daimler-Benz AG, as indicated on the identification plate, will be at your disposition. Should this address not be at hands, please contact

Daimler-Benz Aktiengesellschaft
 Dept. Kundendienst Motoren
 7000 Stuttgart-Untertuerkheim
 Postfach 202

Telephone: 0711-33621
 Telex: daibenz stgt 07-23 901

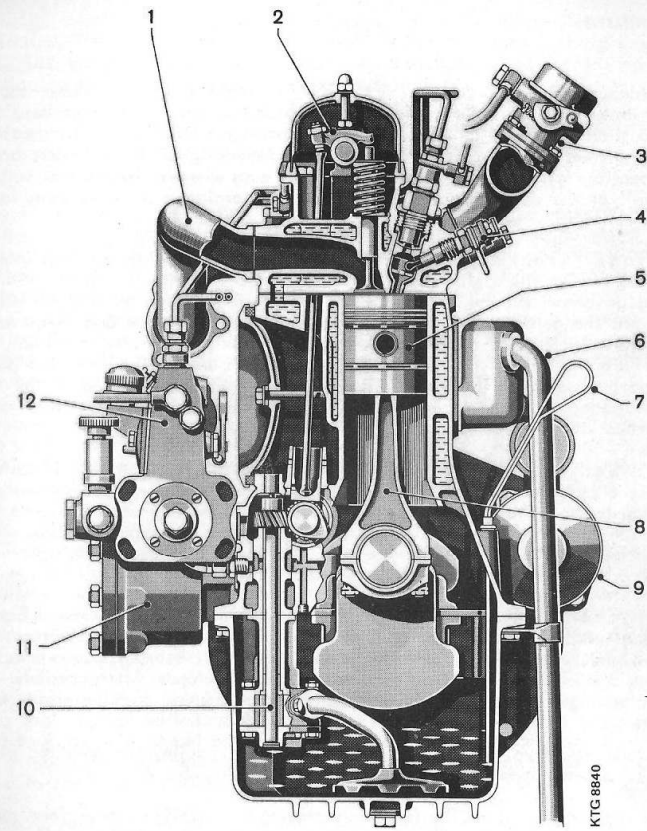
For securing a fast reply of your inquiry or spare parts order, please always state the complete engine number. The identification plate with the engine number is on the right engine side, at the front behind the fuel filter or on the flywheel housing.



KTG 8839

- | | | |
|----------------------|----------------------|---------------|
| 1 Fan | 5 Air-intake pipe | 9 Flywheel |
| 2 Cooling-water pump | 6 Injector | 10 Crankshaft |
| 3 Exhaust valve | 7 Cylinder head | 11 Oil pan |
| 4 Intake valve | 8 Cylinder crankcase | 12 Camshaft |

Figure 1 OM 636 Longitudinal section



KTG 8840

- | | | |
|-------------------------|-------------------------|--------------------------|
| 1 Exhaust-gas collector | 5 Piston | 9 Starter motor |
| 2 Rocker arm | 6 Crankcase ventilation | 10 Oil pump |
| 3 Mixture controller | 7 Dipstick | 11 Horizontal oil filter |
| 4 Heater plug | 8 Connecting rod | 12 Injection pump |

Figure 2 OM 636 Cross section

Structure

The MERCEDES-BENZ Diesel Engine OM 636 is a vertical, water-cooled, four-stroke, four cylinder in-line engine which employs the Daimler-Benz pre-combustion chamber. In the following description of the engine it should be kept in mind that the point of reference for numbering of the cylinders and of the bearings will be the side of the accessory case whereas the sense of rotation as well as the designations clockwise and counterclockwise are referred to the flywheel end.

Cylinder crankcase - The cylinder crankcase of gray iron has integral cylinders. On the right engine side there are the injection pump with the speed governor and the lube-oil filter attached. Situated on the left engine side are the generator, the starter motor, the oil dipstick and the breather pipe for equalization of the pressure in the crank chamber. At the front face there are the helical drive gears for the camshaft and for the injection pump, closed by a cover. The tappet chamber, too, which is located at the right engine side, is closed by a cover. The light-metal oil pan is bolted to the bottom of the cylinder crankcase by hexagon-head screws.

Cylinder head - The common cylinder head of alloy cast iron is fastened onto the cylinder crankcase by hexagon-head bolts. A flat-type gasket seals the combustion chambers of the cylinders and the cooling-water passages from the crankcase to the cylinder head. The intake and the exhaust valves run in guide bushes from gray iron. The cylinder head is closed by a light-metal cover which takes up the oil-filler neck.

Crankshaft - The crankshaft which is drop forged has hardened bearing surfaces and is suspended three times in multi-element friction bearings. The central bearing serves at the same time as the thrust bearing. Counterweights at the crank cheeks compensate the rotating inertia forces and contribute thus to unloading the crankshaft main bearings in quietening the operation of the engine.

The gear for drive of the timing and a vee-belt pulley are mounted at the crankshaft end opposite to the flywheel.

Connecting rod - The forged connecting rod receives a two-piece multi-element friction bearing. The piston pin is supported by a bronze bushing which is pressed-in into the small end. The bearing cap of the connecting-rod big end is screwed to the rod by two fitting bolts and nuts.

Pistons - The light-metal piston has three compression rings and two oil-scrapers rings. The floating piston pin is secured by two circlips. The piston crown is trough shaped.

Camshaft - The camshaft is supported in three light-metal bearings in the crankcase. It is drop forged and possesses hardened bearing surfaces and cams. Against axial displacement it is secured by a collar bearing at the drive side.

The collar bearing as well as the second bearing are split and are held together by circlips. The drive of the camshaft is achieved by the crankshaft via helical gears. The second gear which is bolted to the camshaft serves for driving the injection pump and the injection-timing mechanism.

Valves - Each cylinder has one overhead valve each for the intake and for the exhaust. The valves are timed by the inferior camshaft via tappets, push rods and rocker arms.

Injection units - The fuel feed pump is flanged to the injection pump together with the hand primer. It delivers the fuel from the container via a filter to the injection pump. The fuel is pressed through delivery lines of identical lengths to the injectors (pintle-type injectors). Finely atomized, it is injected into the precombustion chamber. A part of the injected fuel burns in the precombustion chamber. The discharging hot gases cause a pressure rise resulting in a superior and more uniform combustion of the mixture of diesel fuel and air in the combustion chamber proper. The leak fuel of the injectors flows back to the fuel container by a collecting line.

A pneumatic or a centrifugal speed governor which is flanged to the injection pump adapts the fuel quantity to the actual engine load. An automatic injection-timing mechanism, installed on request, advances the point of injection with increasing engine speed.

Lube-oil circuit - The lube oil in the oil pan is aspirated by a gear-type pump via a strainer. This pump is bolted onto the bottom of the crankcase and is driven by the camshaft via helical gears. It primes the lube oil to the main oil gallery via an edge-type or a screen-type filter. From there, it is delivered to the bearings of the crankshaft and of the camshaft by small bores. Bores in the crankshaft direct the oil to the connecting-rod bearings. From the first camshaft bearing, the lube oil rises to the cylinder head by means of a pressure line, situated at the engine exterior, from where it continues its way to the rocker-arm brackets. The rocker-arm bearings as well as the push rods and valves are supplied with lube oil through the hollow rocker-arm shafts. The injection pump with speed governor and the cooling-water pump are equipped with a lubrication of their own. In special cases, the injection pump is connected to the lube-oil circuit.

A by-pass valve in the lube-oil filter and a pressure-relief valve in the main oil gallery protect the oil circuit against overloading. Cylinder contact faces, piston pins, gears and timing cams are lubricated by splash oil.

An oil-pressure gauge permits continuous surveillance of the lube-oil pressure.

Coolant circuit - A cooling-water pump which is driven from the camshaft via a vee-belt aspirates the water which is recooled in the radiator or in the heat exchanger and primes it into the crankcase. The coolant rises at the cylinders, enters the cylinder head by means of bores and flows by an elbow to the thermostat. As long as the engine has not yet reached its operating temperature, the coolant flows back from there by a by-pass line directly to

the cooling-water pump. Not before having attained the operating temperature is the thermostat fully open and the coolant can then flow through the re-cooling system.

Operation

Initial operation

Drain the break-in oil (anti-corrosion oil) which is in the oil pan of engines having undergone a preservative treatment. Further depreserving measures are not required.

Treat the cooling water with 1% of an oil for cooling-water processing (corrosion inhibitor) and fill-in slowly into the radiator or into the attached-type heat exchanger. Open the bleeder valves to allow for escaping of the air trapped in the cooling circuit. Coolant filled-in in excess leaves the circuit by the overflow after having reached the operating temperature.

Fill lube oil into the oil pan and into the injection pump in the prescribed quantities. Use break-in oil (see page 54) for the first replenishment of new or of generally overhauled engines. Moisten the wet-air filter with oil or fill the oil-bath air cleaner, if provided, with oil up to the mark "Normal".

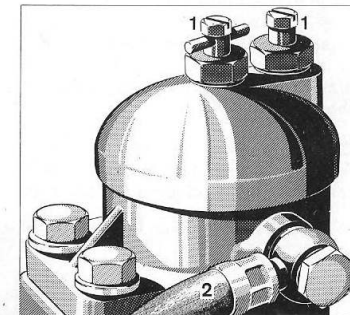
Lubricate the articulations of the control linkage at the injection pump and at the mixture controller by a few drops of oil.

Fill the bearing of the cooling-water pump with oil and lubricate the additional water pump, if provided.

Apply graphite grease to the teeth of the starter-motor pinion and to the ring gear at the flywheel as far as practical.

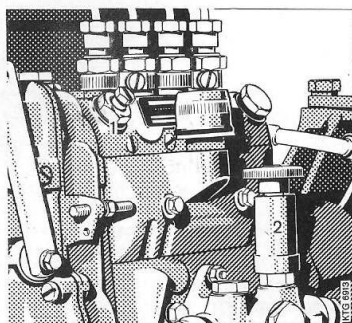
Fill fuel into the storage tank. In doing so, keep impurities out. When the engine has been immobilized for a longer period, first drain the container. Open the stop valve at the fuel container and bleed the fuel system as described subsequently.

Bleeding of the fuel filter - Unscrew the bleeder screw(s) at the filter cover for one or two turns. Slacken the hand primer at the fuel feed pump in turning the knurled nut counterclockwise. Prime until fuel escaping at the



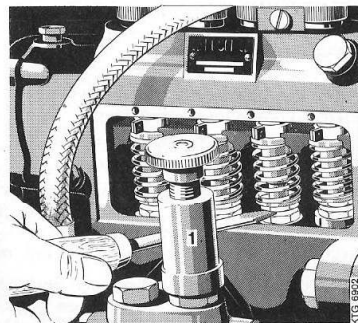
1 Bleeder screws
2 Fuel feed line

Figure 3 Bleeding of fuel filter



1 Bleeder screw
2 Manual fuel primer

Figure 4 Bleeding of injection pump



1 Manual fuel primer

Figure 5 Bleeding of delivery lines

bleeder screw is free from bubbles. Tighten the bleeder screw(s) again and secure the plunger of the hand primer again in turning the knurled nut clockwise.

Bleeding of the injection pump - Unscrew both of the bleeder screws for one or two turns. Slacken the hand primer at the fuel feed pump and prime fuel until it escapes free from bubbles at the bleeder screws. Tighten the bleeder screws again and secure the plunger of the hand primer.

Bleeding of delivery lines - This is required only when the delivery lines are completely empty and when the battery is not fully charged.

Remove the lateral cover at the injection pump. Subsequently move up and down the individual pump elements by means of a suitable tool until the pertinent injector ejects. The plungers of the injection pumps should in this instance be at their bottom dead centers and the fuel rack be in full-load position. After bleeding of all four lines, reinstall the lateral cover in paying attention to the sealing surface.

Other preparations - Examine all hose connections and all pipe branches for leakage. Check the brackets and the fixation bolts of the attached accessories for firm seat, including the bolts for engine suspension. Tighten, if required.

When connecting the battery, ensure that cables are free from oxides.

Regular operation

Examine the coolant level in the surge tank of the attached-type heat exchanger or of the radiator. If required, fill up with cooling water to which 0.5% of a cooling-water processing agent (corrosion inhibitor) has been added.

Do not fill cold water into an engine of operating temperature.

Check the lube-oil level in the oil pan by means of the dipstick and replenish the oil, if required, in adding oil up to the top mark at the oil dipstick. The oil dipstick is calibrated to the normal installation position of the engine.

Check and replenish the fuel level in the storage container. When filling-in, ensure freedom from impurities. Never empty the container completely as otherwise the fuel system has to be bled anew.

Starting

Open the stop valve at the fuel container. Introduce the key into the switch box. In doing so, the red pilot lamp will light up. Cut-in the heater plugs in turning the glow-starter switch into position "1" and keeping it there. Preheat. The duration of preheating is as well a function of the ambient temperature as it is of the engine temperature. It varies between a minimum of 30 seconds for temperatures in excess of +8 °C and a maximum of two minutes for temperatures below -8 °C (see also page 15). The heater-plug indicator resistor is allowed to glow red only. When it glows white, there is a ground contact at one or more than one heater plugs which should be eliminated soonest.

When starting an engine of operating temperature, a preheating is not required. Turn the glow-starter switch into position "2" and keep it there until the engine has fired. Do not cut-in longer than 15 seconds during every starting attempt. Release the switch as soon as the engine has fired. It should return automatically into the position "0". Bring the speed-control lever at the injection pump into the full-load position during the starting procedure. Return the speed-control lever, if possible, into the idling position when the engine has fired.

When the engine does not fire, pause for one minute after every starting attempt in order to save the battery.

Do not actuate the starter motor as long as the engine rotates.

When the engine has fired, immediately check the oil pressure at the oil-pressure gauge. With a cold engine it first will be above the standard reading. When the indication of the oil pressure is below 0.5 kg per sq cm at 650 rpm for an engine at operating temperature, the lube-oil supply is no longer secured. Shutdown the engine at once.

When the engine is started the first time or after a period of longer immobilization, prime the lube oil immediately before the start. In doing so, interrupt

the supply of fuel in acutating the stop lever. Crank the engine a few revolutions by means of the starter motor until the oil-pressure gauge indicates pressure. After firing, warm up the engine for about five minutes at medium speed before loading it. This is particularly true for low ambient temperatures.

Break-in

As a matter of principle, load new or generally overhauled engines but briefly during the first ten hours of operation. This is a crucial factor for its service life, dependability and economy. Perform also the maintenance work indicated in the Maintenance Schedule for the break-in time.

Monitoring

Check regularly available monitoring instruments as, for instance, oil-pressure gauge, coolant telethermometer, tachometer and the like.

The following data should be adhered to:

Coolant temperature *	maximum, continuous	85 °C
	maximum, briefly	90 °C
Lube-oil minimum pressure, engine at operating temperature and 650 rpm		0.5 kpper sq cm
Exhaust-gas bulk temperature, 3,000 rpm, Continuous Rating B and 20 °C intake-air temperature		maximum 600 °C
Speed	for full load	as indicated on identification plate

Check the fuel level. Do not run empty the fuel tank as otherwise the entire fuel system has to be bled.

Check the lube-oil level in the oil pan every 12 hours, if possible during standstill of the engine. Replenish oil, if required.

Check fuel, lube-oil and coolant lines as well as the exhaust-gas collector for leakage from time to time.

Check the exhaust-gas turbidity from time to time. The exhaust gases should neither be blue, white nor black under normal operating conditions.

* We recommend to take a note of the coolant temperature under full load during the initial operation as a basis of comparison. When this temperature is 5 to 10 °C higher under identical operating conditions and identical load after a longer period of duty, it may be necessary to clean the cooling system.

When the oil pressure drops or fluctuates greatly, when speed or output decrease, when the engine breathes heavily or abruptly, when the exhaust shows excessive smoke or when the coolant temperature rises suddenly, the engine is endangered and has to be shutdown immediately.

Shutdown

First unload the engine. Decrease the engine speed gradually by means of the speed control lever to avoid heating of the coolant. Then shutdown.

The engine may be shutdown at once when the duty will require it or also in case of troubles.

Pull the key from the switch box and close the stop valve at the fuel tank.

Winter operation

At the beginning of the cold season, the following advice on the operating agents and for starting of the engine should be kept in mind.

Fuel, see under the section "Operating Agents".

Exchange the lube oil in due time against the less viscous winter oil of the grade SAE 10W, if the ambient temperature drops below freezing point for a period of various days. When the cold ceases, the oil may be mixed with summer oil SAE 30 without risk.

Protect the coolant against frost in due time by the addition of an antifreeze. The antifreeze is of no detrimental influence on the processed cooling water. See also under the section "Operating Agents".

Starting— Even under severe cold, do not pre-heat longer than two minutes and start 15 seconds. After the third starting attempt, interrupt the starting cycle for two minutes minimum in order to allow for a recovery of the battery.

During the cold season, the battery deserves particular attention. The state of full charge is to be aimed at in keeping the consumption of electricity down to the absolute minimum and in also maintaining it carefully. As the starting capacity is greatly reduced with cold, it is a good idea to keep the battery in a heated room after shutdown of the engine.

Operating Hours	F	1600**										
	E	800										
	D	400		1200								
	C	200	600	1000	1400							
	B	100	300	500	700	900	1100	1300	1500			
	A	10-20*										

*) Only during break-in of new or of completely overhauled engines.

***) Thereafter, repeat the cycle anew at 100 operating hours.

Maintenance Work

- 1 Change lube oil of engine
- 2 Clean lube-oil filter
- 3 Check valve clearances. Intake 0.20 mm, exhaust 0.25 mm for coolant temperature below 50°C
- 4 Check vee-belt tension
- 5 Check oil levels in injection pump and governor (self-lubricating pump only). Oil pneumatic governor
- 6 Check oil level in water-pump bearing. If provided, grease additional water pump
- 7 Clean air filter and crankcase-breather filter. More frequently in dusty ambients, possibly daily
- 8 Check battery and cable connections
- 9 Check control linkage at injection pump and at mixture controller, oiling its articulations
- 10 Check for firm seat all nuts and screws including foundation bolts
- 11 Clean fuel strainer at injection pump
- 12 Check carbon brushes of dc generator. Three-phase ac generator is maintenance-free
- 13 Check fuel filter for restrictions and clean, if required
- 14 Replace felt-tube element of fuel filter
- 15 Check carbon brushes of starter motor and grease ring gear of flywheel
- 16 Check compression pressure. Minimum value 16 kp per sq cm (***)
- 17 Check injectors (***)
- 18 Check cooling system and clean, if required (***)
- 19 Check precombustion chambers. Replace ball-pin version (***)
- 20 Check all hoses and pipes for firm seat, leaks and chafings
- 21 Check cylinder-head fixation bolts for firm seat.

***) If possible, to be performed by our Service only or by other authorized expert personnel

Conversion factor for Maintenance Cycle after mileage and fuel consumption:
One operating hour equals 30 km or 6 liters of fuel.

A B C D E F

Maintenance items

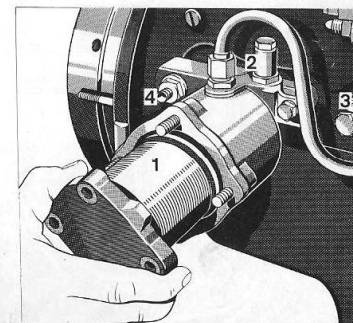
1 Change lube oil of the engine

Drain the lube oil from the oil pan while the engine is still at operating temperature. To this end, unscrew the drain plug at the bottom of the oil pan. Screw-in again the drain plug with a new sealing ring. Before refilling of the engine, however, clean the oil filter. In doing so, examine the filter for metal chips. When metal chips are present, immediately immobilize the engine and eliminate the trouble. Fill the prescribed HD oil in the indicated quantity into the engine by the filler neck in the cylinder-head cover.

2 Clean lube-oil filter

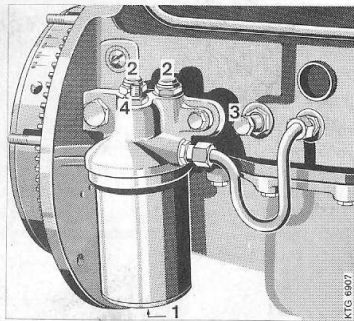
Horizontal oil filter - Unscrew nuts at the cover of the filter, extracting the cover carefully together with the element from the bowl. Place a suitable oil-receiving piece of sheet metal under the filter bowl. Dismantle the element and clean the filtering coil by a brush in gasoline for cleaning purposes or in diesel fuel. Blow out with compressed air, if available. Assemble the filter element and insert it carefully into the bowl together with the cover. The gasket should be faultless. Replace it, if there are damages to it. Tighten nuts again.

Vertical oil filter - Unscrew the hexagon nut at the bottom of the filter bowl and take off the bowl downwards. Open the filter bowl in slackening the nut and take out the outlet ring and the straining jacket. Clean both in gasoline for cleaning purposes or in diesel fuel and blow out by compressed air, if available. Assemble the filter bowl again and insert it into the filter carrier. Introduce the hexagon-head screw into the bowl from below and tighten it.



- 1 Filter element
- 2 Bypass valve, oil filter
- 3 Pressure-relief valve, main oil gallery
- 4 Connection, oil-pressure gauge

Figure 6 Cleaning of horizontal oil filter



- 1 Fixing screw, filter bowl
- 2 Bypass valves, filter
- 3 Pressure-relief valve, main oil gallery
- 4 Connection, oil-pressure gauge

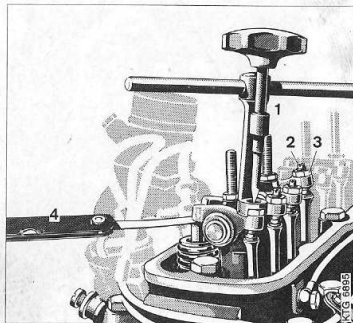
Figure 7 Cleaning of vertical oil filter

3 Check valve clearances

The valve clearance is understood as the gap between the end of the valve stem and the rocker arm. The valve clearance is checked by means of a feeler gauge. For valve clearances, see page 44. For checking purposes, first remove the cylinder-head cover and turn the flywheel in the sense of rotation until the piston of cylinder no. 1 is in the firing top dead center, that is both valves are closed. Push a valve-clearance feeler gauge of suitable thickness between the stem end and the rocker arm and check the valve clearance. When the setting is correct, the feeler gauge is extracted flush. When the clearance is too large or too small, slacken the lock nut and reset the adjusting screw until the feeler gauge may be removed flush, the lock nut tightened.

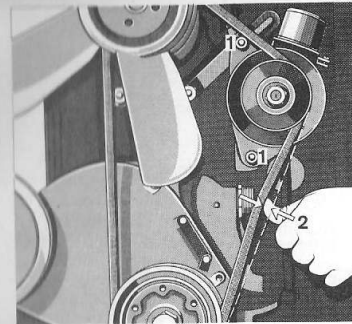
When both valves are checked or reset, turn the flywheel in the sense of rotation until the next cylinder, according to the firing sequence 1-3-4-2, is in its firing top dead center.

Reset the cylinder-head cover with a faultless rubber seal and tighten it.



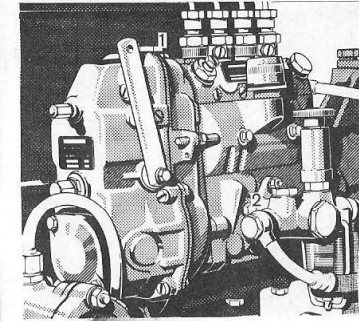
- 1 Special wrench, part no. 000 589 64 09
- 2 Adjusting screw
- 3 Lock nut
- 4 Feeler gauge

Figure 8 Checking of valve clearances



- 1 Lock nuts at generator bracket
- 2 Correct vee-belt tension, abt 5/8 in.

Figure 9 Checking of vee-belt tension



- 1 Oil-filler plug
- 2 Oil-level control plug

Figure 10 Injection pump with centrifugal governor

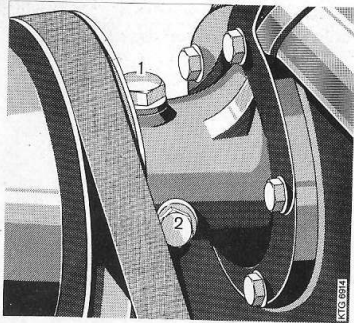
4 Check the vee-belt tension

The vee-belt for drive of the cooling-water pump and of the generator should at all times be so taut that it can be deflected for about 15 mm by the thumb in the center between the points of contact. When the tension is inferior, the vee-belt has to be retightened. To this end, slacken the hexagon-head screws at the generator bracket and at the generator holder swivelling the generator to the outside. Tighten the screws and check the tension of the vee-belt once again. Do not apply force when fitting a new vee-belt (screwdriver, for instance). Slacken instead the generator support. After 15 minutes of operation, retighten a new vee-belt.

Vee-belts and their pulleys should be clean and dry. Never use gasoline, diesel fuel or similar liquids for cleaning but lukewarm soap solution instead.

5 Check oil levels in the injection pump and governor

Pull out the oil dipstick at the injection pump and check the oil level. Replenish lube oil up to the top mark at the oil dipstick, if required. In the event of injection pumps without an oil dipstick, the oil level is checked by the oil-level control plug at the governor. Replenish through the filler plug, if necessary. Fill about one cu cm of lube into the lubricator of the pneumatic governor. In case of injection pumps which are connected to the lube-oil circuit of the engine, there is no check of the oil level.



- 1 Oil-filler plug
- 2 Oil-level control plug

Figure 11 Oiling of cooling-water pump

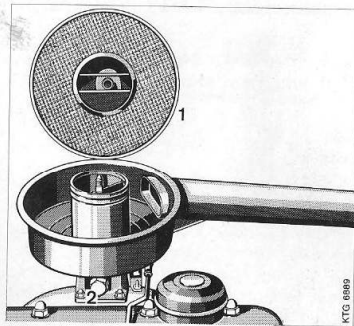
6 Check oil level in water-pump bearing. Grease additional water-pump, if provided

Check the oil level at the oil-level control plug and replenish, if need be, through the filler plug. Ensure that the bleeder bore in the filler plug is not clogged. Grease the additional water pump by the grease gun (cancelled in case of engines with radiator and fan).

7 Clean air filter and crankcase-breather filter

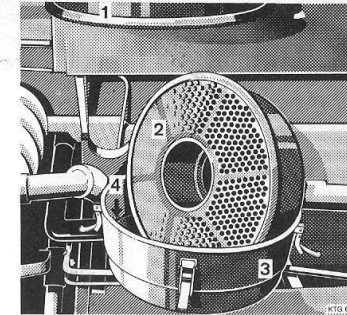
Wet-air filter - Open tensioning locks or wing nut and take off the top part of the filter together with the element from the bottom part. Wash the element in diesel fuel and blow out by compressed air, if available.

After drying, moisten the element uniformly with lube oil (by spray or immersion) and let it drip off. Clean the bottom part of the filter by a gasoline-moistened rag. Assemble top and bottom parts and fasten tensioning locks or wing nut.



- 1 Filter top, with element
- 2 Fixing screw

Figure 12 Cleaning of wet-air filter



- 1 Filter-housing upper part
- 2 Filter element
- 3 Filter-housing lower part
- 4 "Normal level" mark

Figure 13 Cleaning of oil-bath air cleaner

Oil-bath air cleaner - In case of serious dust precipitation, the oil filling in the filter has to be examined more frequently, possibly every day. This is done while the engine is cold and inoperative. To this end, open the tensioning locks and remove the filter-housing lower part together with element. When the oil has become thick by sludging or when it has reached the top mark, change the oil. Wash out the filter element in diesel fuel and spin it dry. Do not use gasoline, water or cleaning agents which contain lyes or acids. Blow out with compressed air, if available. Fill with lube oil up to the mark "Normal". Re-assemble filter-housing lower part together with element. In doing so, take care of the gasket replacing damaged ones.

8 Check battery and cable connections

Keep the battery clean and dry. The bleeder bores in the plugs of the cells should at all times be open to allow easy evacuation of the gases produced during the charge.

When the terminals or the poles are dirty, slacken the terminals, clean them and apply an acid-free and acid-resistant battery grease in order to avoid corrosion.

Do not let the battery compound come into contact with gasoline, oil or grease. Do not place tools onto the battery and keep open fire away.

Check the acid level of the individual cells. The acid level should exceed the top edge of the plates by 10 mm. Replenish with distilled water, if required. Do not use a metal funnel for replenishing. Check the acid level every two weeks during the warm season.

Measure the density of the acid in the individual cells by an acidimeter (hydrometer). The measurement data will give information on the state of charge

of the battery. See the subsequent chart. When the acid level has been replenished, a measurement of the density should be carried out not earlier than 30 minutes thereafter. During measurement, the acid temperature should be 20 to 27 °C.

Acid density		Specific weight		State of charge
normal	tropics	normal	tropics	
32 °Bé	27 °Bé	1.285	1.23	well charged
24 °Bé	16 °Bé	1.21	1.12	semi-charged
14 °Bé	13 °Bé	1.11	1.08	discharged, recharge at once

When greater differences in the acid density between the individual cells are noticed or when the battery is completely discharged, it has to be checked by a battery service and be recharged. Examine even unused batteries periodically to maintain their serviceability.

9 Check control linkage at injection pump and at mixture controller

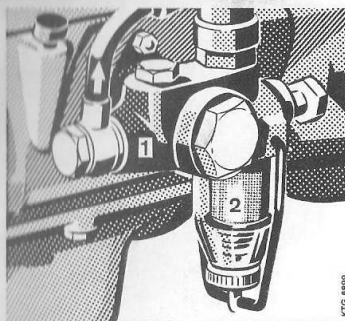
Check the control linkage at the injection pump or at the mixture controller for function and for easy movability. Lubricate its articulations by a few drops of oil. Grease Bowden cables, when provided, from time to time by regular gun grease.

10 Check all bolts and nuts for firm seat

Check all bolts and nuts of the attached assemblies and components for firm seat and retighten, when required. In doing so, adhere to torque data where prescribed. Check also the bolts and nuts of the engine bearers. In case of leaks, tighten the pertinent screws.

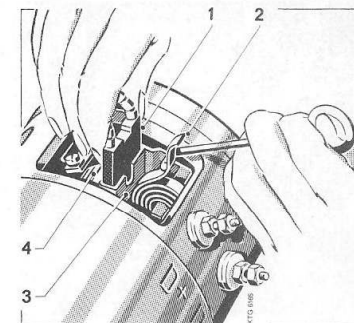
11 Clean fuel strainer

Close the stop valve at the fuel tank. Slacken the knurled nut and swivel upwards the tensioning strap. Remove the wire-mesh insert together with the bowl downwards. Clean element and bowl in clean gasoline or in diesel fuel using a soft brush. Exchange a hardened sealing ring in due time to avoid aspiration of air. When reassembling, the tensioning strap should be straight to avoid jamming of the bowl. Tighten the tensioning nut. Open the stop valve at the fuel tank again. In case of heavy contamination, clean the fuel tank as soon as there is a change.



1 Fuel feed pump
2 Fuel strainer

Figure 14 Fuel strainer



1 Carbon brush
2 Spring
3 Carbon-brush holder
4 Collector

Figure 15 Checking of carbon brushes

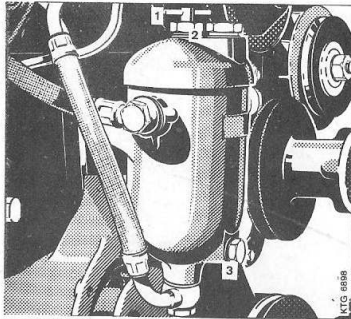
12 Check carbon brushes of dc generator *

Disconnect the negative cable from the battery and remove the cover strap from the generator. Lift the springs pressing the carbon brushes onto the collector and check if they will glide easily in their guides. Dirty or jamming carbon brushes are cleaned by a clean rag which is moistened by gasoline. Do not work on smooth contact faces with emery cloth, file or knife. Blow well out the carbon-brush holder. Heavily worn, unsoldered or broken carbon brushes are exchanged in pairs against new ones of identical type. The brushes should be dry during insertion. They should glide easily in their guides and the spring should not hit the brush when inserted. The surface of the collector should be uniformly smooth, without grooves and of a gray-black color. Should the surface not be free from dust, oil or grease, use a clean rag which is moistened with gasoline for cleaning. A grooved or ovalized collector should be turned down in a special shop. In no case it should be treated with emery paper or a file. Oil generator provided with lubricator.

13 Check fuel filter for restriction and clean, if required

Check for restriction - Unscrew the bleeder screw at the filter cover for some turns, slacken the knurled nut at the hand primer of the fuel feed pump and actuate the pump plunger repeatedly. In doing so, the fuel should escape as a strong jet at the bleeder screw. When the fuel flows weakly only, clean the filter as described subsequently.

* Start or tow engines equipped with three-phase ac generator only when battery connected. Do not disconnect terminals as long as engine rotates. Check voltage by test lamp or voltmeter only.



- 1 Bleeder screw
- 2 Clamping nut
- 3 Drain plug

Figure 16 Cleaning of fuel filter

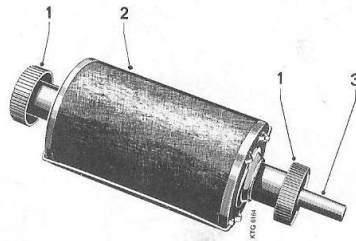
Cleaning of filter

Close the stop valve at the fuel tank. Before taking out the element, drain the filter bowl. To this end open the bleeder screw and unscrew the sludge-drain plug. Slacken the tensioning nut, remove the filter cover and pull out the felt-tube element.

Provisional cleaning (to be carried out only when a device similar to BOSCH, type EFEP, is not available). (See figure 17). Close both ends of the felt-tube element by plugs to allow penetration of the cleaning agent into the interior of the element by the felt only. Brush the element in diesel fuel or in kerosene by a soft, non-metallic brush, shake it and clean it again in clean cleaning agent.

Thorough cleaning (using a device, as for instance, BOSCH type EFEP, see figure 17). Connect the device and brush the felt-tube element with a soft, non-metallic brush in diesel fuel or in kerosene shaking it then. During immersion, keep the small tube of the device closed. Get the element fully soaked and blow through by compressed air or by the mouth until foam bubbles are produced at the exterior of the felt tube. Flush the element and get it completely soaked again. Repeat this cycle four to five times.

Insert the felt-tube element again into the cleaned bowl. Place the cover with a faultless gasket and tighten by the tensioning bolt. Open the stop valve at the fuel tank and prime fuel by the hand primer until it escapes at the bleeder screw. Close the bleeder screw.



- 1 Cleaning device, type EFEP
- 2 Felt-tube element
- 3 Tube, air inlet

Figure 17 Cleaning device

14 Replace felt-tube element of fuel filter

The indications on removal and installation of the element are described in Maintenance Work no. 13 "Check the fuel filter for restriction etc".

15 Check carbon brushes of starter motor

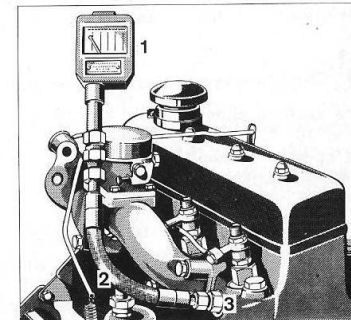
For checking, cleaning and, if need be, for replacing of the carbon brushes as well as for cleaning of the collector the same indications hold true as described in Maintenance Work no. 12 "Checking of the carbon brushes of the dc generator".

Clean the starter-motor pinion and the ring gear of the flywheel with a brush dipped into fuel. Then lubricate with graphite grease. In case of burr at pinion and flywheel, remove it by a file.

16 Check compression pressure

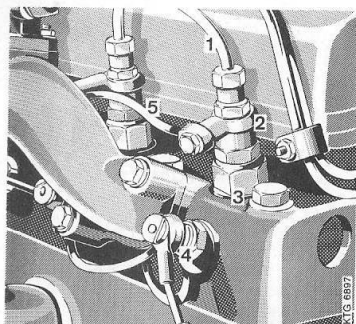
This maintenance work should be carried out, if possible, by our Service or by other authorized expert personnel.

Check the valve clearances of the engine and reset, if desirable. Run the engine up to operating temperature. Disconnect the distributing bars and unscrew all heater plugs. The supply of fuel interrupted, crank the engine various times by the starter motor in order to remove possibly present oil-carbon deposits and soot which might clog up the compression-pressure recorder. Screw-in the connection piece with the sealing ring into the bore of the heater plug connecting the compression-pressure recorder to it by the extension. Bring the measuring sheet in the recorder into the position corresponding to the cylinder. Crank the engine with interrupted fuel supply and fully open mixture controller a few rotations. The duration of the measurement should be identical for all cylinders. When the minimum value (see page 43) is not obtained, the cylinder head has to be removed and the gas-tight seat of the valves, the cylinder-head gasket, piston and piston rings have to be checked. Clean the heater plugs before their installation, examine and replace in case of damage.



- 1 Compression-pressure recorder
- 2 Extension
- 3 Connection piece

Figure 18 Checking of compression pressure



- 1 Delivery line
- 2 Banjo fitting
- 3 Injector holder
- 4 Heater plug
- 5 Leak-fuel line

Figure 19 Injector, mounted

17 Check injectors

Removal of the injector - Unscrew the union nut for fixation of the delivery line and of the leak-fuel line from the injector. When slackening the banjo fitting, secure the injector holder against rotation by a fork spanner. Unscrew the injector holder with socket-spanner element 312 589 00 09 from the precombustion chamber and take out the seal (injector plate).

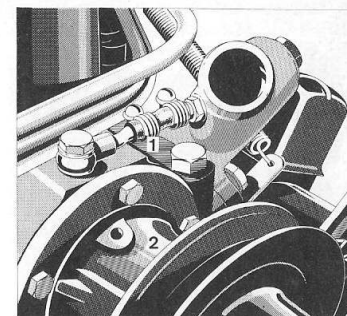
Checking and cleaning of the injector - Clean the exterior of the injector holder in diesel fuel. Unscrew the union nut and remove the injector. The repair of an injector should, if possible, be carried out by our Service only or by other authorized expert personnel.

Installation of the injector* - Crank the engine for a few rotations in order to remove contaminations. Introduce new injector plate into the precombustion chamber. Screw-in the injector holder with a new or with an overhauled injector into the precombustion chamber. Tighten by the socket-spanner element to the prescribed torque (see page 46). Connect the delivery and leak-fuel lines free from stress and check for leaks while the engine is operating.

18 Check cooling system and clean, if required

The cooling system should be cleaned when the temperature of the coolant is 5 to 10 °C higher than the temperature during the initial operation, provided operating conditions and engine load are identical. Vee-belt tension and thermostat should be faultless.

* Do not proceed to this item unless Maintenance Work 19 "Checking the precombustion chambers" has been performed.



- 1 Bleeder line

Figure 20 Bleeding of cylinder head

Exterior cleaning

Radiator - When a light, oil-free contamination only is present, it may suffice to spray a water jet through the radiator from the engine side or blow through then by compressed air. In case of a heavy contamination, the radiator should be removed and be cleaned thoroughly in a 3 to 5% solution of a cleaning agent (as P3 or potassium carbonate). Thereafter, flush the radiator with clean water and blow through with compressed air, if available.

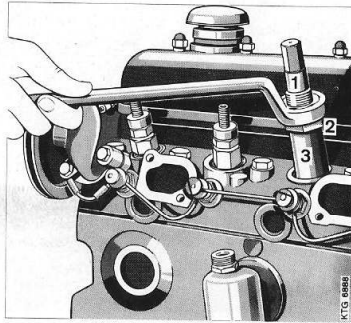
Interior cleaning

Drain the entire coolant. Fill the cooling system with clean, unprocessed water to which 3 to 5% -- (that is 300 to 500 g for 10 liters of water) -- of a commercial, alcalinic, silicone containing detergent (for instance, P3 Dimal 220, Grisiron LZ or WZ and similar brands) have been added. Run the engine with this solution for about three hours. Then drain the detergent and after it has cooled down flush the engine three times with clean water. With the third filling, run the engine up to operating temperature and subsequently drain the water.

Heat exchanger - Unscrew the lateral closing cover (raw-water inlet). A mechanical cleaning will do in the instance of a normal contamination, not necessitating the removal of the cooling element. In the event of serious contamination, the complete heat exchanger should be removed and both closing covers have to be unscrewed for extracting the cooling element. Clean the element thoroughly in a hot alcalinic solution (solution of P3 or potassium carbonate). Then flush well with clean water. Replace the rubber O-rings in the crude-water outlet cover during assembly. Follow this sequence: crude-water outlet cover; cooling element; crude-water inlet cover.

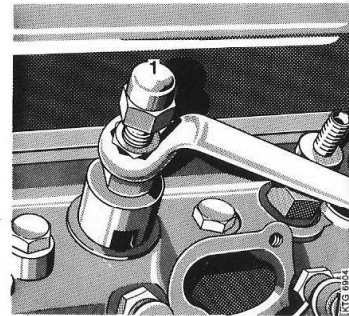
Fill the cooling system with processed water according to the prescription.

Caution: Never fill cold water into hot engine.



- 1 Special wrench, part no. 636 589 01 63
- 2 Hexagon nut
- 3 Pivot spanner, part no. 636 589 01 07 or 02 07

Figure 22 Unscrewing of threaded thrust ring



- 1 Extractor, part no. 636 589 01 33

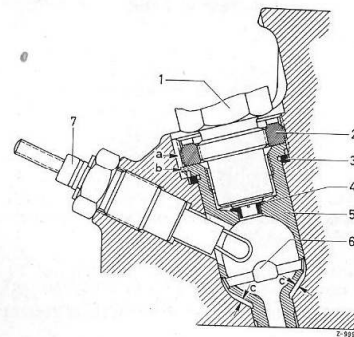
Figure 23 Extraction of precombustion chamber

Check bleeder line between cylinder head and coolant-outlet fitting for restriction. See fig. 20.

19 Check precombustion chambers, replace version with ball pin

This work, however, should only be carried out by our Service or by other competent and authorized personnel, equipped with the necessary special tools.

First, remove the injector as described under Maintenance Work 17. Take off the distributing bar from all four heater plugs. Unscrew the heater plug by a socket spanner SW 21.



- 1 Injector
- 2 Threaded thrust ring
- 3 Sealing ring
- 4 Injector shim
- 5 Precombustion chamber with ball pin
- 6 Ball pin
- 7 Heater plug
- a Groove
- b Nose

Figure 21 Section through precombustion chamber

Unscrew the threaded thrust ring for fixation of the precombustion chamber by the special tool 636 589 01 63 and the sleeves 636 589 01 07 or 636 589 02 07. Lift the precombustion chamber by means of the extractor 636 589 01 33. To this end, screw-in the thrust spindle as deep into the precombustion chamber as practicable. Turn the lifting bell until the recess is exactly over the groove in the cylinder head. The precombustion chamber is lifted in tightening the hexagon nut. During removal, the lifting bell should not be allowed to rotate as otherwise the lug of the prechamber is cut off.

Replace the sealing ring in the cylinder head before installation of a new precombustion chamber. Insert the precombustion chamber into the cylinder head and screw-in the threaded ring in tightening it to the prescribed torque (see page 46). Replace the threaded ring whenever the grooves are damaged. Screw-in again the heater plug and the injector holder. Reconnect distributing bar, delivery lines and leak-fuel lines.

20 Check all pipes and hoses for firm seat, chafings and for leaks

The delivery lines are to be connected free from stress and should be checked for leakage while the engine is running. Eliminate leaks at the fittings by re-tightening and use new seals where required. Exchange damaged lines and brittle or swollen hoses.

21 Check cylinder-head fixation screws for firm seat

Remove the cylinder-head cover and the rocker-arm shafts while the engine is still warm. When using the offset ring spanner 120 589 00 03, the rocker-arm shafts need not be removed.

Tighten the cylinder-head screws in the sequence of figure 24 to the prescribed torque (see page 46). The two screws with the thread M-10 are torqued to abt 6 mkp by a hand wrench. After having re-tightened all screws, mount again the rocker-arm shaft and check the valve clearances. See Maintenance Work 3.

Check all screws and nuts of the intake and exhaust collectors. Re-install the cylinder-head cover with a faultless rubber seal. Do not tighten too much to avoid pressing out of the seal.

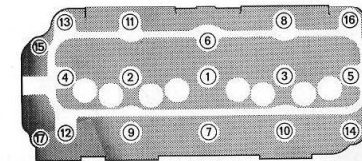


Figure 24 Torquing sequence of cylinder-head bolts