



*Operating Instructions for MAN Industrial Diesel Engines  
Bedienungsanleitung für MAN-Industriedieselmotoren*

**D 2842 ME 601**



Operating Instructions –  
MAN Industrial Diesel Engines





Dear Customer,

these Operating Instructions are intended to familiarize you with your new MAN Diesel engine and how it operates.

This manual is supplemented by the publication “Fuels, Lubricants and Coolants for MAN Diesel Engines” and the “Service record”.

**Note:**

All three publications belong to the engine and must always be kept ready to hand near the engine in the engine room.

Please read this Manual and the “Instructions for the installation of MAN Diesel Engines” before you put the new engine into operation.

Comply in full with instructions relating to operation, prevention of accidents and environmental protection.

MAN Diesel engines are developed and manufactured in line with the latest state of the art. However, trouble-free operation and high performance can only be achieved if the specified maintenance intervals are observed and only approved fuels, lubricants and coolants are used.

It is imperative and in your own interest to entrust your MAN Local Service Centre with the removal of any disturbances and with the performance of checking, setting, and repair work.

Yours faithfully,  
MAN Nutzfahrzeuge Aktiengesellschaft  
Werk Nürnberg

Subject to change to keep abreast with technological progress.

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## Declaration

In accordance with Article 4, paragraph 2, in conjunction with Appendix II, section B, of Directive 89/392/EEC, version 93/44/EEC

### **MAN Nutzfahrzeuge Aktiengesellschaft,**

hereby declares that the engine described below is destined for installation in a machine as defined in the EC directive on machines.

Engine model:

Design:

*For data see original declaration*

Engine number:

*If required this declaration is enclosed with the delivery note.*

Rating / speed:

**Note:**

The manufacturer of the complete ready-to-use machine in which this engine is to be installed must take the further action necessary in the context of indirect safety-related engineering and provision of instructions to ensure that the ready-to-use machine complies with the requirements of the EC directive on machines.

The engine must not be put into operation until the complete machine satisfies the conditions laid down in the EC directive on machines 89/392/EEC, most recently amended by 93/44/EEC, or the latest amendment of said directive.

**MAN Nutzfahrzeuge Aktiengesellschaft**

**Vogelweiherstraße 33**

**D-90441 Nürnberg**



# Nameplates

In all your correspondence please always quote engine model, serial number and job number (Order number).

For this reason it is advisable to read off the data from the engine type plates before putting the engine into operation and to enter them in the appropriate spaces.

The engine type plates are on the crankcase.

Model .....

delivered on .....

installed on .....

Engine serial number .....

Order number .....

MAN Nutzfahrzeuge Aktiengesellschaft  
 Typ   
 Motor-Nr. / Engine No.  NI/II

MAN Nutzfahrzeuge Aktiengesellschaft  
 Werk Nürnberg Germany  
**DIESEL ENGINE**

Bauj. Year	Typ	Model	Motor-Nr.	Serial No
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Werk-Nr.	Job No	Leistung kW Rating kW	Drehz. 1/min	Speed rpm
<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>	<input type="text"/>
Temp.°C	Leistg. PS Rating BHP	Aufstellhöhe m uNN Altitude m		
<input type="text"/>	<input type="text"/>	<input type="text"/>		

-0219



## General notes

**Day-to-day use of power engines and the service products (fuels, lubricants, coolants) necessary for running them presents no problems if the persons occupied with their operation, maintenance and care are given suitable training and think as they work.**

This summary is a compilation of the most important regulations. These are broken down into main sections which contain the information necessary for preventing injury to persons, damage to property and pollution. In addition to these regulations those dictated by the type of engine and its site are to be observed also.

### Important:

If, despite all precautions, an accident occurs, in particular through contact with caustic acids, fuel penetrating the skin, scalding from hot oil, anti-freeze being splashed in the eyes etc., **consult a doctor immediately.**

## 1. Regulations designed to prevent accidents with injury to persons

### During commissioning, starting and operation

- Before putting the engine into operation for the first time, read the operating instructions carefully and familiarize yourself with the “critical” points. If you are unsure, ask your MAN representative.
- For reasons of safety we recommend you attach a notice to the door of the engine room prohibiting the access of unauthorized persons and that you draw the attention of the operating personal to the fact that they are responsible for the safety of persons who enter the engine room.
- The engine must be started and operated only by authorized personnel. Ensure that the engine cannot be started by unauthorized persons.
- When the engine is running, do not get too close to the rotating parts. Wear close-fitting clothing.
- Do not touch the engine with bare hands when it is warm from operation – risk of burns.
- Exhaust gases are toxic. Comply with the instructions for the installation of MAN Diesel engines which are to be operated in enclosed spaces. Ensure that there is adequate ventilation and air extraction.



- Keep vicinity of engine, ladders and stairways free of oil and grease. Accidents caused by slipping can have serious consequences.

### During maintenance and care

- Always carry out maintenance work when the engine is switched off. If the engine has to be maintained while it is running, e.g. changing the elements of change-over filters, remember that there is a risk of scalding. Do not get too close to rotating parts.
- Change the oil when the engine is warm from operation.  
**Caution:**  
There is a risk of burns and scalding. Do not touch oil drain plugs or oil filters with bare hands.
- Take into account the amount of oil in the sump. Use a vessel of sufficient size to ensure that the oil will not overflow.
- Open the coolant circuit only when the engine has cooled down. If opening while the engine is still warm is unavoidable, comply with the instructions in the chapter entitled "Maintenance and Care".
- Neither tighten up nor open pipes and hoses (lube oil circuit, coolant circuit and any additional hydraulic oil circuit) during the operation. The fluids which flow out can cause injury.
- Fuel is inflammable. Do not smoke or use naked lights in its vicinity. The tank must be filled only when the engine is switched off.
- When using compressed air, e.g. for cleaning the radiator, wear goggles.
- Keep service products (anti-freeze) only in containers which can not be confused with drinks containers.
- Comply with the manufacturer's instructions when handling batteries.  
**Caution:**  
Accumulator acid is toxic and caustic. Battery gases are explosive.



### 2. Regulations designed to prevent damage to engine and premature wear

Do not demand more from the engine than it is able to supply in its intended application. Detailed information on this can be found in the sales literature. The injection pump must not be adjusted without prior written permission of MAN Nürnberg.

If faults occur, find the cause immediately and have it eliminated in order to prevent more serious damage.

Use only genuine MAN spare parts. MAN will accept no responsibility for damage resulting from the installation of other parts which are supposedly “just as good”.

In addition to the above, note the following points:

- Never let the engine run when dry, i.e. without lube oil or coolant.
- When starting do not use any additional starting aids (e.g. injection with starting pilot).
- Use only MAN-approved service products (fuel, engine oil, anti-freeze and anti-corrosion agent). Pay attention to cleanliness. The Diesel fuel must be free of water. See “Maintenance and care”.
- Have the engine maintained at the specified intervals.
- Do not switch off the engine immediately when it is warm, but let it run without load for about 5 minutes so that temperature equalization can take place.
- Never put cold coolant into an overheated engine. See “Maintenance and care”.
- ***Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Do not exceed the maximum permissible tilt of the engine.***  
Serious damage to the engine may result if these instructions are not adhered to.
- Always ensure that the testing and monitoring equipment (for battery charge, oil pressure, coolant temperature) function satisfactorily.
- Comply with instructions for operation of the alternator. See “Maintenance and care”.

### 3. Regulations designed to prevent pollution

#### Engine oil and filter elements / cartridges, fuel / fuel filter

- Take old oil only to an old oil collection point.
- Take strict precautions to ensure that no oil or Diesel fuel gets into the drains or the ground.  
The drinking water supply could be contaminated.
- Filter elements are classed as dangerous waste and must be treated as such.

#### Coolant

- Treat undiluted anti-corrosion agent and / or anti-freeze as dangerous waste.
- When disposing of spent coolant comply with the regulations of the relevant local authorities.

### 4. Notes on safety in handling used engine oil \*

Prolonged or repeated contact between the skin and any kind of engine oil decreases the skin. Drying, irritation or inflammation of the skin may therefore occur. Used engine oil also contains dangerous substances which have caused skin cancer in animal experiments. If the basic rules of hygiene and health and safety at work are observed, health risks are not to the expected as a result of handling used engine oil.

#### **Health precautions:**

- Avoid prolonged or repeated skin contact with used engine oil.
- Protect your skin by means of suitable agents (creams etc.) or wear protective gloves.
- Clean skin which has been in contact with engine oil.
  - Wash thoroughly with soap and water. A nailbrush is an effective aid.
  - Certain products make it easier to clean your hands.
  - Do not use petrol, Diesel fuel, gas oil, thinners or solvents as washing agents.
- After washing apply a fatty skin cream to the skin.
- Change oil-soaked clothing and shoes.
- Do not put oily rags into your pockets.

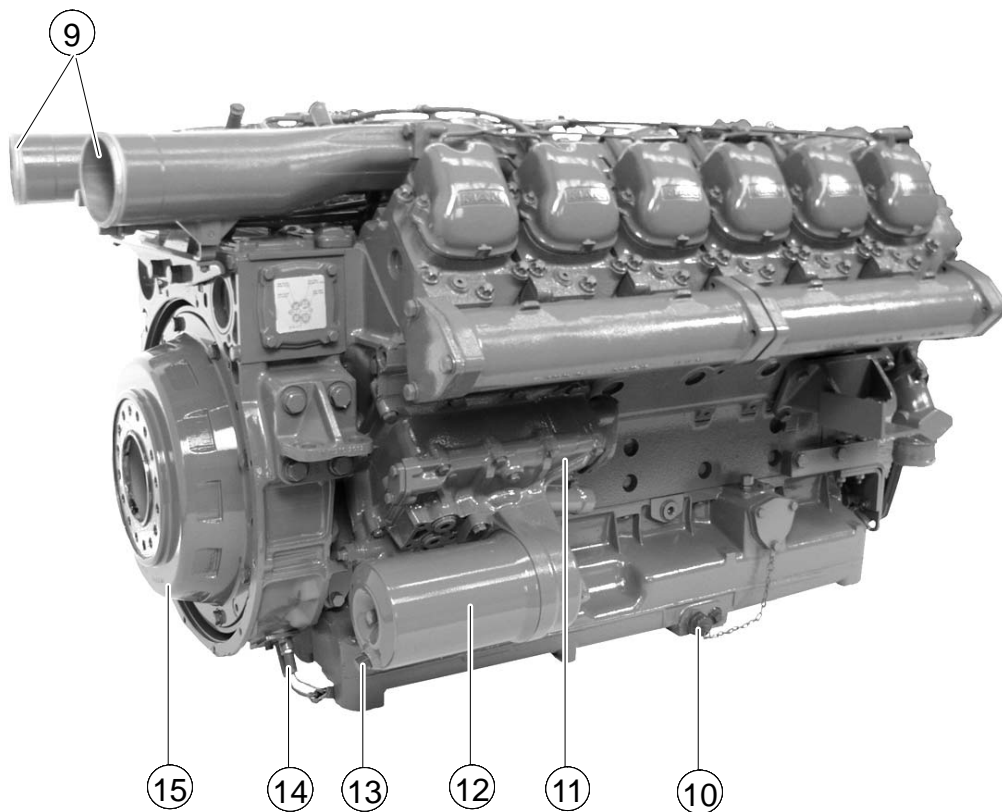
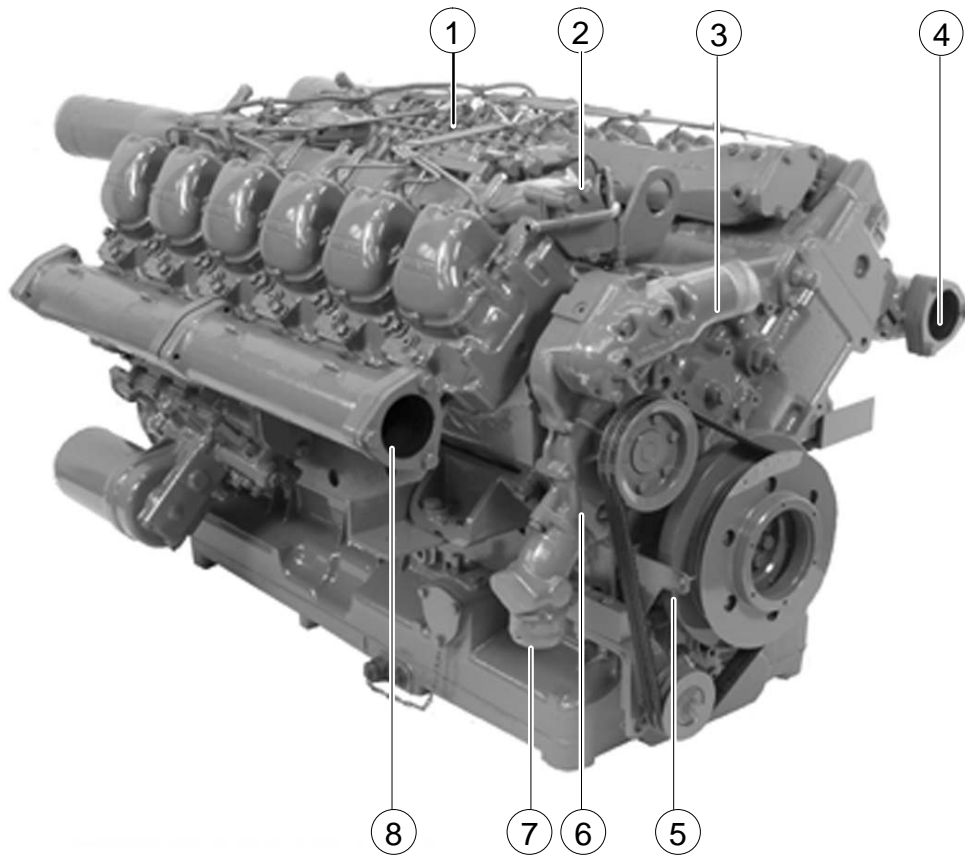
#### **Ensure that used engine oil is disposed of properly – Engine oil can endanger the water supply –**

For this reason do not let engine oil get into the ground, waterways, the drains or the sewers. Violations are punishable.

Collect and dispose of used engine oil carefully. For information on collection points please contact the seller, the supplier or the local authorities.

\* Adapted from "Notes on handling used engine oil".

Engine views D 2842 ME 601



- 
- 1 Injection pump
  - 2 Electrohydraulic shut-off device (EHAB)
  - 3 Coolant outlet
  - 4 Exhaust outlet
  - 5 "OT" (= TDC) pointer
  - 6 Water pump
  - 7 Coolant inlet
  - 8 Exhaust outlet
  - 9 Intake manifold
  - 10 Oil drain
  - 11 Oil cooler
  - 12 Oil filter
  - 13 Oil drain plug
  - 14 RPM sensor
  - 15 Flexible clutch

### Engine

The D 2842 ME 601 Engine is a watercooled 12-cylinder four stroke Diesel engine with direct injektion.

The cylinders are on a 90° -V- pattern.

### Crankcase

The cylinder block is a single pierce of alloy cast iron. To increase it's stiffness, it extanded to a level below the crankshaft centre line. The engine has exchangeable wet cylinder liners and individual cylinderheads with shrunk-in valve seat rings and replaceable valve guides. Wherever a a cylinder head has been removed the cylinder head gasket should be changed.

### Crank assembly

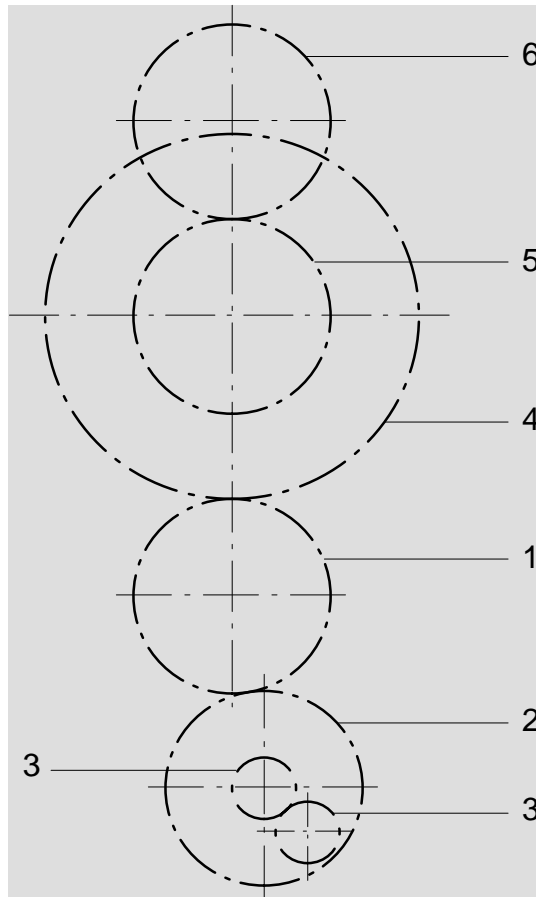
The fotged crankshaft runs on 7 bearings and has screwed-on counterweights. Radial seals with replaceable wearing rings on crankshaft and flywheel are provided to seal the crankcase penetrations.

The connecting rods are die-forged, diagonally splint and can be removed through the top of the cylinders together with the pistons. The crankshat and connecting rods run in ready-backed lead-bronze bearings.



## Engine timing

Camshaft, oil pump and injection pump are driven by a gear train arranged at the flywheel end. The camshaft is located centrally in the "V" and runs on 7 bearings.



- |                           |                             |
|---------------------------|-----------------------------|
| ① Crankshaft gear         | ④ Camshaft drive gear       |
| ② Oil pump drive gear     | ⑤ Idler gear                |
| ③ Oil pump impeller gears | ⑥ Injection pump drive gear |

The crankshaft gear and the camshaft drive gear are match-marked by the digit "1" or "●".

## Valves

The overhaed valves are actuated via chilled cast iron tappets, push rods and rocker arms from the camshaft.

### Engine lubrication

The engine is equipped with forcwe-feed lubrication.

The pressure is generated by a gear pump. The drive gear is in direct mesh with the crankshaft gear at the flywheel end.

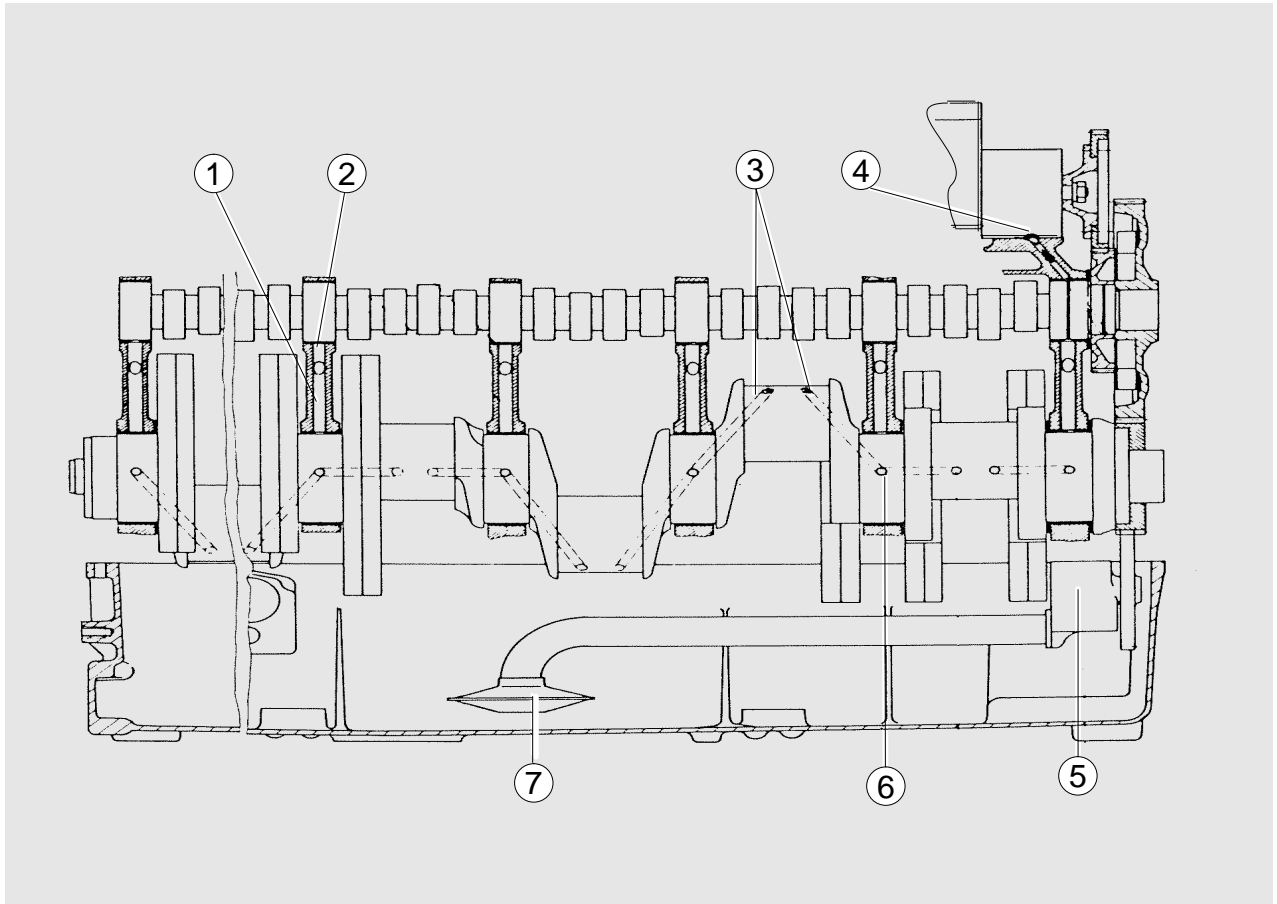
The oil pump draws the oil from the oil sump and delivers it via the oil cooler and oil filter to the main distributor gallery and there to the main bearings, big-end bearings and camshaft bearings as well as to the piston pin bushrings and the rocker arms. The injection is likewise with the oil from the engine's lubrication system.

The cylinder walls and timing gears are splash-lubricated.

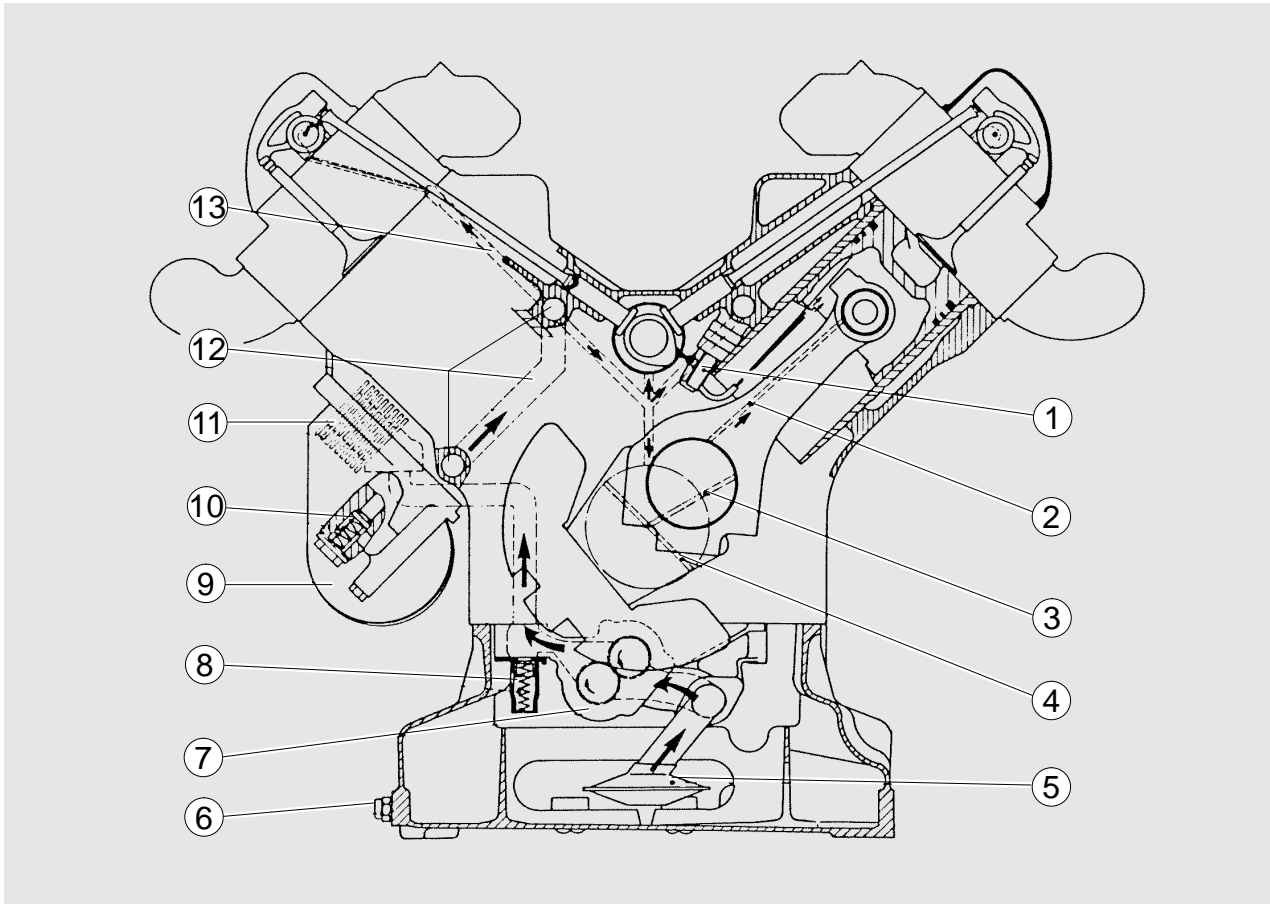
Each cylinder has an oil jet for cooling the piston crown.

The engine is equipped with an oil pressure sensor.

Lubricating system D 2842 ME 601

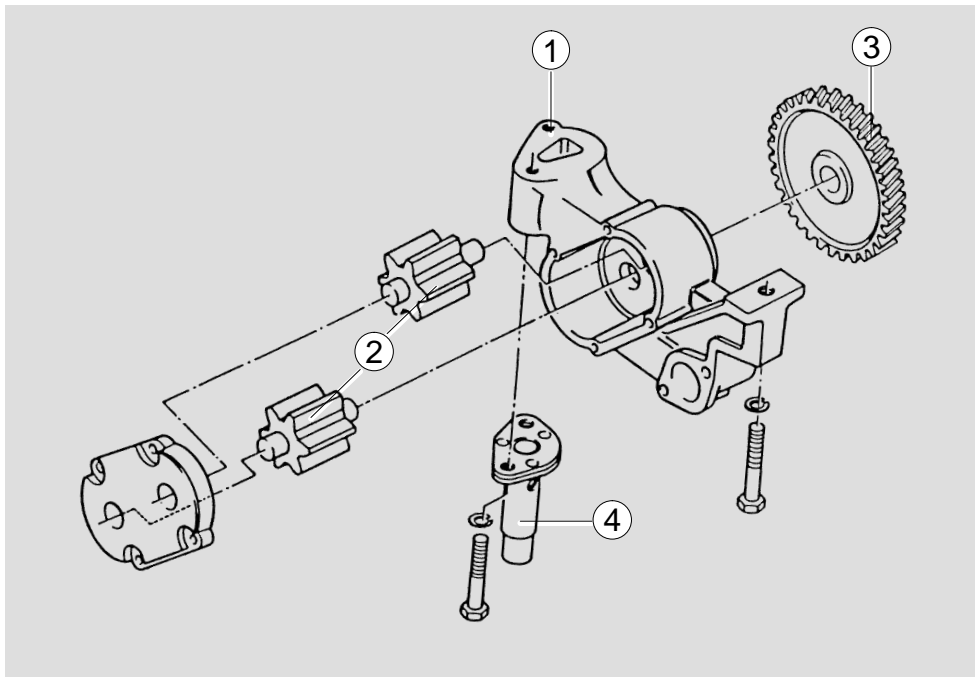


- ① Oil gallery to crankshaft
- ② Camshaft bearing lubrication
- ③ Ports for big-end bearing lubrication
- ④ Injection pump lubrication
- ⑤ Oil pump
- ⑥ Ports for main bearing lubrication
- ⑦ Oil suction pipe

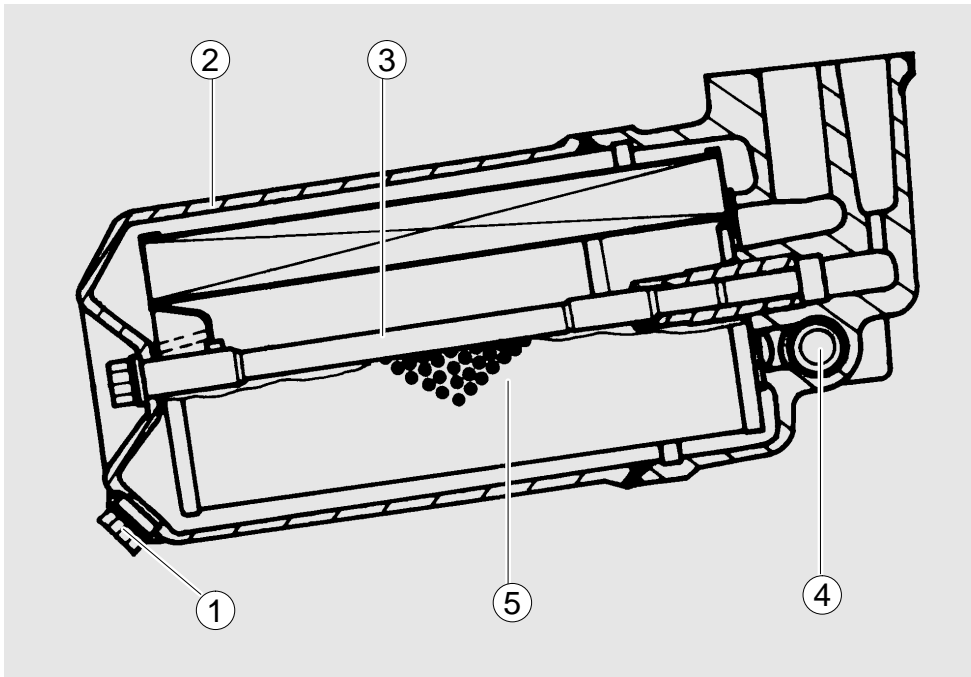


- ① Jets for piston cooling and cam lubrication
- ② Piston pin hushing lubrication
- ③ Ports for big-eng bearing lubrication
- ④ Ports for main bearing lubrication
- ⑤ Oil suction pipe
- ⑥ Oli drain plug
- ⑦ Oil pump
- ⑧ Oil pressure relief valve
- ⑨ Oil filter
- ⑩ bypass valve
- ⑪ Oil cooler
- ⑫ Main oil galleries
- ⑬ Rocker arm lubrication

A pressure relief valve is installed in the oil pump. It responds if the resistance in the lines and galleries after the oil pump is too great and lets the oil draw out of the sump flow back into it.



- ① Oil pump housing
- ② Oil pump impeller gears
- ③ Oil pump drive gear
- ④ Oil pressure relief valve



- ① Drain plugfilter bowls
- ② Filter bowls
- ③ Clamping bolts
- ④ Bypass valve
- ⑤ Filter cartridges

The oil filter attached by a flange to the oil cooler casing.

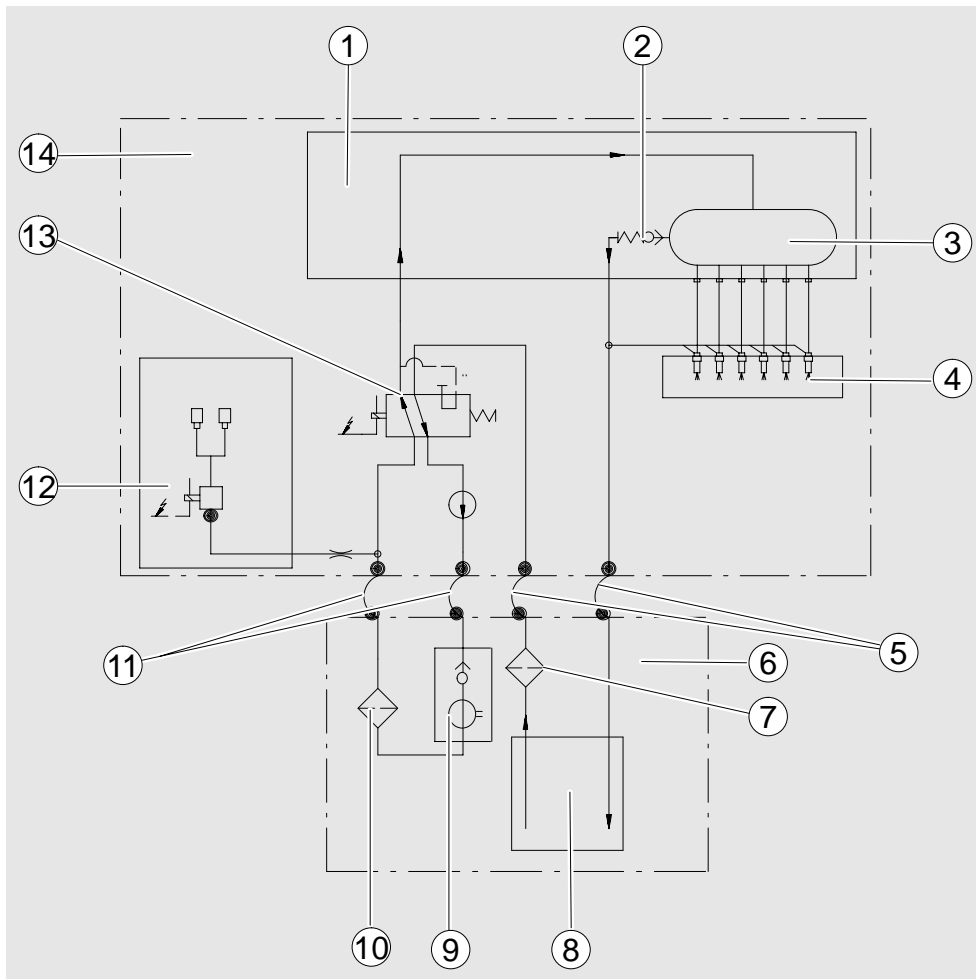
The lubrication oil is cleaned in a full-flow filter. The element consists of a paper cartridge.

The bypass valve in the oil filter casing safeguards the oil supply to the engine even if the filter element is clogged.

An oil cooler is fitted between the oil filter and the crankcase. This cooler is of the flat tube type with turbulence inserts and is operated by the cooling water.

## Fuel system

Fuel system engine is running

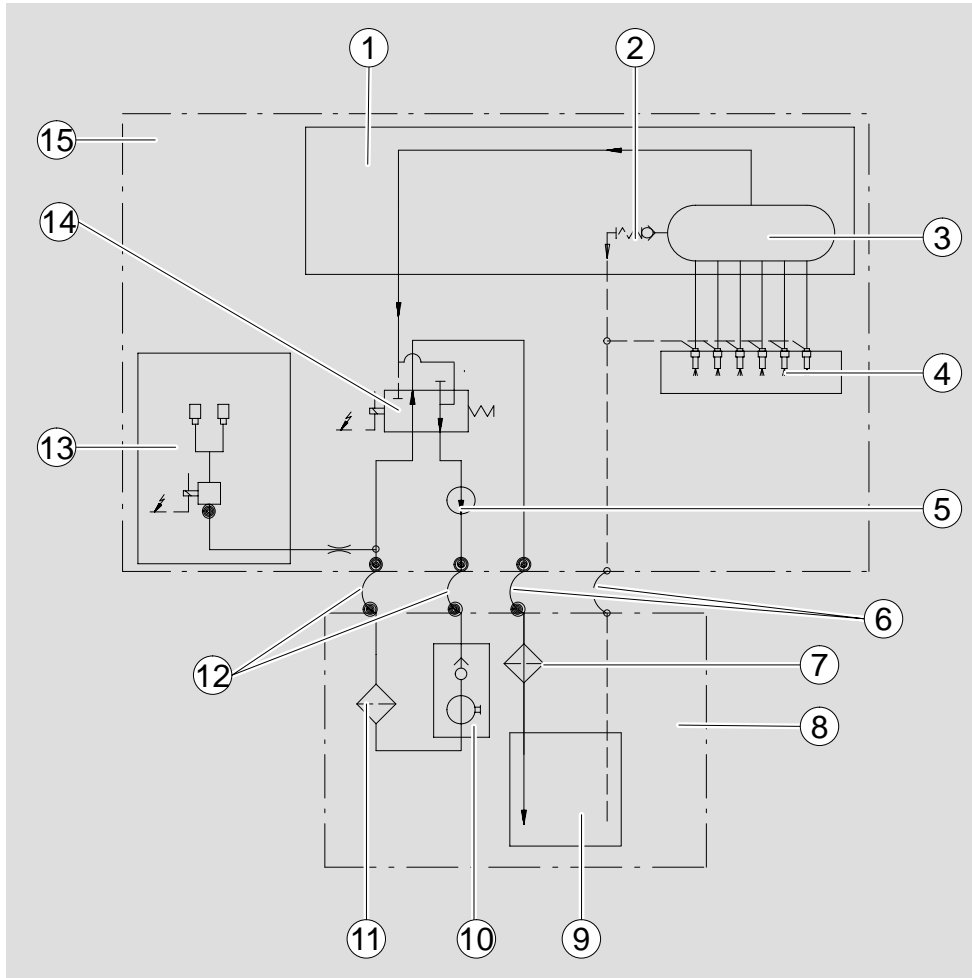


- |                                |   |
|--------------------------------|---|
| ① Injection pump               | ⑧ Fuel tank                             |
| ② Overflow valve               | ⑨ Manual primer                         |
| ③ suction gallery              | ⑩ Fuel filter                           |
| ④ Injector                     | ⑪ Connecting hose                       |
| ⑤ Connection hose              | ⑫ Flame start system                    |
| ⑥ Vehicle                      | ⑬ Electromagnetic shut-off valve (EHAB) |
| ⑦ Fuel filter with prestrainer | ⑭ Engine                                |

\* When the engine is turned off by means of the electro-hydraulic cutout (emergency stop), the direction of fuel flow is switched so that fuel is returned from the suction gallery of the injection pump to the fuel tank. In this case the bypass serves to bypass the hand primer through which fuel can flow in one direction only.

## Fuel system

Fuel system engine is not running ( shut-off by EHAB)

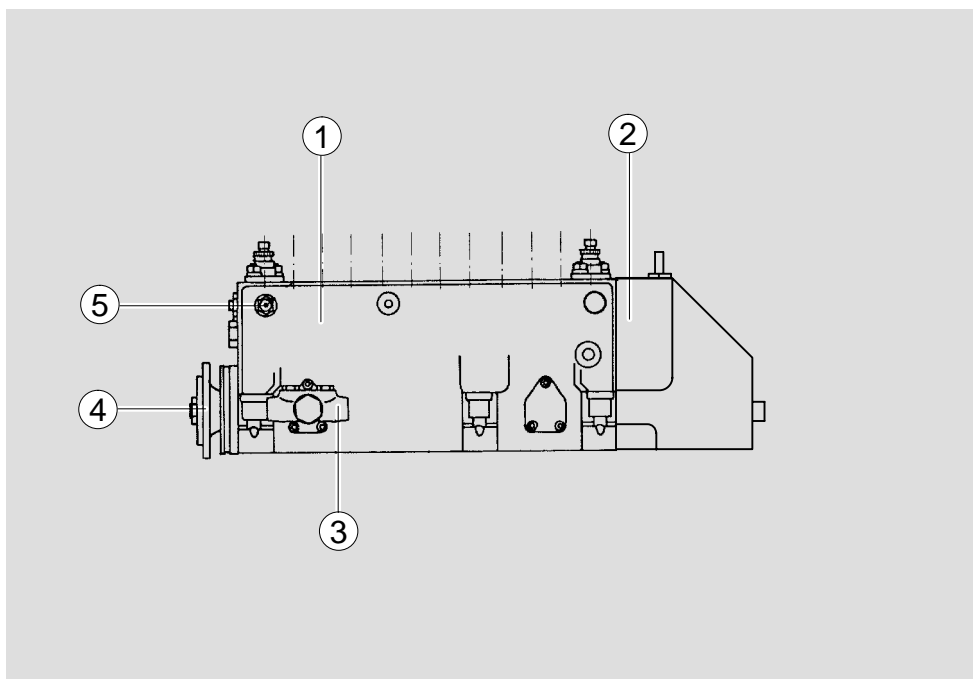


- |                                |   |
|--------------------------------|---|
| ① Injection pump               | ⑧ Vehicle                               |
| ② Overflow valve               | ⑨ Fuel tank                             |
| ③ suction gallery              | ⑩ Manual primer                         |
| ④ Injector                     | ⑪ Fuel filter                           |
| ⑤ Fuel lift pump               | ⑫ Connecting hose                       |
| ⑥ Connection hose              | ⑬ Flame start system                    |
| ⑦ Fuel filter with prestrainer | ⑭ Electromagnetic shut-off valve (EHAB) |
|                                | ⑮ Engine                                |



## Injection pump

The in-line injection pump is driven from the crankshaft via gears. It is connected to the force-feed lubrication system of the engine and consequently maintenance-free. The GAC-electronic speed governor is mounted attached to injection pump housing.



- ① Injection pump
- ② GAC-electronic speed governor
- ③ Fuel lift pump
- ④ Driving hub
- ⑤ Overflow valve

### Fuel lift pump

The fuel lift pump is a mechanical reciprocating pump and is attached to the injection pump. Its spring-loaded piston is driven via roller by cam on the injection pump camshaft.

### Fuel strainer, manual primer

The strainer and the manual primer are mounted together with the fuel filter on a bracketed (not supplied). They are fitted in the intake line between the fuel tank and the fuel lift pump.

The strainer protects the fuel lift pump and also prevents larger impurities from entering the filter.

With the help of the manual primer the injection system can be filled with fuel after repairs etc. before the engine is started. It also serves to bleed the fuel system.

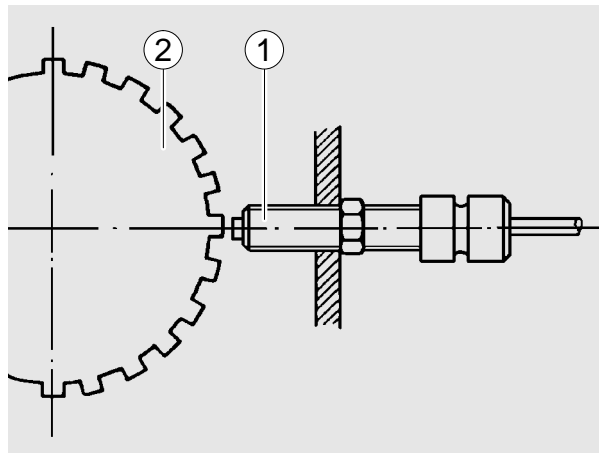
## Basic design

An electronic control system consists of three components:

### 1. Speed pickup

In MAN engines the speed pickup ①, which works according to the induction principle, is located on the flywheel housing. It consists of a permanent magnet surrounded by a coil.

Depending on whether a tooth of the starter gear ring ② is before the magnet or not, the magnetic field changes and induces in the coil an alternating voltage which is proportional to the engine speed and serves as input signal for the control unit.



### 2. Electronic control unit

The electronic control unit receives the signal (actual value) generated by the pickup and compares it with a preset value (nominal value).

If the actual and the nominal values are identical, the electronic control unit will generate an output signal with which the final control element will be triggered.

### 3. Final control element

In GAC governors, for example, the final control element is a spring-loaded linear solenoid.

This solenoid is connected to the control rod of the injection pump and changes its position according to the signal from the control unit. As a result, the injection quantity and, consequently, engine speed are controlled.

### Flame start system

The flame start system is an aid to starting the diesel engine in cold weather.

The principle is basically one of heating the intake air by burning fuel from the vehicle's own tank in the pipe of the engine

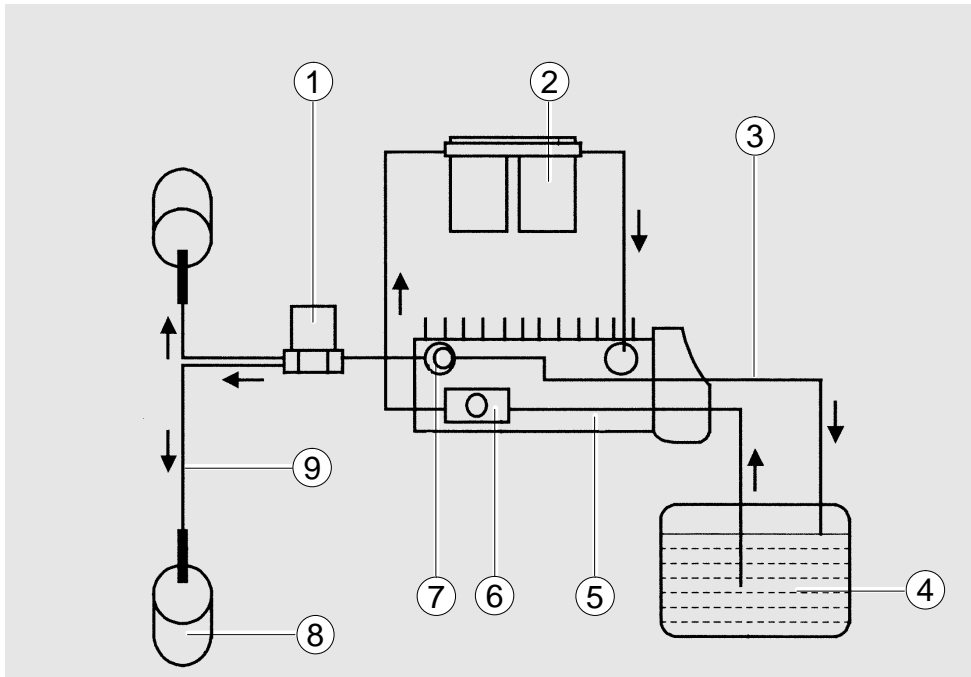
The flame glow plug is screwed into a pocket in the air intake at the flywheel end. For each cylinder bank there is one glow plug. The tip of the plug warms up after approximately 1 minute of pre-glowing to about 100°C. A metering insert in the supply line to the glow plug meters the fuel to it, and the fuel evaporates under the heat of the glow plug. The fuel vapour flows out forwards the tip of the plug, there by mixing with air, which comes in through bores in the protective case of the plug. This mixture ignites at the tip of the glow plug and the resulting flame heats up the intake air. The protective case at the same time prevents the flame from going out if the air is moving at a fairly high speed.

The fuel for the flame glow plug is taken from the suction gallery of the injection pump before overflow valve.

The pressure is generated as the engine turns over by the engine's own fuel lift pump.

The supply of the fuel is controlled automatically by a solenoid valve. When this is not under voltage it blocks the fuel line even under the vibratory acceleration that occurs when the engine is running. Only when the flame start switch is pressed the solenoid valve clears the line to the glow plug.

The solenoid valve opens simultaneously with the switching on of the telltale lamp.



- ① Solenoid valve
- ② Fuel filter
- ③ Fuel return line
- ④ Fuel tank
- ⑤ Injection pump
- ⑥ Fuel lift pump
- ⑦ Overflow valve
- ⑧ Fuel line
- ⑨ Flame glow plug

## Electronic speed governor (not shown)

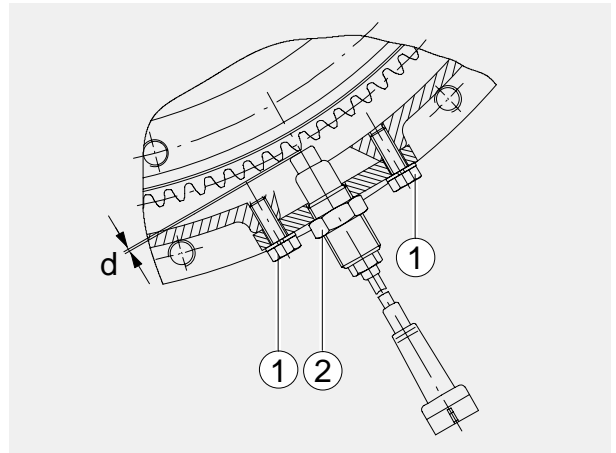
Before removing the governor carefully mark (note) its position in the bracket on the engine and the adjusting length of the linkage between the two levers.

On reinstallation restore original installation position and settings as accurately as possible.

There must be no play in the linkage and it should move freely.

With the governor in “stop” position the pointer must be on 0–2 graduations of the injection rate scale.

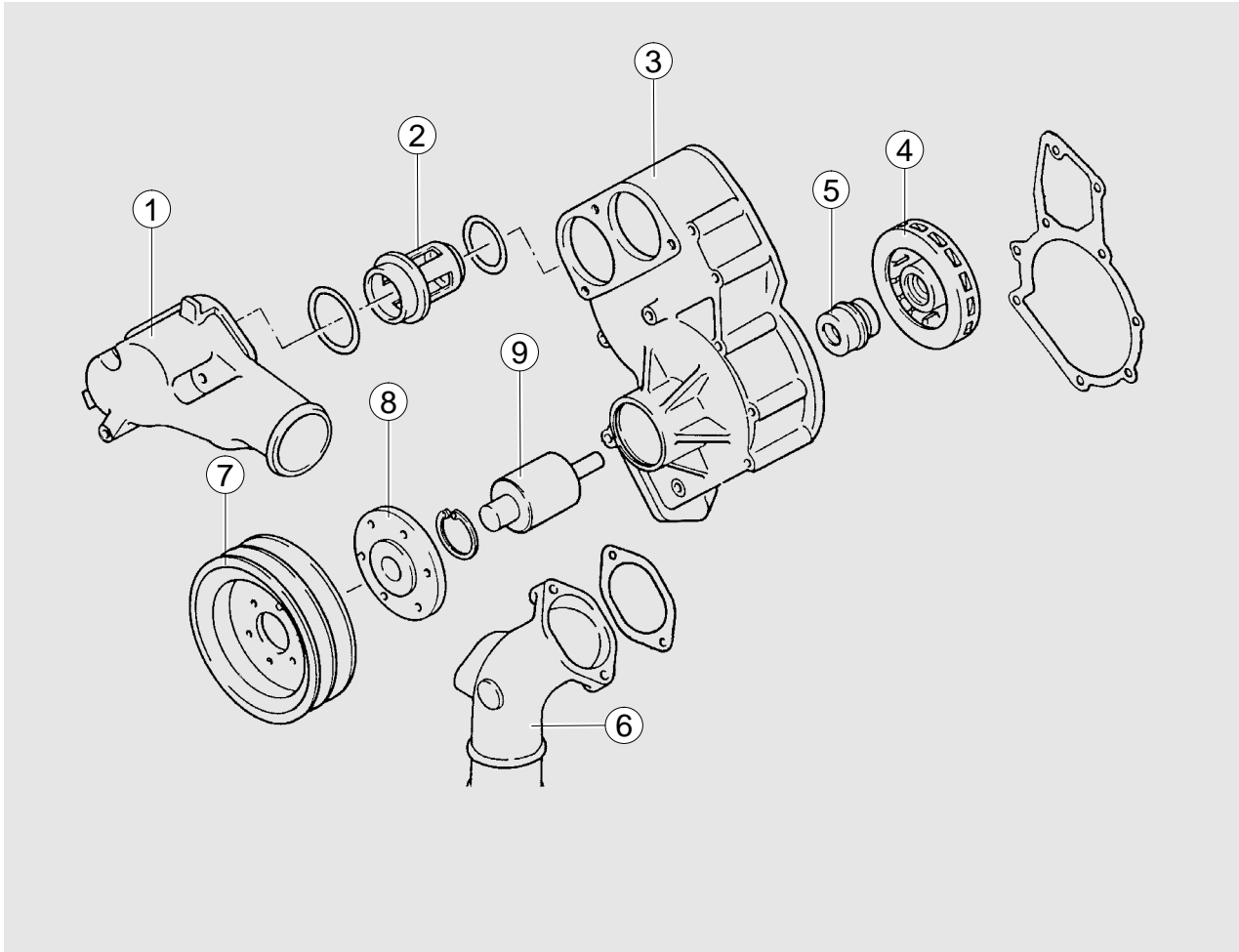
Adjust the distance between pickup and tooth tip of start ring gear as follows:  
Screw pickup into cover ①, until it contacts the gear tip and then back off approx. 1 turn and tighten locknut ②.



## Cooling

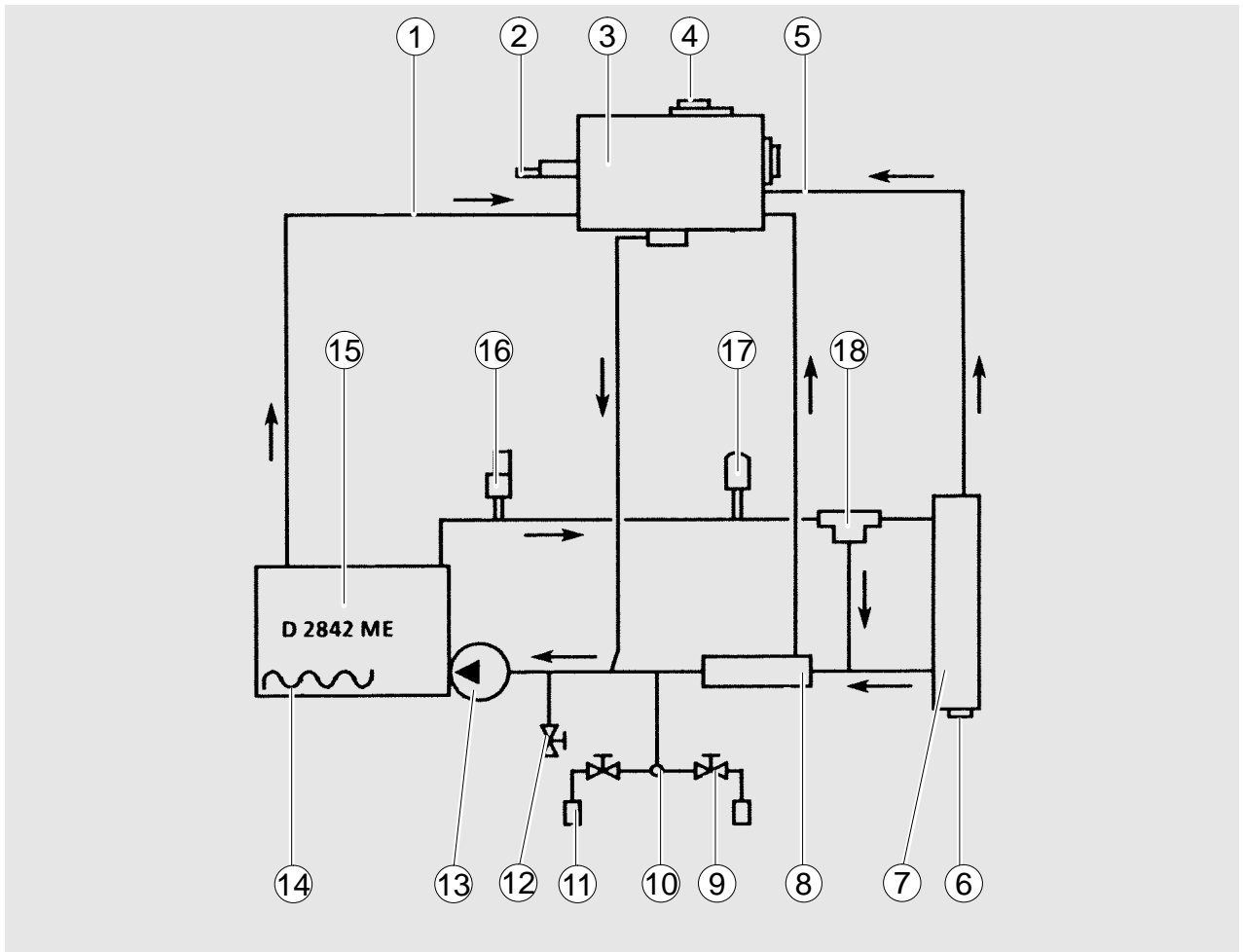
The engine has a water-cooling system.

The water pump is a maintenance-free impeller pump with short-circuit inserts and is driven by V-belts from the crankshaft pulley.



- ① Coolant outlet pipe
- ② Short-circuit insert
- ③ Waterpump housing
- ④ Impeller
- ⑤ Axial face seal
- ⑥ Coolant supply pipe
- ⑦ V-belt pulley
- ⑧ Hub
- ⑨ Water pump bearing

## Cooling water diagram



- ① Bleed line
- ② Low water level switch
- ③ Expansions tank
- ④ Exess pressure valve
- ⑤ Tank contants
- ⑥ Drain plug
- ⑦ Radiator frame
- ⑧ Gearbox oil heat exchanger
- ⑨ Shut off cock
- ⑩ Drain cock
- ⑪ UIC filler nck
- ⑫ ADrain cock
- ⑬ Water pump
- ⑭ Engine oil cooler
- ⑮ Diesel engine D 2842 ME 601
- ⑯ Resistance thermometer
- ⑰ Temperature sensor
- ⑱ Short-circuit regulator

### Air cleaner

The air filters are not included in the extent of delivery of the engine.

The Maintenance intervals for the filters depend on the operating conditions of the engine and the instructions of the manufacturer.

The connecting elements between filters and the air intake pipes should be checked from times to times for leaks. If unfiltered air gets into the engine it may lead to increased wear in the pistons and cylinders.

### Electrical equipment

#### Starter motor

The electric pre-engaged-drive starting motor is flanged to the rear of the flywheel housing on the left-hand side.

As part of every engine overhaul, the starter pinion and ring gear should be cleaned with a brush dipped in fuel and then greased again.

**Warning:** *Always disconnect the battery earth cable before starting work on the electrical system. Connect up the earth cable last, as there is otherwise a risk of short-circuits.*



## Lubrication system

Ensure utmost cleanliness when handling fuels, lubricants and coolants.

**Note:**

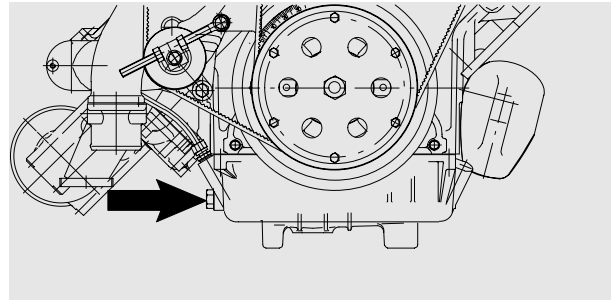
Use only approved fuels, lubricants etc. (see brochure "Fuels, lubricants etc."). Otherwise the manufacturer's warranty will become null and void.

### Engine oil change

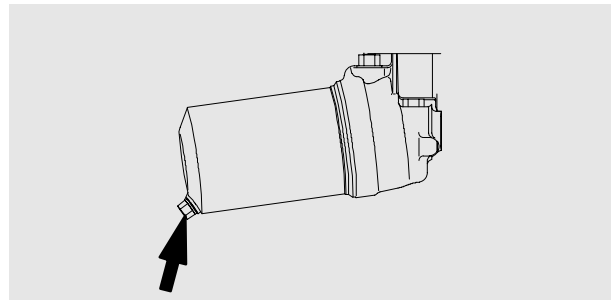


**Danger:**

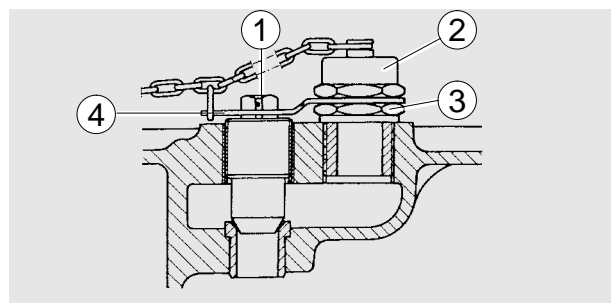
The oil is hot- risk of scalding. Do not touch the oil drain plug with bare fingers. Oil is an environmental hazard. Handle it with care!



With the engine at operating temperature, remove the oil drain plugs on the oil sump and the oil filter bowl and allow the old oil to drain off completely.

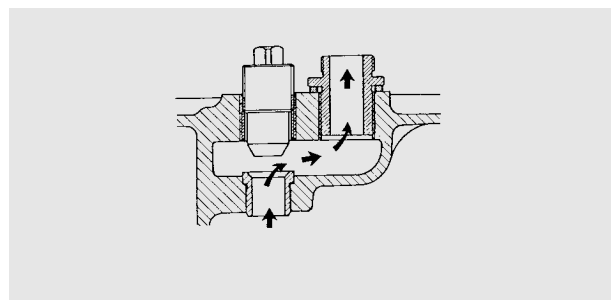


- Unscrew cap nut ②
- Take off locking plate ④
- Screw out valve stem ① until oil flows quickly out of the screw neck ③
- Unscrew oil drain plug on oil filter bowl



Use a vessel of sufficient size to ensure that the oil does not overflow.

Refit the oil drain plugs with new gaskets.



**Note:**

Change the oil filter elements every time the engine oil is changed.

### Refilling with oil

**Caution:**

Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.

Refill with fresh engine oil at the oil filler neck (arrow).

- Bajonet fastener ①
- Dipstick ②
- Oil filler neck ③

After filling start the engine and let it run for a few minutes at low speed.

**Caution:**

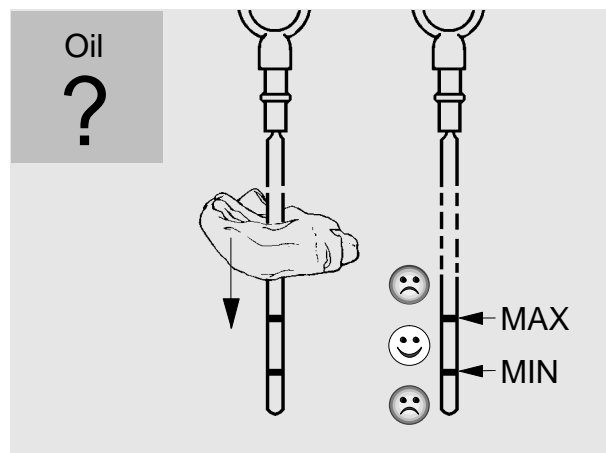
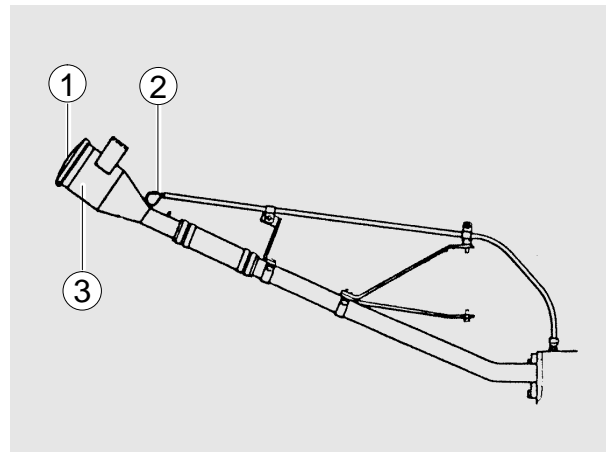
If no oil pressure builds up after approx. 10 seconds switch off the engine immediately.

Check oil pressure and check that there is no oil leakage.

Then shut down the engine. After about 20 minutes, check the oil level.

- Pull out dipstick
- wipe it with a clean, lintfree cloth
- and push it in again up to the stop
- Pull out dipstick again

The oil level should be between the two notches in the dipstick and must never fall below the lower notch. Top up oil as necessary.



## Changing oil filter

However, oil filter cartridges must be changed at every oil change.

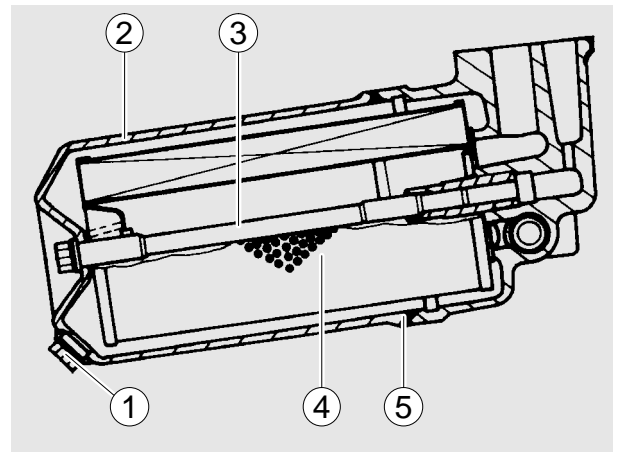
### Renewal of filter cartridges

- Allow the filter content to run off along drain plugs ①.  
Hold a suitable vessel under hole



**Danger:**

The oil is hot and under pressure when the drain plug is opened.  
Risk of burns and scalds.



- Take off the filter housing ② after removing the mounting bolt ③.
- Renew filter cartridge ④ Thoroughly clean all other parts in cleaning fluid
- Mount the filter housing ② with new round sealing ⑤.

**Note:**

To prevent the sealing ring ⑤ twisting hold the filter housing ② firmly when tightening up the mounting bolt ③.

**Caution:**

Used oil filters are classed as dangerous waste and must be disposed of accordingly.

### Fuel system

#### Fuel

If Diesel fuel which contains moisture is used the injection system and the cylinder liners / pistons will be damaged. This can be prevented to some extent by filling the tank as soon as the engine is switched off while the fuel tank is still warm (formation of condensation is prevented). Drain moisture from storage tanks regularly. Installation of a water trap upstream of the fuel filter is also advisable. Do not use any additives to improve flow properties in winter.

#### Injection pump

No alterations must be made to the injection pump. If the lead seal is damaged the warranty on the engine will become null and void.

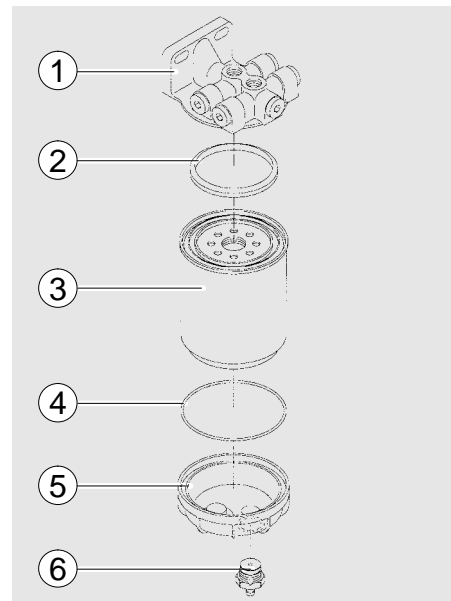
#### Faults

We urgently recommend that you have faults in the injection pump rectified only in an authorised specialist workshop.

#### Cleaning fuel pre-cleaner

Strip the fuel pre-cleaner:

- open drain valve ⑥
- remove the sight glass ⑤ and gasket ④ from filter cartridge ③
- remove filter cartridge ③ and gasket from the filter head ①
- wash out Filter head ①, sight glass ⑤ and drain valve ⑥ in clean Diesel fuel and blow them out with compressed air
- Reassemble using new seal
- Screw on new filter cartridge and tighten it by hand
- Actuate plunger of hand priming pump until the overflow valve of the injection pump opens audibly
- Start engine
- Check fuel pre-cleaner for leaks



## Fuel filter

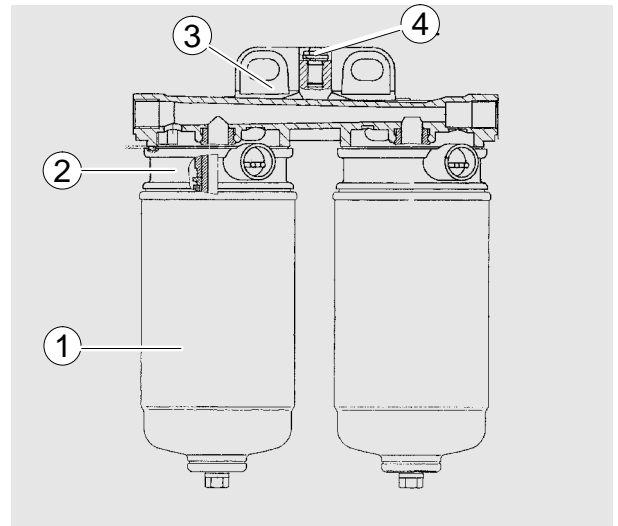
### Changing fuel filter

Only when engine is switched off

- Loosen filter cartridge ① by means of tape wrench, unscrew it by hand and take it off
- Moisten the seals on the new filter cartridge with fuel
- Screw on the filter cartridges and tighten them vigorously by hand
- Bleed fuel system
- Check filter for leaks

**Caution:**

Used fuel filters are classed as dangerous waste and must be disposed of accordingly.



- ① Filter cartridge
- ② Fuel preheater
- ③ Filter head
- ④ Bleed screw

## Bleeding fuel system

**Note:**

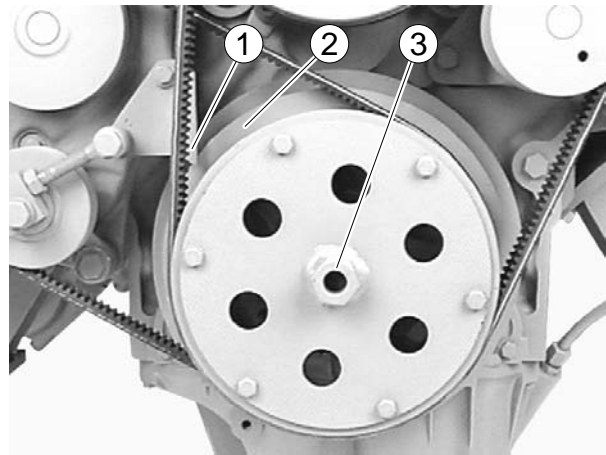
When bleeding the fuel system switch on the electromagnetic shut-off valve (EHAB) without fail (ignition on), as otherwise fuel cannot reach the injection pump suction gallery / suction chamber.

- Open bleed screws ④ at fuel filter.
- Actuate hand priming pump until bubble-free fuel emerges.
- Close bleed screws ④.
- Check system for leaks.

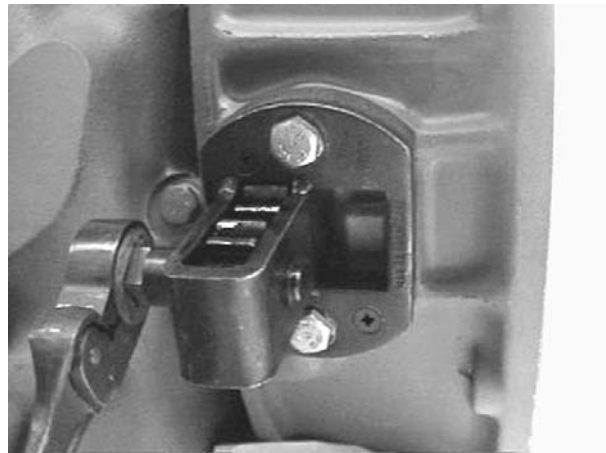
### Checking start of delivery

For the purpose of checking the start-of-delivery setting, an "OT" (= TDC) mark and a scale from 10 ... 50° before TDC are engraved on a disc ② fitted in front of the torsional vibration damper.

The scale marks are read against a pointer ① fitted to the crankcase.

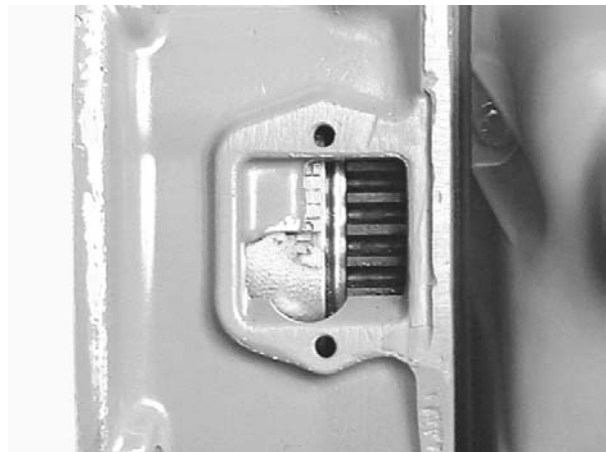


In order to enable the engine to be rotated manually during adjustments, there is a plate with a central hexagon driver ③ fitted to the front of the crankshaft pulley (bar-ring device).



An engine cranking device (special tool) may be mounted also at the inspection hole of the flywheel housing. For this purpose, the speed pickup together with the plate is to be previously detached.

There is another scale engraved on the flywheel which can be read through an inspection hole in the flywheel housing but access may be difficult. The scale should be used for readjusting the pointer after the vibration damper has been removed or replaced.

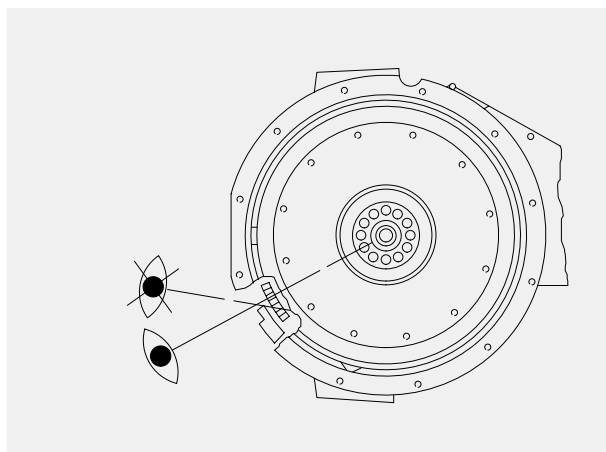


In other words, before the vibration damper with the scale disc is installed, the engine should be positioned at "OT" (top dead centre) by means of the scale on the flywheel.

The pointer should then be aligned such that its measuring edge exactly coincides with the "OT" mark on the scale disc.

To avoid incorrect readings, always look past the notch on the flywheel housing and straight towards the flywheel centre.

The marking on the graduated scale must be on the imaginary "notch - flywheel centre" line.



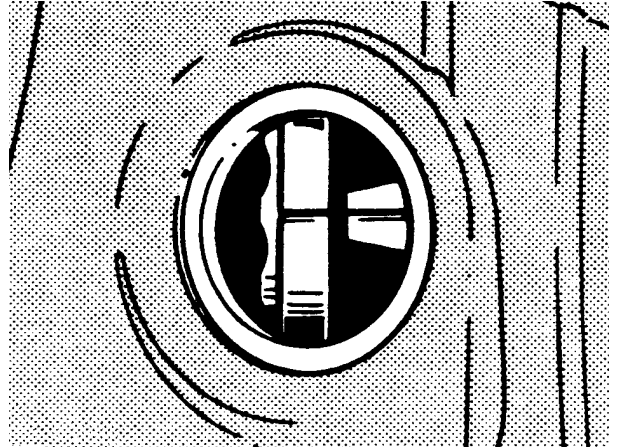
Remove plug from inspection hole in timing case cover.

Then rotate engine so that mark on pointer fitted to injection pump coincides with mark on pump hub.

Read degrees on scale engraved on disc on torsional vibration damper.

The reading should equal the specified start-of-delivery setting (see "Engineering • Data • Setting values").

If not, correct start-of-delivery setting.



### Adjusting start of delivery

To adjust the start of delivery, the injection pump drive must be made accessible.

For this purpose the fuel filter is to be removed.

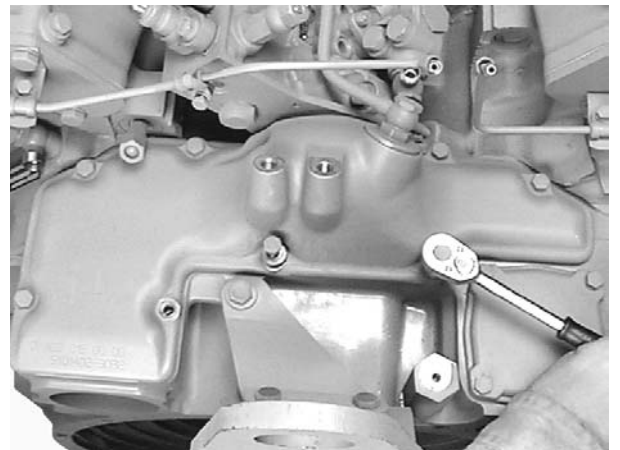
Close cut-off valve from fuel tank to engine.

Remove timing case cover.

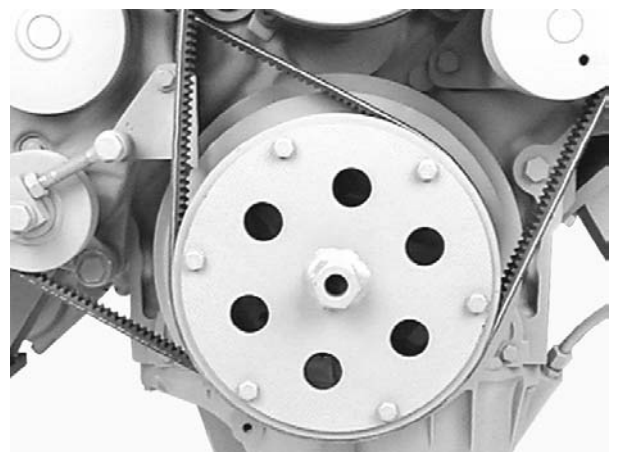
**Note:**

Pipes are attached to the timing case cover.

To facilitate reassembly, note down the positions of the brackets, pipe clamps, spacer sleeves etc.



Turn engine to specified angle for delivery start.

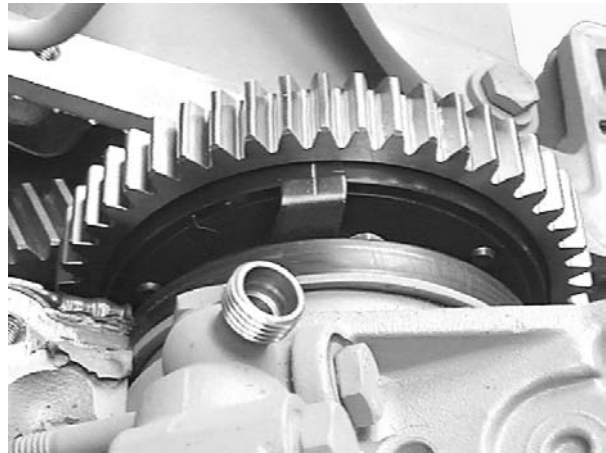


Loosen all bolts fastening the drive gear to the injection pump hub. For this, two complete turns of the engine are necessary.

Turn the injection pump camshaft at the drive flange either to the left or right until the markings are aligned with each other.

**Note:**

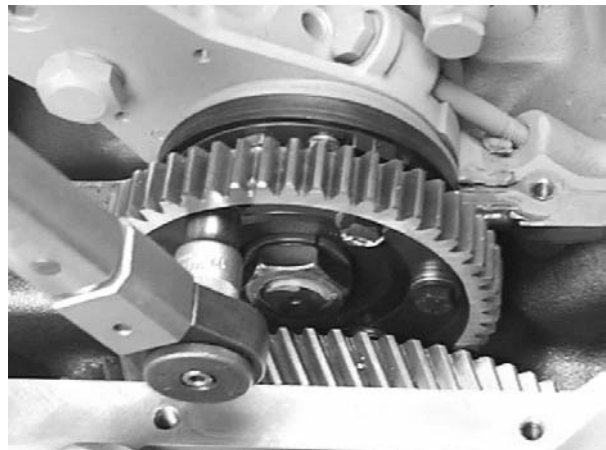
If the setting specified cannot be reached by turning the injection pump hub, the installation of the injection pump is to be checked.



Tighten bolts for fastening drive gear to drive flange consecutively to 5 Nm and then to 38 Nm.

**Note:**

Use only M8x22 mounting bolts (property class 12.9).



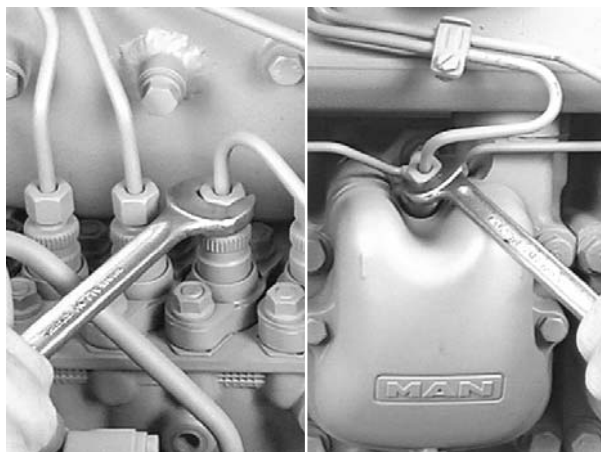
Check delivery start once again.  
Refit all parts previously removed.



## Removing fuel injectors

Remove the injection lines from the injection nozzles and from the injection pump.

Remove the fuel return lines.

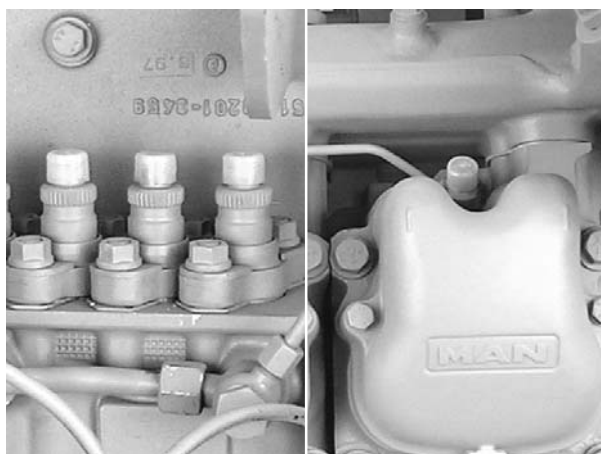


After removal of the injection lines we recommend fitting caps to the connections on the injection nozzles and injection pump. This prevents dirt from getting into the injection system.

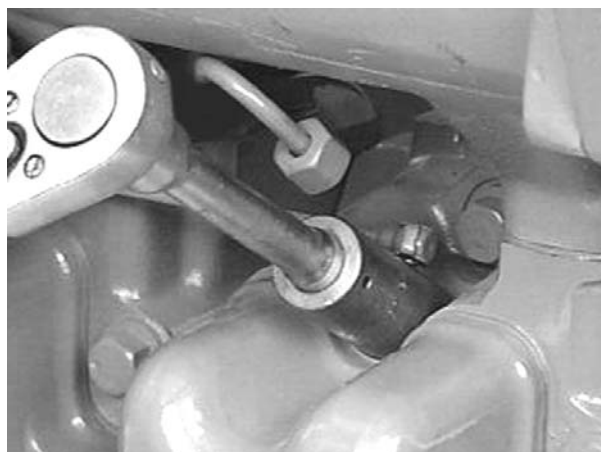
**Attention:**

Dirt in the injection system causes:

- nozzles to jam
- the injection-pump drive gear to break

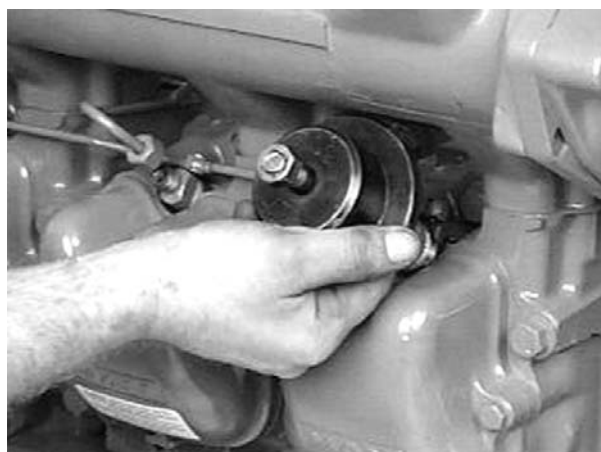


Remove pressure screw from fuel injector using a pin spanner.



Screw adapter on to nozzle holder.  
Screw on inertia extractor and knock out nozzle holder.

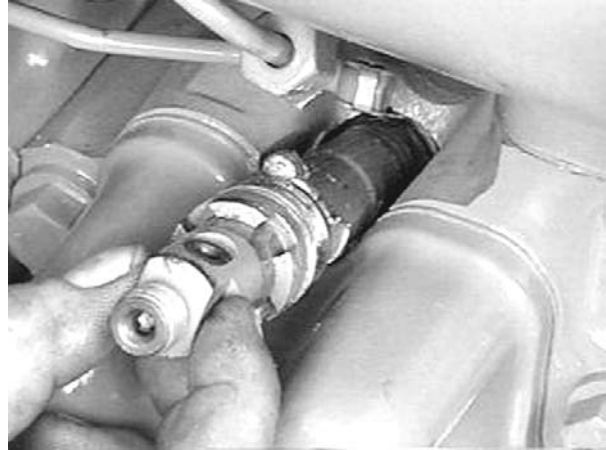
Take sealing ring off the injection nozzle.  
Check and repair injector.



### Installing fuel injectors

Insert new sealing ring, apply "Never Seeze" to the contact points of the nozzle holder and insert nozzle holder with nozzle into cylinder head.

Screw in injector with new seal. Screw on union nut and tighten to specified torque.



Fit fuel return line together with new sealing rings to the nozzle holders and tighten to specified torque.

Screw the pressure lines to the nozzle holders and to the injection pump and tighten to specified torque.

Fit the charge-air elbow and the charge-air pipes to the turbocharger. Exchange the O-ring seals.



## Checking fuel injectors

The nozzle tester (manual test stand) is used to check the

- opening pressure
- tightness
- spray pattern of the injection nozzle.

Use pure testing oil or pure Diesel fuel for the test.

Prior to testing, clean nozzle and check it for wear.

Check injector assembly.

Connect the nozzle's supply connection to the test unit's pressure line.



### Danger:

The high opening pressure may lead to severe injuries. Do not place hands under the jet. Wear safety goggles.

### 1. Checking opening pressure:

Switch on the pressure gauge and slowly press lever downwards until the nozzle emits a jet with a light grating noise.

Read **opening pressure** from the pressure gauge.

In the event of a pressure deviation insert a different shim.

If the pressure is too low, insert thicker shims, if it is too high, insert thinner shims ⑦.

The initial tension of the compression spring ⑥ decreases if a high number of operating hours has been clocked up.

Consequently, the injection pressure drops slightly.

When repairing injection nozzles, always set the opening pressure to the upper limit (+ 8 bar).

### Note:

Shims are available in 0.05 mm steps from 1.0 mm to 1.98 mm.

### 2. Checking tightness:

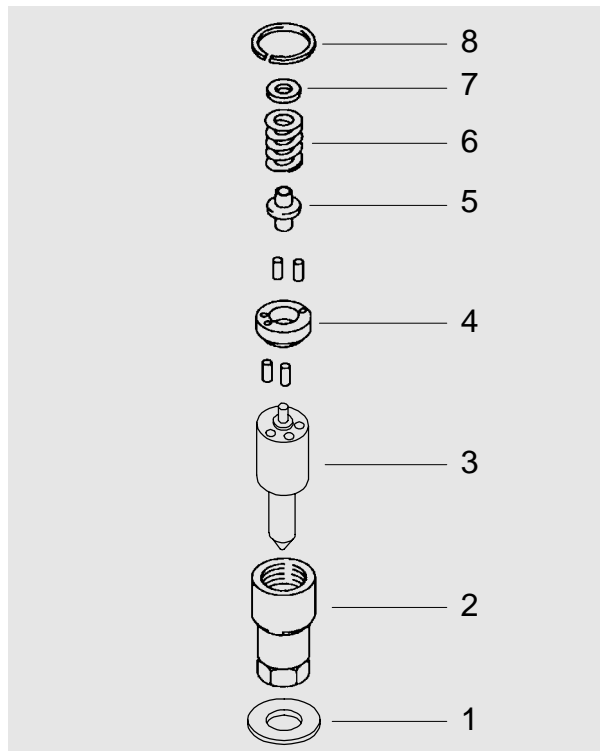
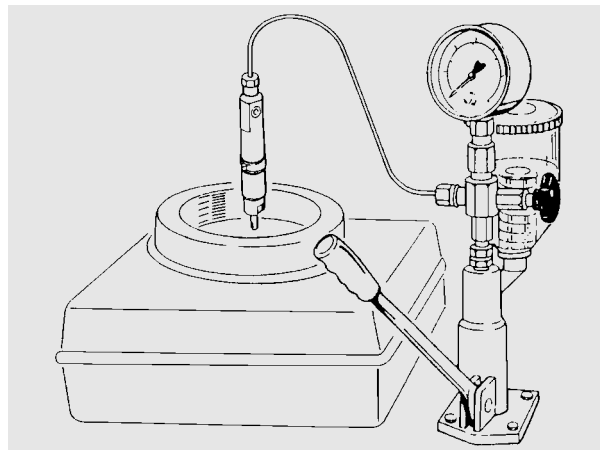
Actuate hand lever.

At a pressure of 20 bar below the opening pressure set not a single drop must fall from the nozzle opening within 10 sec.

### 3. Checking jet:

**Switch off** pressure gauge and carry out some swift strokes. The nozzle must emit an audible grating noise and/or a well-atomised jet.

Nozzles that satisfy these three requirements can be reused.



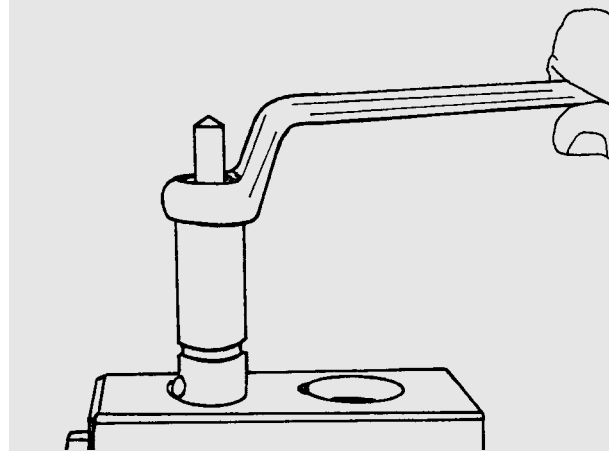
- ① Seal
- ② Nozzle tension nut
- ③ Injection nozzle
- ④ Intermediate washer
- ⑤ Pressure pin
- ⑥ Compression spring
- ⑦ Shim
- ⑧ Circlip

### Disassembling fuel injectors

Insert injector assembly (the inlet orifice facing downwards) into the clamping device and hold in a vice.

Remove union nut and take out nozzle body, intermediate washer, pressure pin, compression spring and shim.

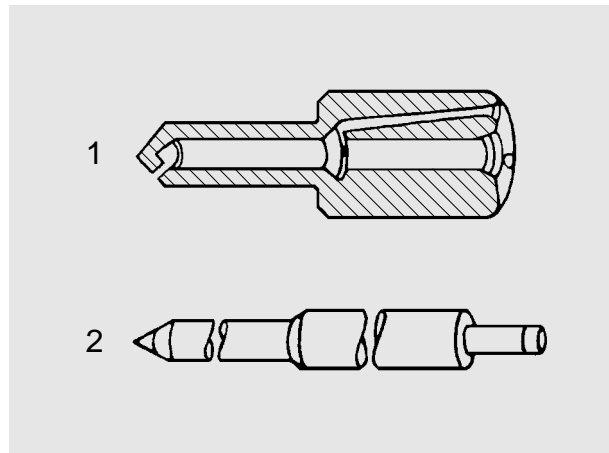
Take pressure pipe neck out of holder.



### Repairing fuel injectors

Clean interior of injection body ① with a small wooden stick and petrol or Diesel fuel.

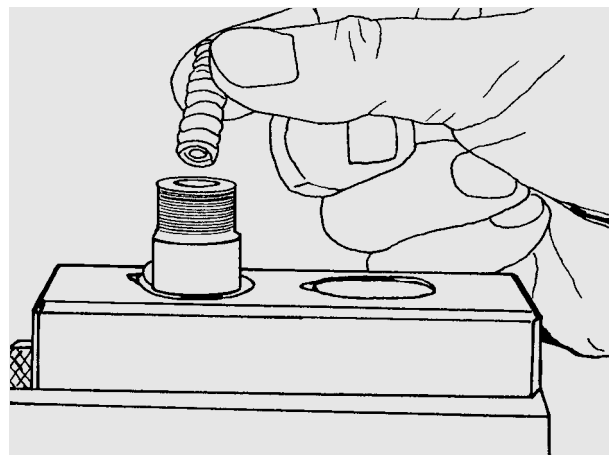
Clean nozzle needle ② with a clean cloth. Clean coked nozzle needle surface on lathe with a piece of wood (not too hard) dipped into oil.



#### Note:

To prevent corrosion, do not touch lapped faces of nozzle needle with the fingers. The needle and injection nozzle are matched to each other and must not be interchanged.

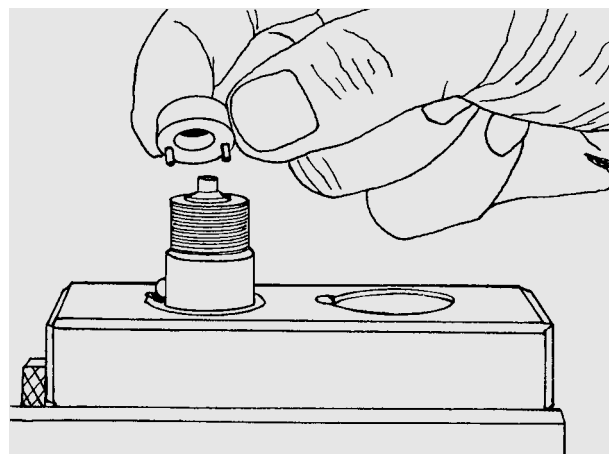
Check cleaned parts for wear and damage, replacing them if necessary. Degrease new parts.



### Assembling fuel injectors

Insert pressure pipe neck into clamping device. Insert shim and compression spring.

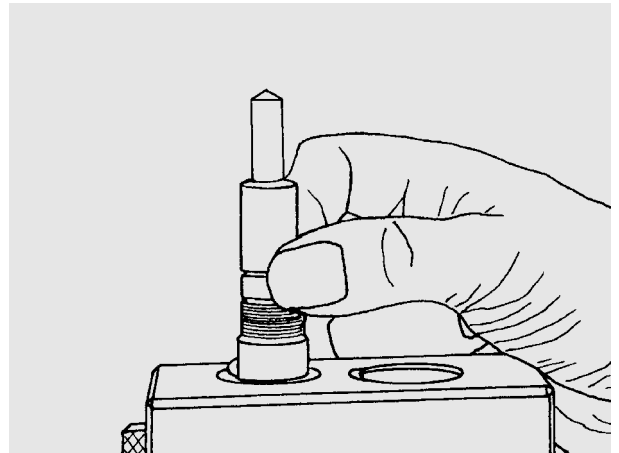
Check intermediate piece for wear. Insert pressure pin and intermediate washer.



Dip nozzle body and nozzle needle separately into filtered Diesel fuel and check their gliding quality.

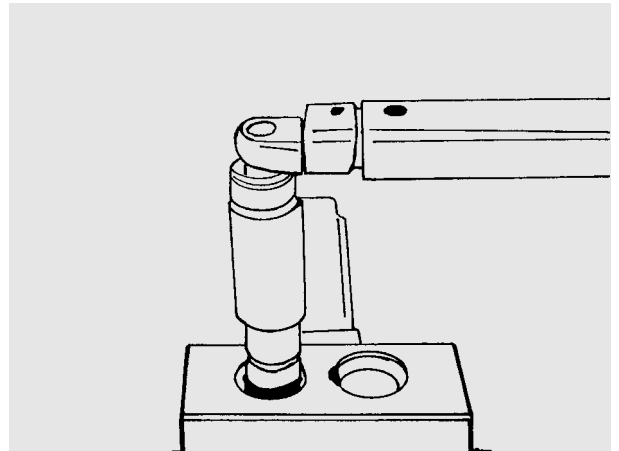
When pulled out of the nozzle body by up to a third of its length the nozzle needle must sink back to its seat under its own weight when released.

Place injection nozzle on top, ensuring that the associated pins are correctly fitted.



Screw on union nut, tightening it to the specified torque (see "Engineering • Data • Setting values").

Check injector on the manual test stand.



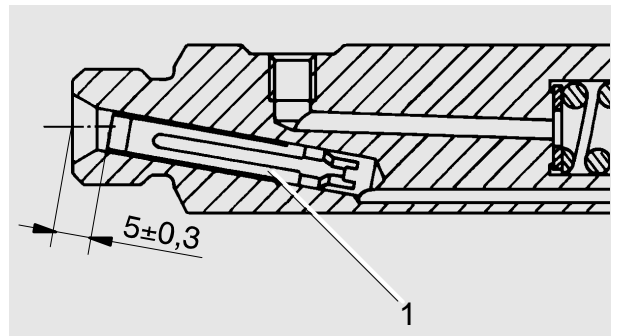
### **Ensure that the edge-type filter is correctly seated in the injector body.**

A dislocated sieve bar filter throttles and prolongs the injection and consequently causes poor performance, high consumption and heavy smoke formation in conjunction with heavy engine vibrations.

For this reason measure the rim offset of the sieve bar filter in the nozzle inlet.

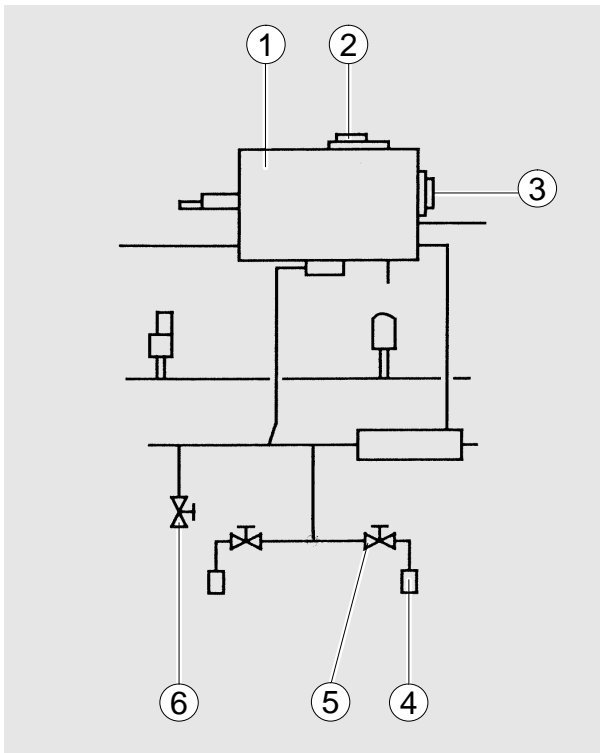
The sieve bar filter must not be pressed into the nozzle holder farther than approx 5 mm.

In the event of larger rim offsets, the nozzle holder is to be replaced.



## Cooling system

Schematic diagram of cooling system



- ① Surge tank
- ② Positive pressure valve
- ③ Coolant level
- ④ UIC-filler neck
- ⑤ Shut-off valve
- ⑥ Shut-off valve

## Draining coolant

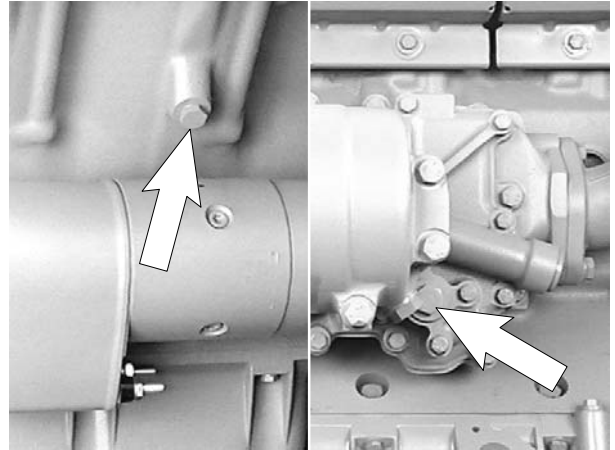
**Danger:**

Draining hot coolant involves a risk of scalding.

**Caution:**

Drain coolant into a suitable container and dispose of it in accordance with regulations.

Drain coolant as follows when cooling system has cooled down:



- Open drain plug in crankcase or in the oil cooler housing (arrows).
- Catch emerging coolant in a suitable container.
- Refit screw plugs
- Filling / bleeding the cooling system

### **Filling up with coolant**(only when engine has cooled down)

Fill the cooling system of the engine with a mixture of drinkable tap water and anti-freeze agent on ethylene glycole basis or anti-corrosion agent.

See Publication "Fuels, Lubricants and Coolants for industrial and marine Diesel engines".

### **Coolant must be added at the filler neck only.**

Ensure that the ratio of water to anti-freeze is correct.

- Slowly fill up with coolant until correct coolant level is reached
- Refit end cover
- Run the engine briefly and then check coolant level once more



#### **Danger:**

If, in an **exceptional** case, the coolant level has to be checked in an engine that has reached operating temperature, first carefully turn the cap with safety valve to the first stop, let off pressure, then open carefully.



### Cleaning the inside of the cooling system

Investigations have shown that in many cases the poor condition of the coolant and / or the cooling system accounts for damage to the water pump mechanical seal. The poor condition of the cooling system is normally due to use of unsuitable or no anti-freezing agents and corrosion inhibitor or defect, not early enough replaced covers for filler neck and working valves.

If twice in a short time the water pump of an engine develops leaks or the coolant is heavily contaminated (dull, brown, mechanically contaminated, grey or black signs of a leakage on the water pump casing, after the defect on the oil cooler) clean the cooling system **prior to** removing that water pump as follows:

- a) Drain coolant
- b) Open thermostats positively (use short-circuit inserts), so that the entire coolant circuit is flushed in the cleaning operation
- c) Fill coolant circuit with a mixture of hot water (min. 50°C) and Henkel P 3 neutrasel 5265 detergent (1.5% by volume) (-5266, -5225, Kluthe Hakopur 316), refer to Publication "Fuels, Lubricants ..."
- d) Warm up engine under load. After a temperature of 60°C is reached, run engine for a further 15 minutes
- e) Drain cleaning fluid
- f) Repeat steps c) and d)
- g) Flush cooling system. To this effect
- h) Replace drain plug by drain plug with a bore of 8 mm dia
- i) Fill cooling system with hot water
- k) Run engine at idle for 30 minutes. At the same time continuously replenish the water leaking from the bore in drain plug by adding fresh water

Repair water pump only now. Thereafter, fill the cooling system with approved cooling fluid. See Publication "Fuels, Lubricants ...".

**Note:**

Only sediments and suspended particles can be removed by this cleaning method. If corrosion and lime deposits are found, proceed according to the following section:

### Removal of lime deposits in the cooling system

#### **Procedure:**

- Drain the coolant
- Fill the system with undiluted original pickling fluid (Lithsolventsäure or engine pickling fluid RB-06), see sources of supply
- Let the engine run (also in normal operation) for approx. 8 hours with this filling in the cooling circuit
- Drain the pickling fluid and thoroughly flush the system with tap water
- If necessary, refill the circuit again with fresh pickling fluid and pickle the engine for another 8 hours
- Drain the pickling fluid, fill the system with tap water, and run the engine at idle for 5 minutes to flush out all fluid; then drain the water
- Fill the system with a 1% soda solution. Drain the soda solution after running the engine at idle for 5 minutes, and flush with tap water until the discharging water is clear
- Fill cooling circuit with a mixture of potable tap water and anti-freeze with at least 40% by volume, refer to Publication "Fuels, Lubricants ..."

#### **Note:**

Older radiators may develop leaks when such deposits are removed. The surge tank should be filled only up to the bottom edge as otherwise foaming will cause the pickling fluid to spill over. Damaged tube bundles may develop leaks when dirt deposits are removed.

### Filler caps and working valves of cooling system

The rubber gaskets of the filler caps and working valves (negative pressure and positive pressure valves) of the cooling system are subject to natural aging.

To preclude leakages in the cooling system and tailing pressure drop and its consequences up to severe engine damage, renew the filler caps and working valves in line with the change of coolant (every two years at the latest) see also "Filling-in of coolant" in this chapter.

### Waste water treatment

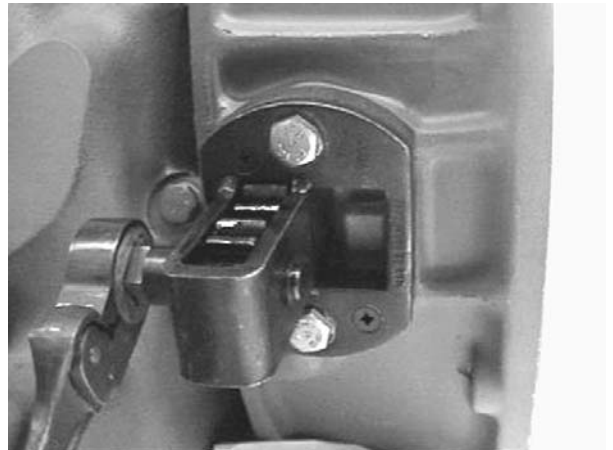
Drained and spent cleaning and pickling fluid should be brought up to a pH value of 7.5 to 8.5 with the aid of caustic soda. Once the precipitation has settled to the bottom of the container the clear fluid above can be dumped into the sewer. The sludge at the bottom should be taken to a special waste dump. Anyway, it is recommended to consult the local authorities for more information about waste water rules or restrictions.

Adjust the valves only when engine is cold (max. coolant temperature 50°C).

Remove cylinder head cover.

**Attention:**

Residual amounts of oil may emerge during this operation.  
Used oil is dangerous waste.  
Observe safety regulations to prevent damage to the environment.



The speed pickup is fitted to the bottom right-hand side of the flywheel housing. Remove the mounting bolts from the retaining plate and take off plate together with the speed pickup.

Use cranking device to turn engine until the piston of the cylinder to be adjusted is at ignition TDC and the rocker arms are relieved.

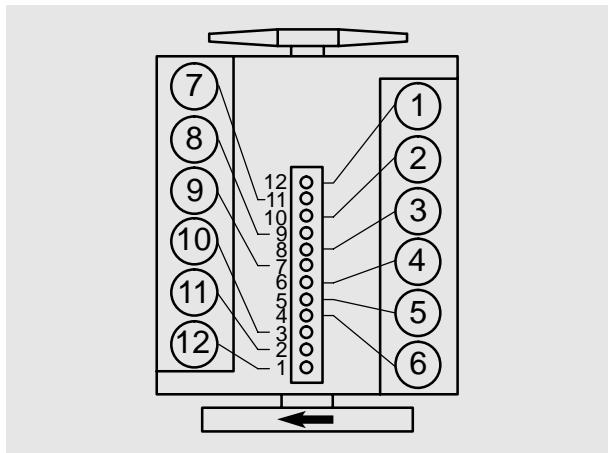
The valves of the synchronous cylinder are then in cross-over.

D 2842 ME 601.

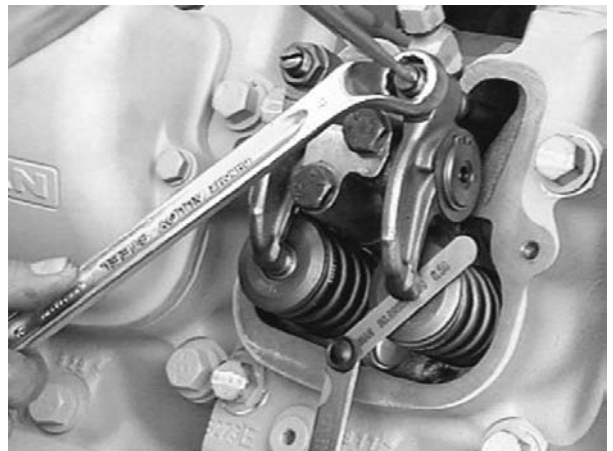
Set valves in the cylinder

1	12	5	8	3	10	6	7	2	11	4	9
6	7	2	11	4	9	1	12	5	8	3	10

Valves are in cross-over in cylinder



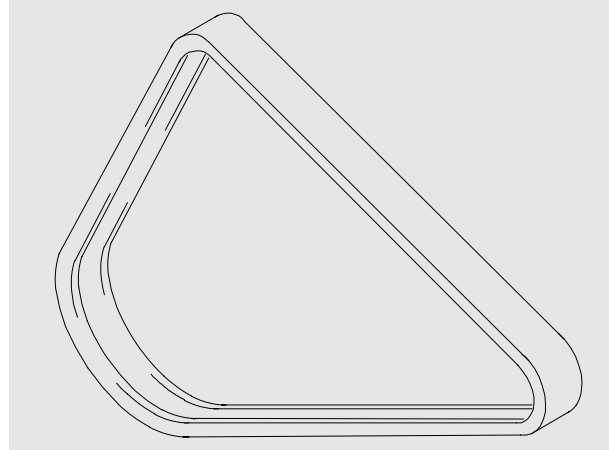
- Push feeler gauge between valve stem and rocker arm
- Loosen lock nut (17 mm) and turn adjusting screw with screwdriver until feeler gauge can be moved with slight resistance
- Tighten lock nut to the specified torque
- Check clearance again
- Refit cylinder head covers with new gaskets.
- Tighten the bolts to the specified torque



## Checking condition

Fig. 1

- Check V-belts for cracks, oil, overheating and wear
- Change damaged V-belts



## Checking tension

Fig. 2

Use V-belt tension tester to check V-belt tension.

- Lower indicator arm ① into the scale

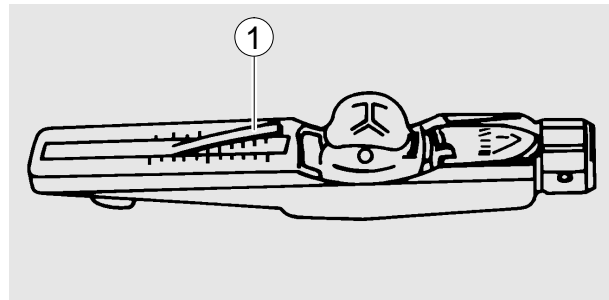
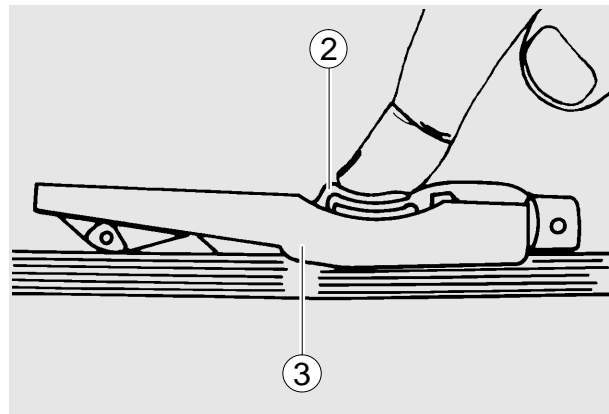


Fig. 3

- Apply tester to belt at a point midway between two pulleys so that edge of contact surface ② is flush with the V-belt
- Slowly depress pad ③ until the spring can be heard to disengage. This will cause the indicator to move upwards

If pressure is maintained after the spring has disengaged a false reading will be obtained!



## Reading of tension

- Read of the tensioning force of the belt at the point where the top surface of the indicator arm intersects with the scale
- Before taking readings make ensure that the indicator arm remains in its position

If the value measured deviates from the setting value specified, the V-belt tension must be corrected.

Drive belt width	Tensioning forces according to the kg graduation on the tester		
	New installation		When servicing after long running time
	Installation	After 10 min. running time	
9,5	50	45	40
12,5	55	50	45
20	75	70	60
22	75	70	60

## First commissioning

At the time of initial commissioning of a new or overhauled engine make sure to have observed the “Technical Information for the installation of MAN Diesel engines”.

It is recommended that new or overhauled engines should not be operated at a load higher than about 75% maximum load during the first few hours of operation. Initial run-in should be at varying speeds. After this initial run-in, the engine should be brought up to full output gradually.

**Note:**

Use only approved fuels, lubricants etc. (see brochure “Fuels, lubricants etc.”). Otherwise the manufacturer’s warranty will become null and void.

## Filling with fuel

**Caution:**

Fill the tank only when the engine is switched off. Pay attention to cleanliness. Do not spill fuel. Use only approved fuels (see “Fuels, Lubricants etc.”)

## Filling-in of coolant

Fill the cooling system of the engine with a mixture of drinkable tap water and anti-freeze agent on ethylene glycole basis or anti-corrosion agent. See Publication “Fuels, Lubricants and Coolants for MAN Diesel Engines”.

- Pour in coolant slowly via expansion tank, see page 50
- For coolant filling quantity, see “Technical data”

## Filling with engine oil

**Caution:**

Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.

The engines are as a rule supplied without oil. Pour oil into engine via filler neck, see page 36. For the quantity required see “Technical Data”.

## Commissioning

Before daily starting the engine, check fuel level, coolant level and engine oil level and replenish, if necessary.

**Note:**

Use only approved fuels, lubricants etc. (see brochure “Fuels, lubricants etc.”).  
Otherwise the manufacturer’s warranty will become null and void.

## Checking oil level

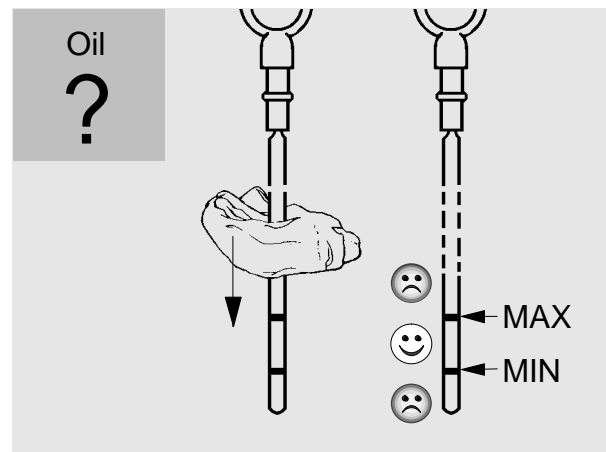
Check the oil level when the engine is horizontal, but only if at least 20 minutes have passed since the machine was switched off.

- Pull out dipstick
- wipe it with a clean, lintfree cloth
- and push it in again up to the stop
- Pull out dipstick again

The oil level should be between the two notches in the dipstick and must never fall below the lower notch. Top up oil as necessary.

**Caution:**

Do not add so much engine oil that the oil level rises above the max. marking on the dipstick. Overfilling will result in damage to the engine.



Ensure utmost cleanliness when handling fuels, lubricants and coolants.

## Starting

**Danger:**

Before starting make sure that no-one is in the engine's danger area.

**Caution:**

When starting do not use any additional starting aids (e.g. injection with starting pilot).

- Ensure that no load is on the engine before starting it, eg switch off load, disengage clutch, put gearbox into neutral etc..

With engines without starting aid or at temperatures above 5-10°C or when engine without flame starter is already hot:

- Insert starter key in starting lock
- Press starter button until engine starts

With engines with starting aid (flame starter), at temperatures around 0°C and below:

- Insert starter key in starting lock
- Switch on flame starter; signal lamp "Preheating" is on
- Signal lamp "Preheating" is flashing; press starter button until engine starts

**Caution:**

- When engine starts, release starter button immediately
- If engine does not start, actuate starter for about 10 seconds, wait for 30 seconds and then attempt to start engine again and so on

With engine with automatic starting (eg standby power units) it is indispensable that none of the moving parts be accessible. Warning signs "Unit starts automatically" are to be attached to the engine. Regulation on this which may apply locally are to be satisfied.

When engine is running, lube oil pressure must build up at the oil pressure gauge. If not switch off engine immediately.

Avoid running the cold engine for any length of time since in any internal combustion engine this is liable to cause increased wear due to corrosion. Prolonged idling is harmful to the environment.

### Operation monitoring system

**Caution:**

Do not overload the engine. Do not exceed the maximum permissible engine tilt. If faults occur, find their cause immediately and have them eliminated in order to prevent more serious damage!

During operation the oil pressure in the engine lubrication system must be monitored. If the monitoring devices register a drop in the lube oil pressure, switch off the engine immediately.

### Shutting down

Do not switch off engine immediately operation at high loads, but let it idle for about 5 minutes to achieve a temperature equalisation.

Then switch off the engine via the shut-off device provided (shut-off solenoid, electric speed governor etc.).

**Danger:**

Ensure that the engine can not be started by unauthorized persons.



## Tightening torque guide values



### Note:

All screws and bolts not listed in the following table must be tightened according to the guiding values of MAN works standard M 3059.

Apply a light film of oil to all screws and bolts before they are fitted!

### Plugs

#### DIN 908

M 14 x 1,5, M 16 x 1,5 .....	80 Nm
M 18 x 1,5, M 22 x 1,5 .....	100 Nm
M 24 x 1,5, M 26 x 1,5 .....	120 Nm
M 30 x 1,5 .....	150 Nm

#### DIN 7604

AM 10 x 1, M 12 x 1,5 .....	50 Nm
AM 14 x 1,5 .....	80 Nm

### Crankcase, crankshaft assembly

Timing case to crankcase M10, 12.9 .....	75 Nm
Timing case to crankcase M12x1,5, 12.9 .....	100 Nm
Thrust washer to timing case M8, 12.9 .....	40 Nm
Crankshaft bearing caps to crankcase M18 x 2	
initial torque .....	300 – 330 Nm
rotation angle .....	90 – 100°
Crankshaft main bearing caps (side) M12 x 1,5	
Hex bolt	
initial torque .....	80 Nm
rotation angle .....	90°
12 point rolled shank bolt	
initial torque .....	80 – 90 Nm
rotation angle .....	90 – 100°
Counterweight to crankshaft M16 x 1,5	
initial torque .....	140 – 160 Nm
rotation angle .....	90 – 100°
Vibration damper hub to crankshaft M16 x 1,5, 10.9 .....	260 Nm
Flywheel to crankshaft M16 x 1,5	
initial torque .....	100 – 110 Nm
1st rotation angle .....	90 – 100°
2nd rotation angle .....	90 – 100°
Connecting rod bearing caps M14 x 1,5	
initial torque .....	100 – 110 Nm
rotation angle .....	90 – 100°

### Cylinder head

Tightening / retightening of cylinder head bolts, see page 60.

Rocker arm bracket to cylinder head .....	65 Nm
Locknut on valve adjusting screw .....	50 Nm



## Timing devices

Adjusting segment to camshaft gear M10 .....	90 Nm
Adjusting segment to intermediate gear M10 .....	90 Nm

## Lubrication system

Oil pump to crankcase M8, 8.8 .....	22 Nm
Oil pump cover M8, 8.8 .....	22 Nm
Oil cooler to oil filter head M8, 8.8 .....	22 Nm
Filter bowl to oil filter head M12, 12.9 .....	50 Nm
Plug (oil drain plug) in oil pan M26 x 1,5 .....	80 Nm
Oil jet flange to crankcase M14 x 1,5 .....	70 Nm

## Exhaust / Intake manifolds

Exhaust manifold to cylinder head M10	
initial torque .....	60 – 65 Nm
rotation angle .....	90 – 100°
Intake pipe to cylinder head M8, 8.8 .....	22 Nm

## Fuel system

Injector to cylinder head M28 x 1,5 .....	120 – 125 Nm
Fuel filter M12, 8.8 .....	80 Nm
Pressure pipe to injector .....	15 – 25 Nm
Pressure pipe to injection pump .....	15 – 25 Nm

## Starter / alternator

Starter to timing case M12 x 1,5 .....	80 Nm
.....	40 – 50 Nm

## Transmitter

Oil pressure transmitter .....	80 Nm
Temperature transmitter .....	20 Nm

## Tightening torque guide values



### Tightening torque values according to Works Standard M 3059

Bolts / nuts with external or internal hexagon, head without collar or flange

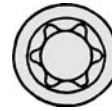
Thread size x pitch	Grade / Tightening torque in Nm		
	for <b>8.8 / 8</b>	for <b>10.9 / 10</b>	for <b>12.9 / 12</b>
M 4	2,5	4,0	4,5
M 5	5,0	7,5	9,0
M 6	9,0	13,0	15,0
M 7	14,0	20,0	25,0
M 8	22,0	30,0	35,0
M 8 x 1	23,0	35,0	40,0
M 10	45,0	65,0	75,0
M 10 x 1,25	45,0	65,0	75,0
M 10 x 1	50,0	70,0	85,0
M 12	75,0	105,0	125,0
M 12 x 1,5	75,0	110,0	130,0
M 12 x 1,25	80,0	115,0	135,0
M 14	115,0	170,0	200,0
M 14 x 1,5	125,0	185,0	215,0
M 16	180,0	260,0	310,0
M 16 x 1,5	190,0	280,0	330,0
M 18	260,0	370,0	430,0
M 18 x 2	270,0	290,0	450,0
M 18 x 1,5	290,0	410,0	480,0
M 20	360,0	520,0	600,0
M 20 x 2	380,0	540,0	630,0
M 20 x 1,5	400,0	570,0	670,0
M 22	490,0	700,0	820,0
M 22 x 2	510,0	730,0	860,0
M 22 x 1,5	540,0	770,0	900,0
M 24	620,0	890,0	1040,0
M 24 x 2	680,0	960,0	1130,0
M 24 x 1,5	740,0	1030,0	1220,0

## Cylinder head bolts

### General notes

The engine may have either of the following two types of cylinder head bolt:

- Cylinder head bolts with hex head tightened by the angle-of-rotation method, socket size 19
- Cylinder head bolts with Torx head tightened by the angle-of-rotation method, Torx wrench size E18



### Bolts to be used in event of repairs:

Bolts with hex head may be replaced by bolts with Torx head if all the bolts on the engine are to be changed.

Do not use bolts with hex head and bolts with Torx head on the same engine.

## Retightening cylinder head bolts on new engines (engine cold or warm)

The cylinder heads are mounted with cylinder head bolts which are tightened by the angle-of-rotation method. On new engines the cylinder head bolts are tightened up for the first time at the factory after the engine has been broken in. The sticker "**First retightening of cylinder head bolts ...**" is then attached to one of the cylinder head covers.

**Erster Nachzug der Zylinderkopfschrauben erledigt**

**First retightening of cylinder-head-bolts completed**

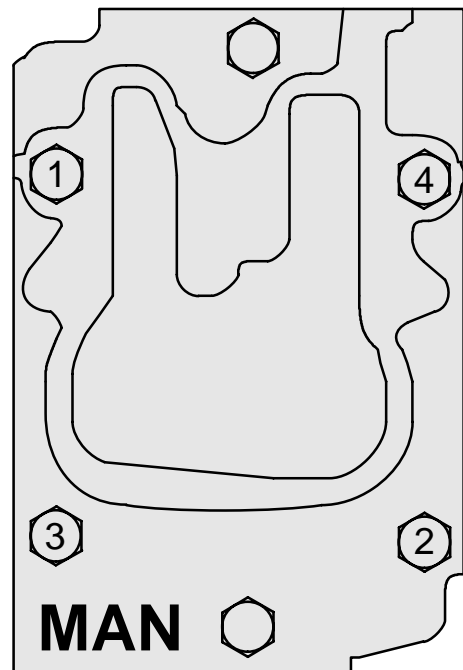
Spare part No. 51.97801-0211

After the first 400 hours of operation retighten cylinder head bolts 1 to 4 in the order shown in Tightening diagram "1" by a further 90° (1/4 revolution).

The two outer screws (intake and exhaust sides) must not be retightened.

**Note:**

The cylinder head bolts to be retightened must not be loosened first, but simply tightened by a further 90° (1/4 revolution) from their actual position.



Tightening diagram "1"

Remove the sticker "**First retightening of cylinder head bolts ...**" and attach the sticker "**Second retightening of cylinder head bolts ...**" to show that the cylinder head bolts have been retightened for the second time.

**Zweiter Nachzug der Zylinderkopfschrauben erledigt**

**Second retightening of cylinder-head-bolts completed**

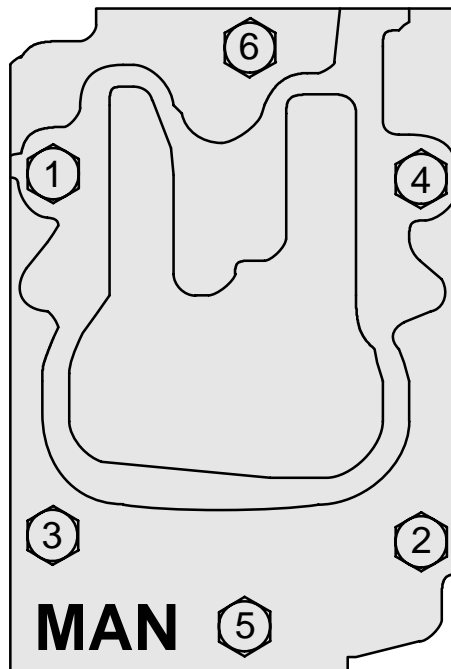
Spare part No. 51.97801-0212

### Tightening cylinder head bolts after a repair (engine cold)

Before inserting the cylinder head bolts oil them with engine oil on the thread (not to the bore) and coat the contact face of the bolt head with "Optimoly White T" assembly paste. Do not use any oils or oil additives that contain MoS<sub>2</sub>. The bolts must be tightened by the angle-of-rotation method as shown in Tightening diagram "2".

- 1st pretightening step = to 10 Nm
- 2nd pretightening step = to 80 Nm
- 3rd pretightening step = to 150 Nm
- 4th pretightening step = turn by 90°
- Final tightening = turn by 90°

Adjust valve clearance.



Tightening diagram "2"

### Retightening cylinder head bolts after repairs (engine cold or warm)

After the first 10 to 20 hours of operation after a repair turn the cylinder head bolts by a further 90° (1/4 revolution) in the order shown in Tightening diagram "2".

The cylinder head bolts to be retightened must not be loosened first, but simply tightened by a further 90° (1/4 revolution) from their actual position.

Attach the sticker "**First retightening of cylinder head bolts ...**" (Remove any other stickers which may already be attached).

After the first 400 hours of operation after a repair tighten cylinder head bolts 1 to 4 in the order shown in Tightening diagram "1" again by a further 90° (1/4 revolution).

The two outside screws (intake and exhaust side) must not be retightened.

Attach the sticker "**Second retightening of cylinder head bolts ...**".

#### Note:

When a cylinder head has been removed the cylinder head gasket must always be changed.

## Re-using old cylinder head bolts

### Checking

Before re-using old cylinder head bolts check them as follows:

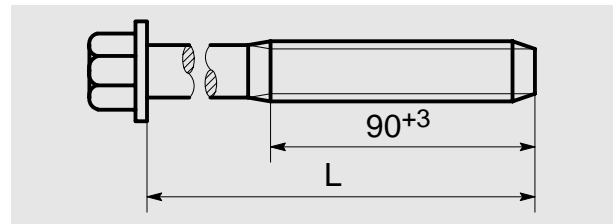
### Length

During tightening the bolts are intentionally stressed beyond the yield point and therefore subjected to some permanent elongation each time they are tightened.

### Surface

The surface of the bolts must be in satisfactory condition, i.e. the phosphate coating must be intact and there must be no rust.

Rusted or damaged bolts or bolts elongated beyond the maximum permissible length must immediately be made unusable – e.g. by destroying the threads with a hammer – and scrapped.



**L** = Shank length

Shaft lengths "L" in case of new bolts	Largest permitted dimension
109 mm	111 mm
144 mm	146 mm
168 mm	170 mm



## Technical data

Model	<b>D 2842 ME 601</b>	
Design	V-form, 90°	
Cycle	4-stroke Diesel	
Combustion system	Direct injection	
Number of cylinders	12	
Bore	128 mm	
Stroke	142 mm	
Swept volume	21 930 cm <sup>3</sup>	
Compression ratio	17 : 1	
Rating	305 kW (see engine nameplate)	
Rating	256 kW	
at	2100 rpm	
Firing order	1-12-5-8-3-10-6-7-2-11-4-9	
Valve clearance (cold engine)		
Intake	0.25 mm	
Exhaust	0.40 mm	
Valve timing		
Intake opens	12° before TDC	
Intake closes	48° after BDC	
Exhaust opens	61° before BDC	
Exhaust closes	11° after TDC	
Fuel system		
Injection	In-line pump, V-saddle-mounted	
Governor	Electronic speed governor (GAC)	
Injectors	one-hole nozzles	
Opening pressure of injector		
New nozzle holder:	280 + 8 bar	
Start of delivery	26°	± 1° KW before TDC
Engine cooling system	Liquid cooling	
Operating temperature	80–90°C, temporarily 90°C allowed	
Electrical equipment		
Starter	24 V; 6.5 kW	



## Technical data



Engine lubrication	Force feed	
Oil capacity in oil sump (litres)	min.	max.
	35 l	50 l
Oil pressure during operation (depending on oil temperature, oil viscosity class and engine rpm)	must be monitored by oil pressure monitors / gauges	
Opening pressure of excess pressure valve on oil pump	9 + 1 bar	
Opening pressure of bypass valve in oil filter	min.	max.
	3,0–2,8 bar	3,0–3,6 bar
Oil filter	Full-flow filter with paper filter elements	

**Observe safety instructions!**

Maintenance chart	Maintenance intervals in operating hours					
	1	2	3	4	5	6
Checking oil and coolant level	•					
Engine oil change		•	•			
Change the oil filter elements		•	•			
check V-belt tension.		•	•			
Adjust the valves		•		•		
Check that removable unions (bolts, hose clips, pipe fittings) are firmly in position and, if necessary, retighten		•				
Service the air cleaner (earlier if severe operating conditions demand it)			•			
Changing fuel filter					•	
Change coolant						•
Renew filler cap and working valve of cooling system						•
1st retightening of cylinder head bolts (with overhauled engine)		•				
2nd retightening of cylinder head bolts (with new or overhauled engine)						

- 1 – Daily
- 2 – After the first 10 to 20 hours of operation (with new or overhauled engine)
- 3 – Every 200 hours of operation
- 4 – Every 400 hours of operation
- 5 – Every 1000 hours of operation
- 6 – Every 2 years

## Oil change

Engine oil change intervals in hours of operation, depending on the oil grade used.

Engine	Engine oils according to MAN Works Standard*			
	270	271	M 3275	M 3277
D 2842 ME 601	400 h	400 h	400 h	400 h

\*) See Publication "Fuels, Lubricants and Coolants for industrial and marine Diesel engines".

### Note:

- Use only approved engine oils
- Where Diesel fuels with a sulphur content greater than 1% are used, the oil change intervals are to be halved
- Irrespective of the periods stated, the engine oil should be changed at least once every year
- Change the oil filter elements every time the engine oil is changed

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