Operating Instructions for MAN Marine Diesel engines
Bedienungsanleitung für MAN-Schiffsdieselmotoren
Instrucciones de servicio para Motores Diesel MAN para barcos
Instruction de service pour Moteurs Diesel marins MAN
Norme di servicio per Motori Diesel MAN per applicationi navali

D 2866 LE 401 / 402 / 403 / 405
D 2876 LE 403

Dear Customer,

these Operating Instructions are intended to familiarize you with your new MAN Diesel engine and how it operates.
This manual contains information on “Fuels, Lubricants and Coolants for MAN Diesel Enginess”.
This manual is supplemented by the publication “Service record book”.

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

Note:
Only use fuel, coolants and lubricants in accordance with MAN’s regulations otherwise the manufacturer’s warranty will not apply!
For basic information on the fuels see the publication “Fuels, Lubricants and Coolants for MAN Diesel Engines”.
You can find the approved products in the internet under:
–**http://www.man-mn.com/** → **Products & Solutions** → **E-Business**–

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.

MTDB Technical status: 02.2005 51.99493–8499

Important instructions which concern technical safety and protection of persons are emphasised as shown below.

Danger:
This refers to working and operating procedures which must be complied with in order to rule out the risk to persons.

Caution:
This refers to working and operating procedures which must be complied with in order to prevent damage to or destruction of material.

Note:
Explanations useful for understanding the working or operating procedure to be performed.

Fitting flat seals / gaskets

Flat seals / gaskets are often inserted with sealing agents or adhesives to make fitting them easier or to achieve better sealing. Flat seals may slip in operation due to the “sewing-machine” effect, in particular if they are used between parts with different rates of linear expansion under heat (e.g. aluminium and cast iron), and leaks may then occur.

Example:
the cap of the front crankshaft seal. If a sealing agent or an adhesive is used here the flat seal will move inwards in the course of time as a result of the different expansion rates of the materials. Oil will be lost, for which the shaft seal may be thought to be responsible.

Flat seals / gaskets can be fitted properly only if the following points are observed:

- Use only genuine MAN seals/gaskets.
- The sealing faces must be undamaged and clean.
- Do not use any sealing agent or adhesive – as an aid to fitting the seals a little grease can be used if necessary so that the seal will stick to the part to be fitted.
- Tighten bolts evenly to the specified torque.

Contents

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.*

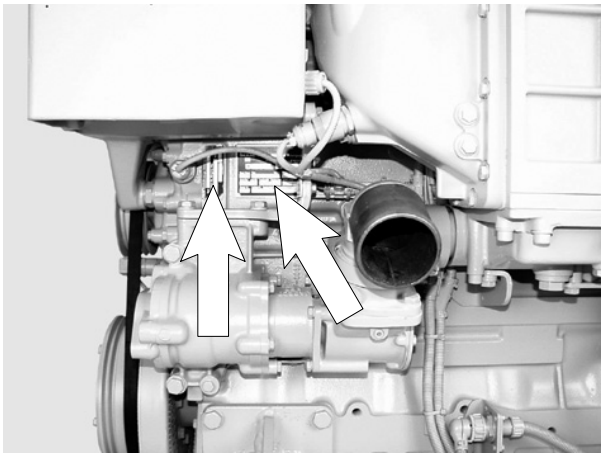
Rating / speed:

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



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 (see illustration).

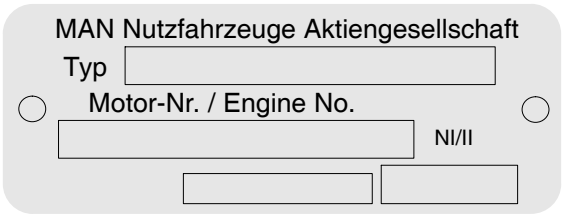
Model .....

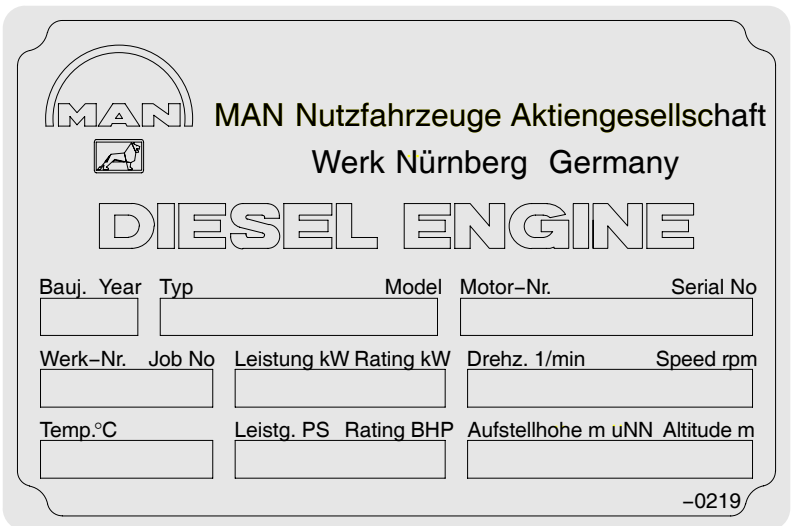
delivered on .....

installed on .....

Engine serial number .....

Order number .....





General notes

Handling diesel engines and the necessary resources is no problem when the personnel commissioned with operation and maintenance are trained accordingly and use their common sense.

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 engines 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.
- It is advisable to switch off the engine if an alarm of any kind is displayed in the engine monitoring and diagnostic system. If this is not possible for any reason, the engine should be run no faster than 1200 rpm until the fault is remedied, see page 21.
- Comply with instructions for operation of the alternator. See “Maintenance and care”.
- Do not let the seawater pump run dry. If there is a risk of frost, drain the pump when the engine is switched off.

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.
  Caution:
  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.

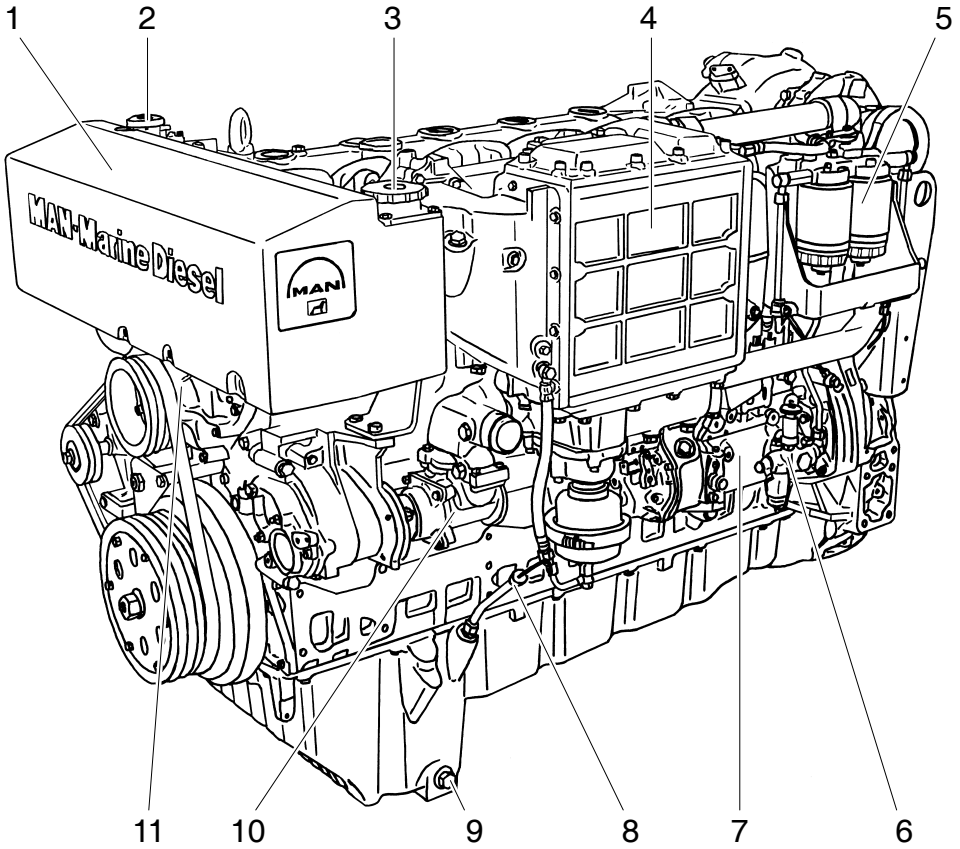
Ensure that used engine oil is disposed of properly
– Engine oil can endanger the water supply –

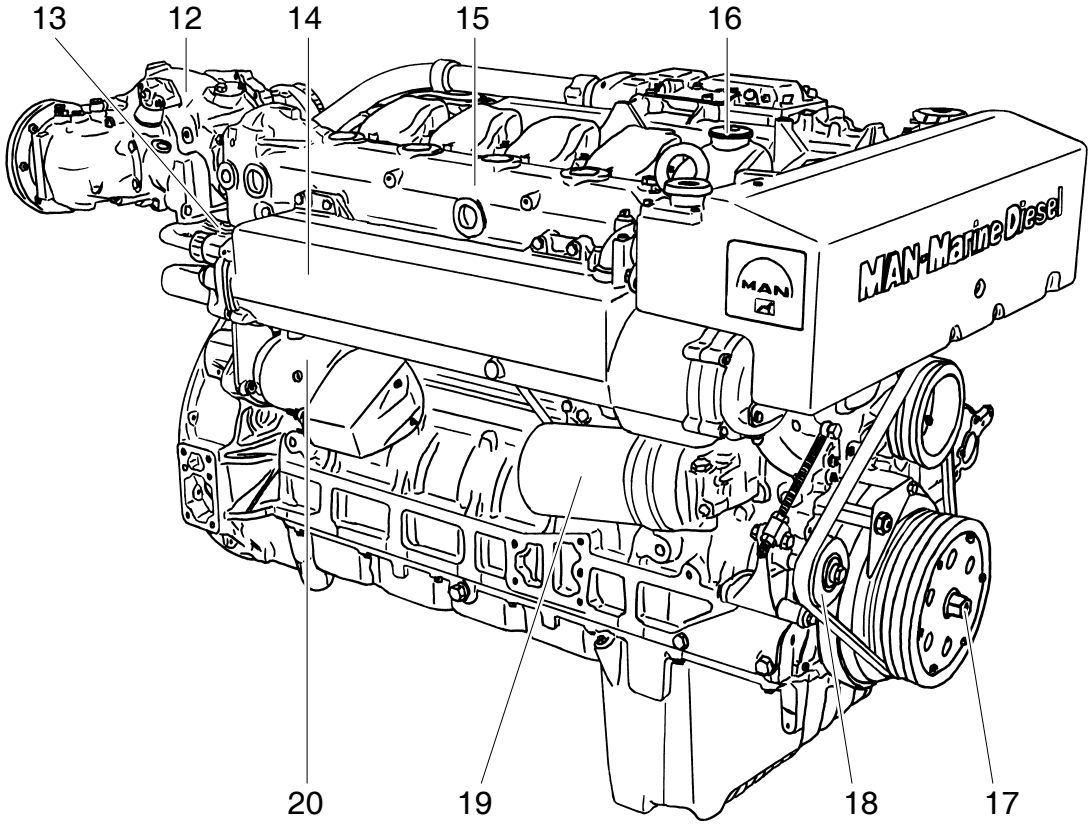
For this reason do not let engine oil get into the ground, waterways, the drains or the sewers. Violations are punishable.

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 2866 LE 401





1 Coolant surge tank

2 Relief valve on coolant surge tank

3 Coolant filler neck

4 Intercooler

5 Fuel filter

6 Fuel lift pump with prestrainer

7 Injection pump

8 Oil dipstick

9 Oil drain plug

10 Seawater pump

11 Coolant pump

12 Turbocharger, liquid-cooled

13 Waste Gate

14 Heat exchanger

15 Exhaust pipe, liquid-cooled

16 Oil filler neck

17 Engine cranking device

18 Tensioning pulley

19 Oil filter

20 Starter motor

First commissioning

When putting a new or overhauled engine into operation for the first time pay attention to the “Installation instructions for MAN marine diesel engines” without fail.

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”.

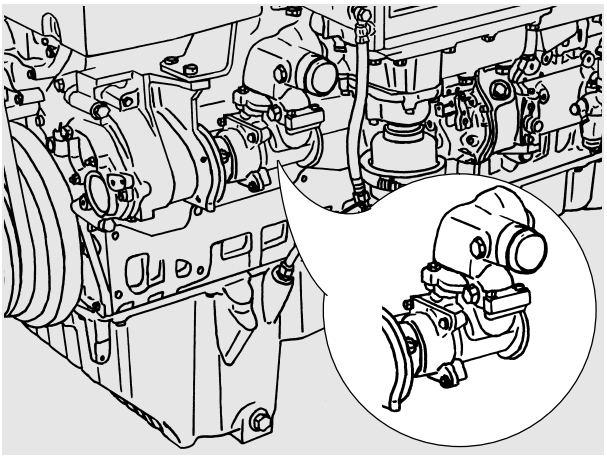
- Pour in coolant slowly via expansion tank, see page 31
- For coolant filling quantity, see “Technical data”

Seawater pump

Do not let seawater pump run dry.

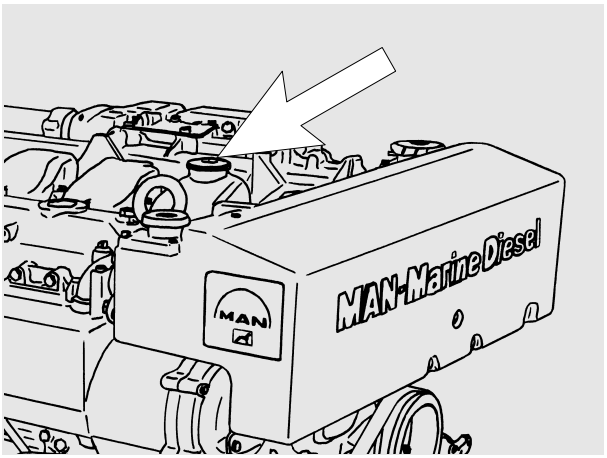
Make sure that all valves / cocks in the seawater circuit are open.

If there is a risk of frost, drain the seawater pump.



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.



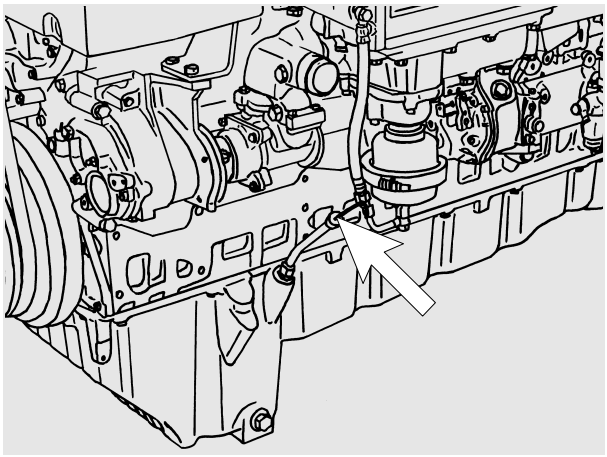
The engines are as a rule supplied without oil.
Pour oil into engine via filler neck (arrow), see page 25.
For the quantity required see “Technical Data”.

Commissioning

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

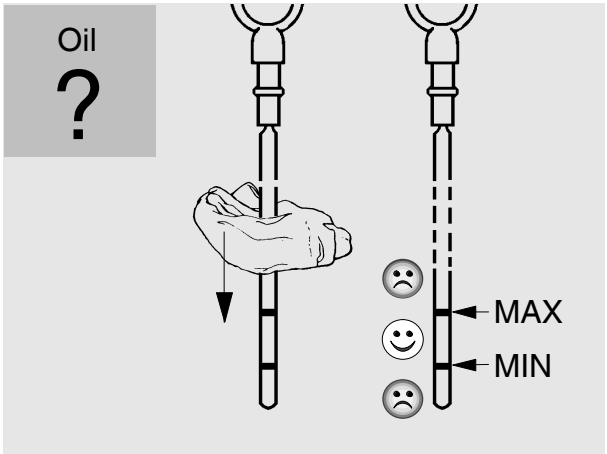
Note:
Use only approved fuels, lubricants etc. (see brochure “Fuels, lubricants etc.”). Otherwise the manufacturer’s warranty will become null and void.

Checking oil level



Check engine oil level only approx. 20 minutes after the unit has been switched off.

- Pull out dipstick (arrow)
- 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 outmost cleanliness when handling fuels, lubricants and coolants.

Starting

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

Ensure that the gearbox is in neutral.

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

Insert starter key and turn it to position "I". The check lamp comes on to show that the engine is ready for operation.

Turn starter key further to position "II" (pre-glow). The display lamp (usually in the driver's station) comes on.

After the pre-glow period the display lamp begins to flash. This signalizes that the engine is ready for starting.

Note:
If the engine is not equipped with a pre-glowing function, immediately turn the starter key through to position "III".

Turn key further up to the stop (position "III"). The display lamp goes out. The starter motor is actuated.

Lube oil pressure must build up at the oil pressure gauge. If it does not, switch off the engine immediately.

For cold engines (<20°C) move control lever into starting position (against stop for maximum engine speed).

Note:
When starting the cold engine (control lever in starting position) retract the control lever **as quickly as possible** into lower idling position after the engine has started.

The warm engine can also be started with the control lever in idling position.

Do not operate starter for longer than 10 seconds at a time.

After ignition of the engine, release the starter button and adjust control lever for desired speed.

If engine fails to start, release the key, wait about 30 seconds, then operate starter again.

For repeated starting turn the key back to OFF.

If the engine is kept idling for long periods it may cool down and thus start to emit white or blue smoke.
We therefore recommend that you do not let the engine idle for more than 5 minutes.
It is well known that with any internal combustion engine wear is higher during idling.
Idling for longer periods is also an environmental nuisance.

Operation monitoring system

Caution:
If an engine / gear box alarm is displayed on the monitoring device, the engine is to be turned off, i.e. operated at low-pressure at a max. of 1200 rpm.

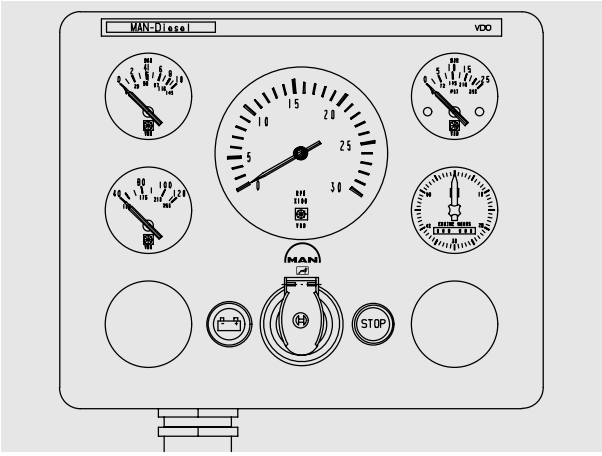
When following alarms are activated
- engine oil pressure / reduction of lubrication oil pressure
- engine coolant temperature / overheating of engine coolant
- engine charge-air temperature

the engine is to be turned off immediately and the cause of the error properly remedied, i.e. in a specialist workshop.

Do not put this engine into operation again until the error has been eliminated.

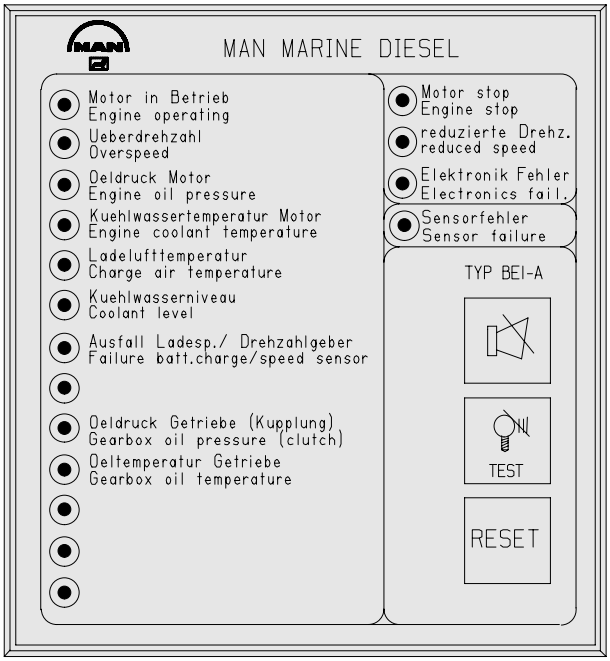
Caution:
Do not overload the engine. Do not exceed the maximum permissible engine tilt. If faults occur, find their cause immediately and have them eliminated in order to prevent more serious damage!

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.



Operation of the engine monitoring system

The engine monitoring system warns the ship operator if important engine operating values are outside the permissible tolerance range.



The display unit of the engine monitoring system (see picture) is installed in the main navigating stand and, as an option, in the secondary navigating stand (flybridge) too. The alarm is raised:

- acoustically by means of a horn
- visually by the flashing of the respective red check lamp (exception: in the event of a fault in the electronic system the respective check lamp is permanently illuminated)

To protect the engine, the speed will be reduced if alarm warnings like engine oil pressure, engine coolant temperature, charge-air temperature and coolant level) is raised. The check lamp “reduced speed” is then illuminated permanently.

Note on engines with electronically controlled diesel injection (EDC):
After the ignition has been switched on, the lamp “Fault in the electronic system” will come on momentarily (lamp check). If there is a fault in the electronically controlled diesel injection system (EDC), the lamp “Fault in the electronic system” will be illuminated permanently.

Operation of the engine monitoring system after an alarm has been triggered

The display unit has the following operating buttons:

Switching off of the alarm horn.

TEST

Switching off of the flashing signal of the respective check lamp, ie the flashing light changes into permanent light. Before the flashing signal can be switched off, the alarm horn must be switched off.

RESET

Lifting of the alarm message (the red check lamp will go out).
Precondition for lifting an alarm message:

- Pressing of buttons “Horn off” and “Test” in the order indicated
- Elimination of the cause of the alarm
- Short-term reduction of the engine speed below 800 rpm, to again achieve higher engine speeds

Functional test of the check lamps

If no alarm is raised, the check lamps may be checked. Upon pressing the button “Test”, all check lamps must come on.

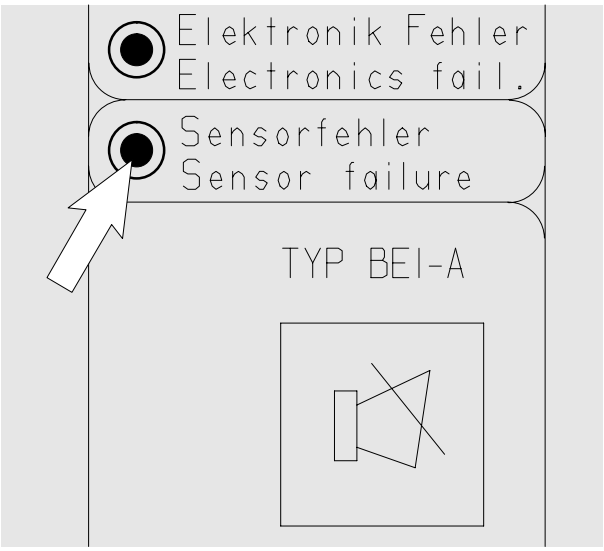
Self-test of system

To achieve optimum operational reliability, the system distinguishes between sensor fault and “real alarm”.

The following sensors are checked for sensor fault and parting of wire:

- Engine speed
- Engine oil pressure
- Coolant temperature
- Charge-air temperature
- Coolant level

If the signal sent by the sensor is a value which does not occur in practice or if the wire connection is interrupted, the check lamp “Sensor fault” and the check lamp of the associated function will start flashing.



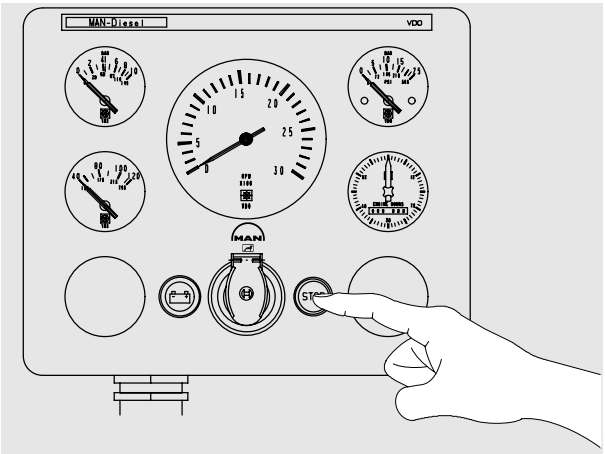
Danger:
Ensure that the engine can not be started by unauthorized persons.

Shutting down

After the engine has been running at a high load level, do not shut it down immediately but allow it to idle about 5 minutes so that temperatures may equalize.

Set deck switch to “Neutral” and switch off the engine at the stop button / ignition key.

Remove key from starting lock.



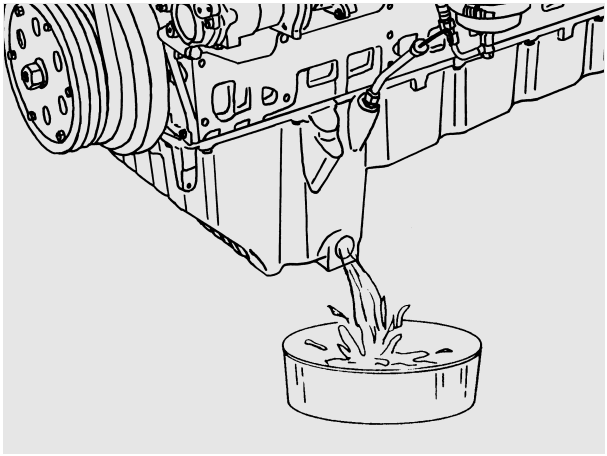
Lubrication system

Ensure outmost cleanliness when handling fuels, lubricants and coolants.

Note:
Only use fuels, lubricants etc. in accordance with MAN's regulations. Otherwise the manufacturer's liability for defects will not apply!

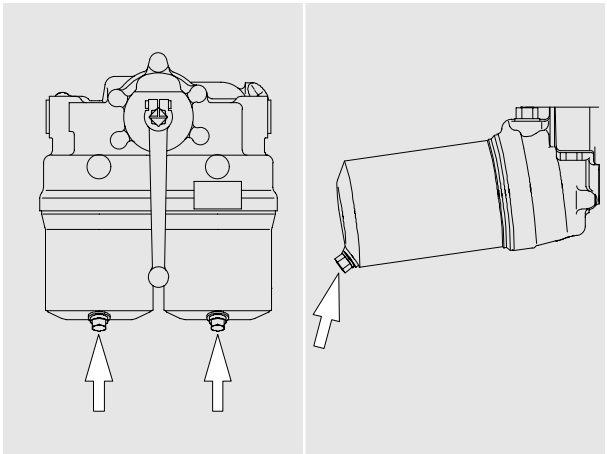
Engine oil change

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!



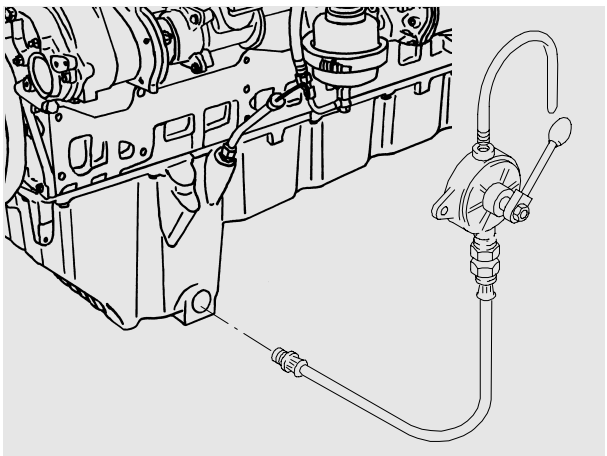
With the engine at operating temperature, remove the oil drain plugs on the oil sump and the oil filter bowl and allow the old oil to drain off completely.

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



As the oil drain plug is often not accessible, a manually operated vane pump may be attached to the engine for draining the oil.

Pump the old oil out of the sump while the engine is still warm. Remove oil drain plugs in oil filter bowl and let old oil drain out of oil filters.
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.

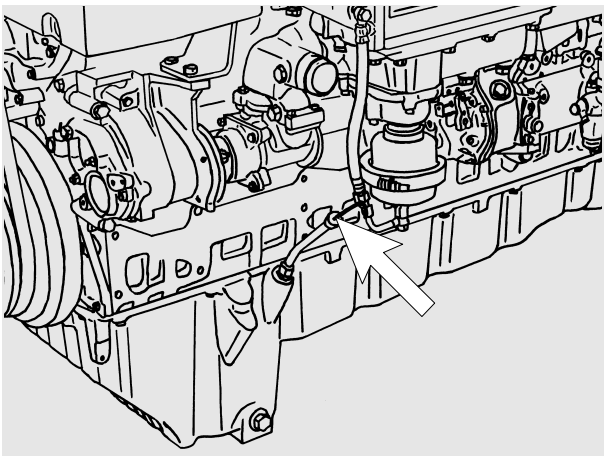
Refilling with oil

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.

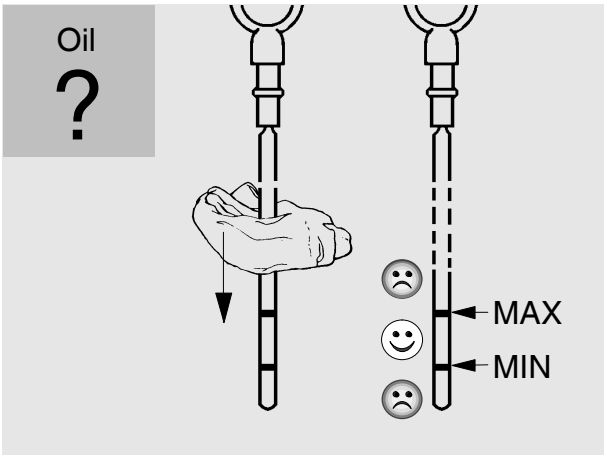
Refill with fresh engine oil at the oil filler neck (arrow).

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.

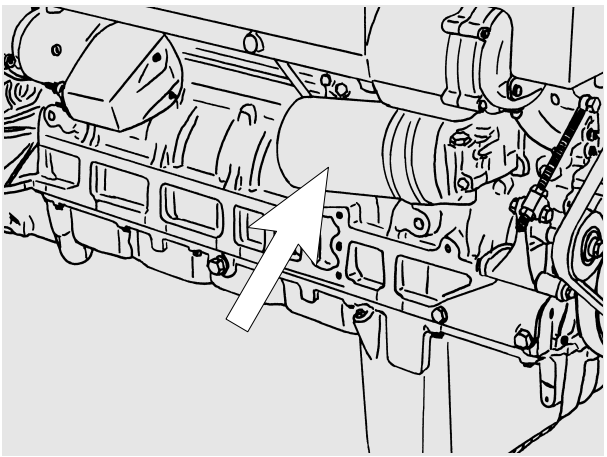


- Pull out dipstick (arrow)
- wipe it with a clean, lintfree cloth
- and push it in again up to the stop
- Pull out dipstick again

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

A changeover-type oil filter, the filter elements of which can be replaced even during operation, can be fitted on request.



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

During continuous operation position the selector lever that both filter halves are in operation.
Observe positions of selector lever!

Continuous operation (both filter halves in operation)

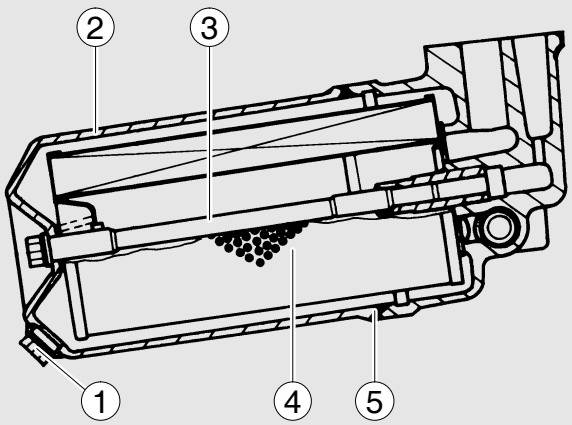
Right-hand filter cut out

Left-hand filter cut out

Caution:
Do not leave selector lever in any intermediate position because this would be liable to interfere with oil supply. If in doubt stop engine to change oil filter.

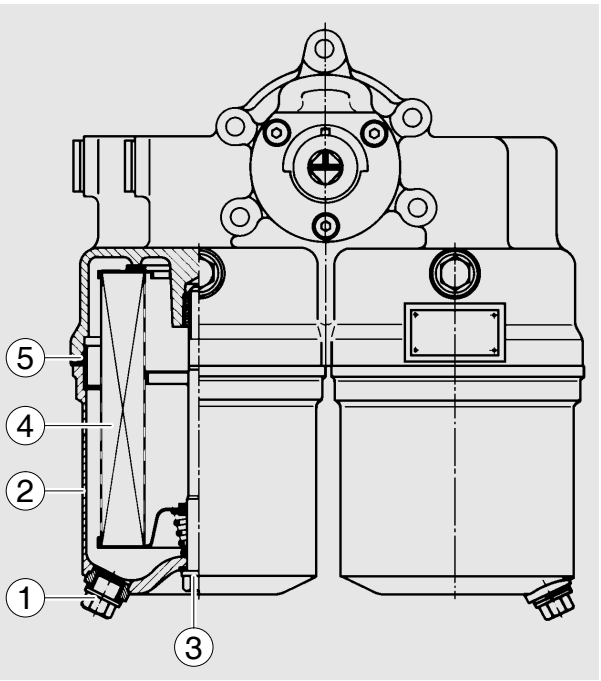
Renewal of filter cartridges

- 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.

- After releasing the clamping bolts ③ remove filter bowls ②
- Renew filter cartridges ④. Thoroughly clean all other parts in cleaning fluid (do not allow cleaning fluid to enter the oil circuit)
- Use new gaskets ⑤ for reassembly of filter bowls



Note:
To prevent the seal ⑤ from twisting hold the filter bowl ② firmly when tightening the tensioning screw 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 same 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.

Caution:
Use only approved fuels, lubricants etc. (see brochure “Fuels, lubricants etc.”). Otherwise the liability for defects will become null and void!

Injection pump

Neither the injection pump nor the control unit must be modified in any way. If the lead seal is damaged the engine warranty will become null and void.

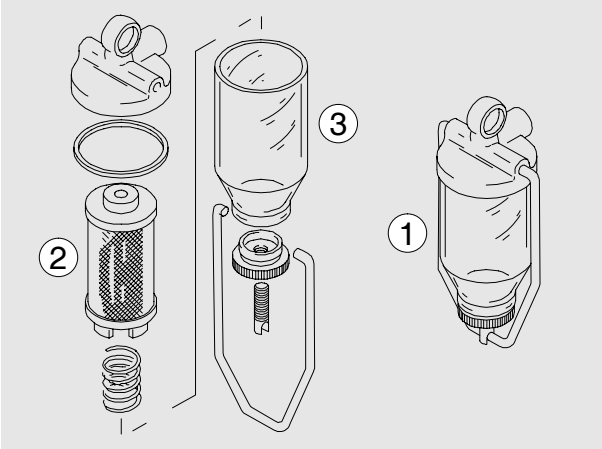
Faults

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

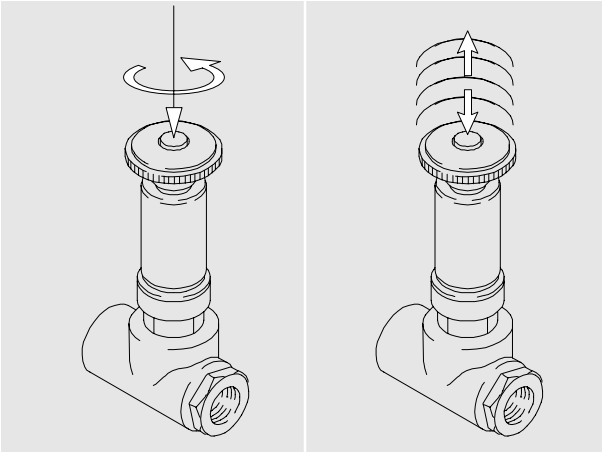
Cleaning fuel pre-cleaner

Strip the fuel pre-cleaner ①:

- Unscrew knurled nut of pre-cleaner
- Swing out retaining arm and take out filter housing ③ with strainer filter ②
- Wash out filter housing and strainer filter in clean Diesel fuel and blow dry with compressed air
- Re-assemble in reserve order

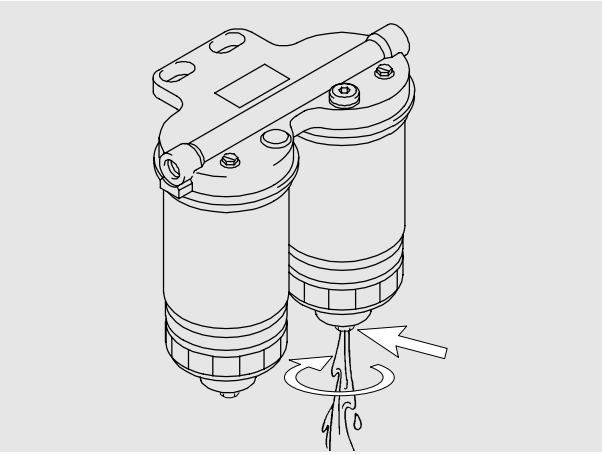


- Actuate tappet of hand primer until overflow valve of injection pump is heard to open
- Screw in the tappet of the hand pump again and tighten it
- Start engine
- Check fuel pre-cleaner for leaks



Parallel fuel filter

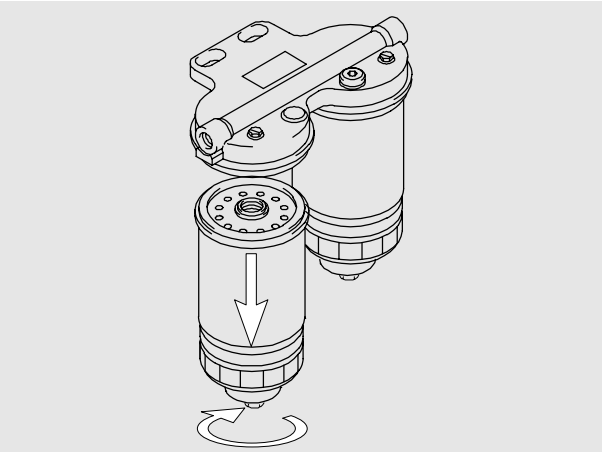
Draining moisture:
Unscrew drain plugs at every oil change until moisture has been discharged and clean fuel flows out.



Changing fuel filter

Only when engine is switched off

- Loosen filter with tape wrench and remove it
- Wet seal on new filter with fuel
- Screw on filter by hand
- After this, bleed the fuel system
- Check filter for leaks



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

Change-over fuel filter

Where the changeover-type filter is installed, the servicing procedure is for the filter side requiring to be shut off with the engine running. During continuous operation, the selector lever should be placed in a position where both filter halves are in operation.

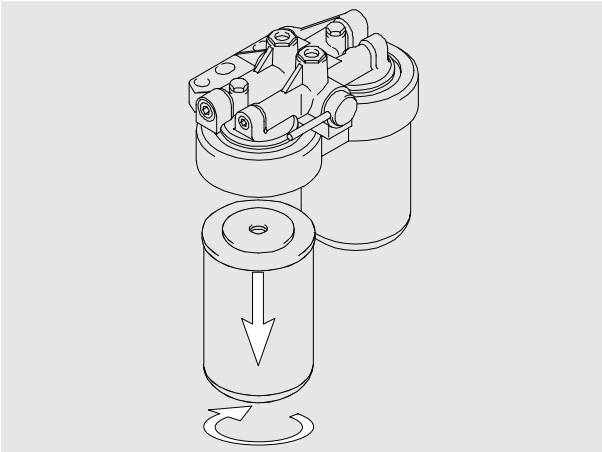
Continuous operation (both filter halves in operation)

Right-hand filter cut out

Left-hand filter cut out

Caution:
Do not leave selector lever in any intermediate position because this would be liable to interfere with fuel supply. If in doubt stop the engine to change the fuel filter.

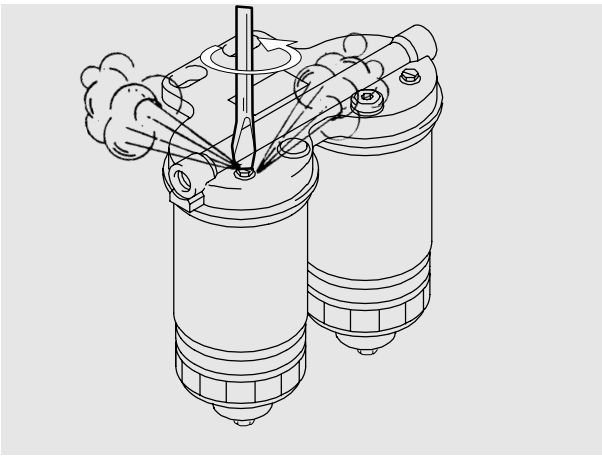
Changing fuel filter



- Loosen filter with tape wrench and remove it
- Wet seal on new filter with fuel
- Screw on filter by hand
- After this, bleed the fuel system
- Check filter for leaks

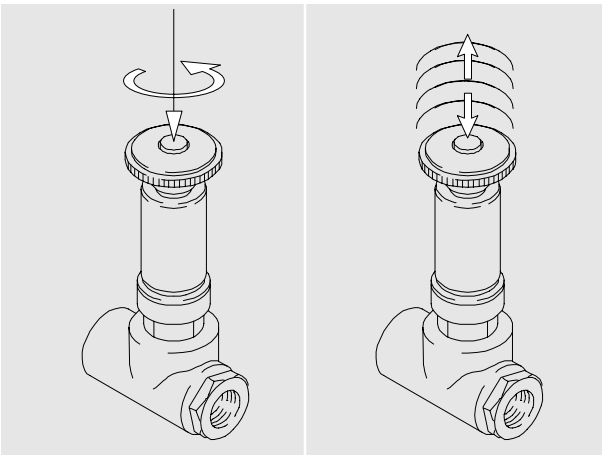
Caution:
Used fuel filters are classed as dangerous waste and must be disposed of accordingly.

Bleeding the fuel system



An arrow on the filter head indicates the direction of fuel flow.

- Unscrew bleed screw of first filter in direction of flow by one or two turns
- Actuate tappet of hand primer until fuel emerges without bubbles
- Screw in the tappet of the hand pump again and tighten it
- Close bleed screw again
- Repeat this procedure at the second bleed screw
- Check filter for leaks



Cooling system

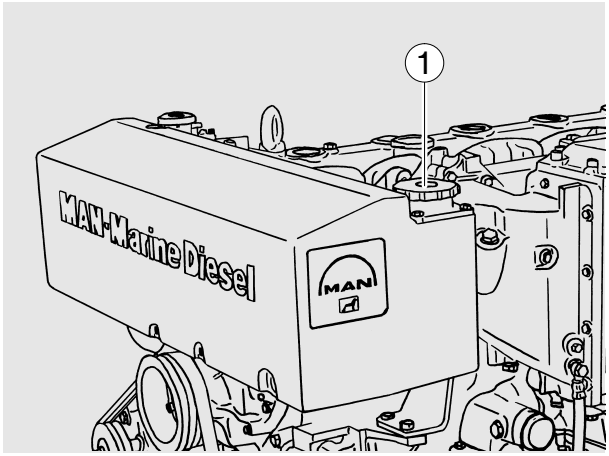
Danger:
Draining hot coolant involves a risk of scalding.

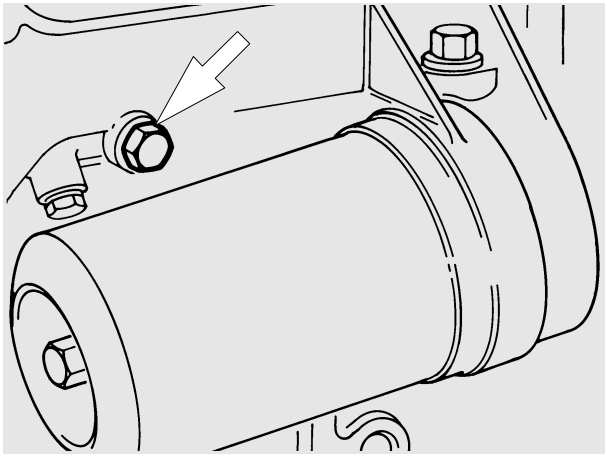
Draining the cooling system

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

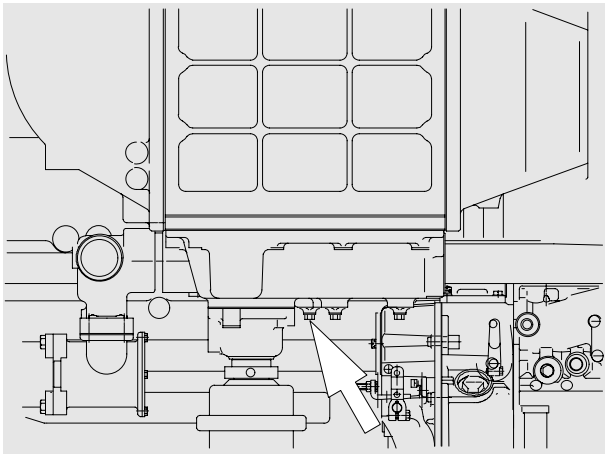
Drain coolant as follows, but only ***when the engine has cooled down***.

- Briefly open cap (①, large cap) on the filler neck of the expansion tank for pressure compensation
- Unscrew and remove drain plugs in oil cooler housing and intercooler
- Then remove cap ①
- Drain coolant into a container of adequate size
- Refit screw plugs
- Filling / bleeding the cooling system





Drain plug in oil cooler housing



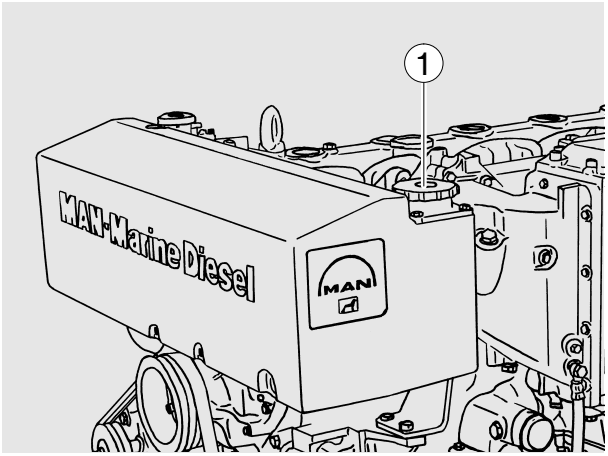
Drain plug on intercooler

Filling / bleeding the cooling system (only when engine has cooled down)

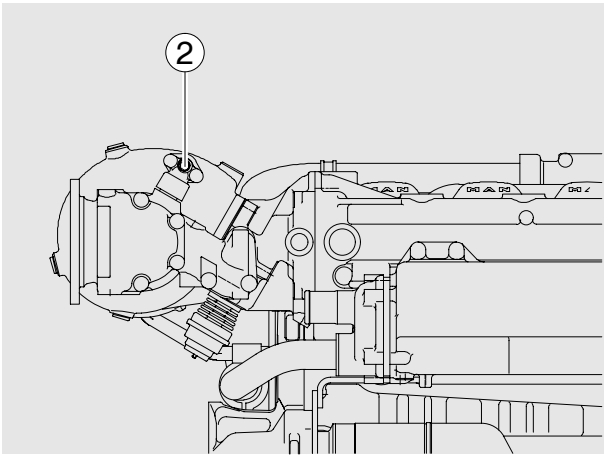
Fill the cooling system of the engine with a mixture of drinkable tap water and anti-freeze agent on ethylene glycole basis or anti-corrosion agent.

Caution:
Use only approved fuels, lubricants etc. (see brochure “Fuels, lubricants etc.”). Otherwise the liability for defects will become null and void!

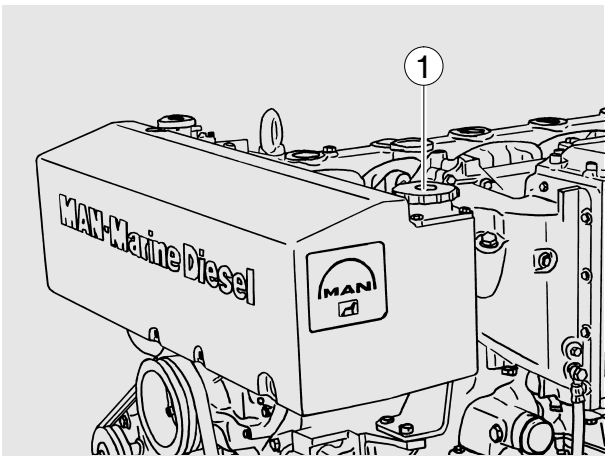
Coolant must be added at the filler neck only (①, large cap). When topping up do not add cold coolant if the engine is still warm from operation.
Ensure that the ratio of water to anti-freeze is correct. Find the cause of the loss of coolant and have it eliminated.



- Remove cap (①, large cap)
- Set heating (if fitted) to full output, open all shut-off valves, open bleeders (if fitted)

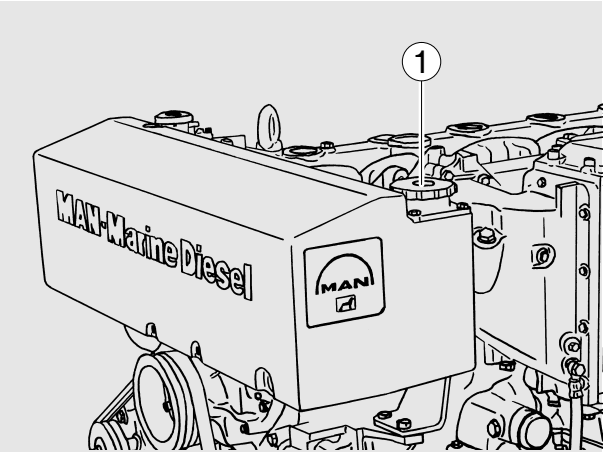


- Unscrew bleed screw ② on liquid-cooled turbocharger
- Slowly fill up with coolant via filler neck on expansion tank until fluid level has reached the lower edge of the filler neck
- Screw in bleeder screws ② again and refit cap ①
- Let engine run at a speed of 2,000 rpm for approx. 5 minutes
- Switch off engine, carefully turn cap ① with safety valve to first detent –let off pressure– then carefully take off cap



Danger:
Risk of scalding and burning yourself!

- Top up with coolant (approx. 6 litres) and refit cap ①



Before the engine is next put into operation (with the engine cold) check the coolant level and top up if necessary.

Note:
The turbochargers must not be bled while the cooling system is being topped up.

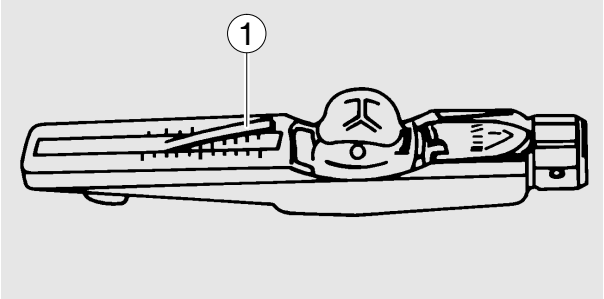
Danger:
If, in an **exceptional** case, the coolant level has to be checked in an engine that has reached operating temperature, first carefully turn the cap (①, large cap) with safety valve to the first stop, let off pressure, then open carefully.

V-belts

Checking condition

If, in the case of a multiple belt drive, wear or differing tensions are found, always replace the complete set of belts.

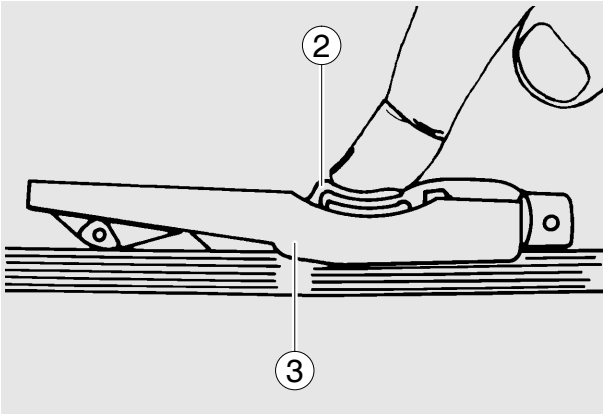
- Check V-belts for cracks, oil, overheating and wear
- Change demaged V-belts



Checking tension

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

- Lower indicator arm ① into the scale
- 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 ① intersects with the scale
- Before taking readings make ensure that the indicator arm remains in its position

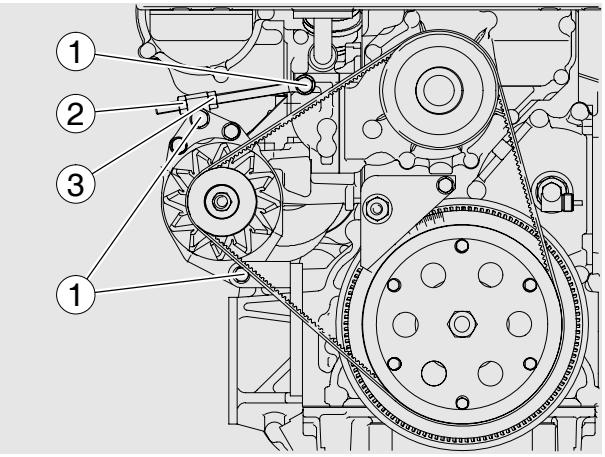
If the value measured deviates from the setting value specified, the V-belt tension must be corrected.

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	45–50	40–45	30
10.0	45–50	35–40	30
12.5	50–55	45–50	35
13.0	50–55	40–45	35
20.0	75	70	60
22.0	75	70	60
2/3VX	90–100	70–80	60
3/3VX	135–150	105–120	90

Tensioning and changing V-belt

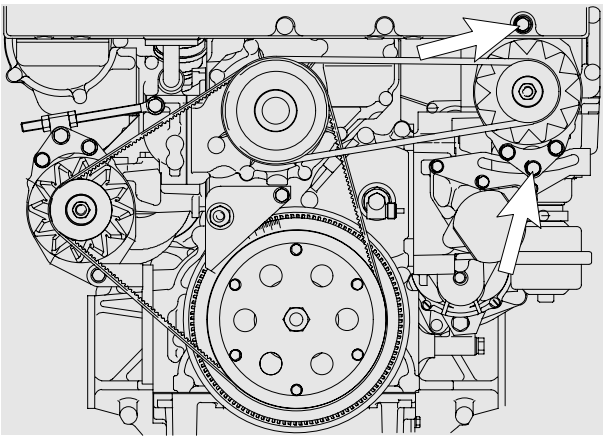
- Remove fixing bolts ①
- Remove lock-nut ②
- Adjust nut ③ until V-belts have correct tensions
- Retighten lock-nut and fixing bolts

To replace the V-belts loosen lock-nut and swing alternator inwards.



- Remove fixing bolts
- Swivel alternator outwards until correct V-belt tension is achieved
- Retighten fixing bolts

To change the V-belts, loosen the fixing bolts and swivel alternator inwards.



Alternator

The alternator is maintenance-free.
Nevertheless, it must be protected against dust and, above all, against moisture.

In order to avoid damage to the alternator, observe the following instructions:

While the engine is running

- Do not de-energize the main battery switch!
- Do not disconnect the battery or pole terminals or the cables!
- If, durig operation, the battery charge lamp suddenly lights up, stop the engine immediately and remedy the fault in the electrical system!
- Do not run the engine unless the battery charge control is in satisfactory order!
- Do not short-circuit the connections of the alternator with those of the regulator or said connections with ground, not even by briefly bringing the connections into contact!
- Do not operate the alternator without battery connection!

Temporary decommissioning of engines

Temporary anti-corrosion protection according to MAN works norm M 3069 is required for engines which are to be put out of service for fairly long periods.

The works standard can be obtained from our After-Sales Service department in Nuremberg.

Model	**D 2866 LE 401 / 402 / 403 / 405**
Design	in-line vertical
Cycle	4-stroke Diesel with turbocharging / intercooling and wastegate
Combustion system	Direct injection
Turbocharging	Turbocharger with intercooling and wastegate
Number of cylinders	6
Bore	128 mm
Stroke	155 mm
Swept volume	11 967 cm^3
Compression ratio	15.5 : 1
Rating	see engine nameplate
Firing order	1–5–3–6–2–4
Valve clearance (cold engine)	
Intake	0.50 mm
Exhaust	0.50 mm
Valve timing	
Intake opens	23° before TDC
Intake closes	37° after BDC
Exhaust opens	60° before BDC
Exhaust closes	30° after TDC
Fuel system	
Injection	In-line pump, with flange fastening
Governor	Centrifugal governor (variable-speed governor with RQV-K eccentric disc) with charge-air-pressure-dependent full-load stop (LDA)
Start of delivery	
D 2866 LE 401	17° – 1° before TDC
D 2866 LE 402	18° ± 1° before TDC
D 2866 LE 403	14° ± 0,5° before TDC
D 2866 LE 405	19° ± 0,5° before TDC
Injectors	six-hole nozzles
Opening pressure of injector	
New nozzle holder:	340 + 10 bar
Used nozzle holder:	320 + 10 bar

Engine lubrication	Force feed	
Oil capacity in oil sump (litres)	min.	max.
deep	14 l	18 l
shallow	16 l	20 l
for 30° tilt	14 l	18 l
Oil change quantity (with filter)		
deep	21 l	
shallow	23 l	
for 30° tilt	21 l	
Oil pressure during operation (depending on oil temperature, oil viscosity class and engine rpm)	must by monitored by oil pressure monitors / gauges	
Oil filter	Full flow filter with paper cartridges	
Engine cooling system	Liquid cooling	
Coolant temperature	80–85°C, temporarily 90°C allowed	
Coolant filling quantity	58 l	
Electrical equipment		
Starter	24 V; 5.4 or 6.5 kW	
Alternator	28 V; 55 A	

Model	**D 2876 LE 403**
Design	in-line vertical
Cycle	4-stroke Diesel with turbocharging / intercooling and wastegate
Combustion system	Direct injection
Turbocharging	Turbocharger with intercooling and wastegate
Number of cylinders	6
Bore	128 mm
Stroke	166 mm
Swept volume	12 816 cm^3
Compression ratio	15.5 : 1
Rating	see engine nameplate
Firing order	1–5–3–6–2–4
Valve clearance (cold engine)	
Intake	0.50 mm
Exhaust	0.50 mm
Valve timing	
Intake opens	23° before TDC
Intake closes	37° after BDC
Exhaust opens	60° before BDC
Exhaust closes	30° after TDC
Fuel system	
Injection	In-line pump, with flange fastening
Governor	Centrifugal governor (variable-speed governor with RQV-K eccentric disc) with charge-air-pressure-dependent full-load stop (LDA)
Start of delivery	14° before TDC
Injectors	six-hole nozzles
Opening pressure of injector	
New nozzle holder:	340 + 10 bar
Used nozzle holder:	320 + 10 bar

Engine lubrication	Force feed	
Oil capacity in oil sump (litres)	min.	max.
deep	26 l	30 l
Oil change quantity (with filter)		
deep	33 l	
Oil pressure during operation (depending on oil temperature, oil viscosity class and engine rpm)	must by monitored by oil pressure monitors / gauges	
Oil filter	Full flow filter with paper cartridges	
Engine cooling system	Liquid cooling	
Coolant temperature	80–90°C, temporarily 95°C allowed	
Coolant filling quantity	58 l	
Electrical equipment		
Starter	24 V; 5.4 or 6.5 kW	
Alternator	28 V; 55 A	

Fault												
Engine does not start, or starts only with difficulty												
	Engine starts but does not reach full speed or stalls											
		Engine idles out of true when warm, misfiring										
			Engine speed fluctuates during operation									
				Power output unsatisfactory								
					Coolant temperature too high, coolant being lost							
						Lube oil pressure too low						
							Lube oil pressure too high					
								Black smoke accompanied by loss of power				
									Blue smoke			
										White smoke		
											Knocking in the engine	
												Engine “too loud”
												Reason
●												Fuel tank empty
●												Fuel cock closed
●		●	●	●					●			Air in fuel system
●	●	●		●					●			Fuel pre-filter / pre-cleaner clogged
●												Condensation in fuel
●	●			●			●					Air filter clogged
●												Electric circuit interrupted
●												Batteries flat
●												Starter / solenoid switch defective
●		●					●		●	●		Start of delivery not correct / incorrectly set
●												Injection nozzles clogged
●												Internal damage to engine (piston seized, possibly caused by water in fuel)
	●			●					●			Fuel quality not in accordance with specifications or fueled severely contaminated
		●										Lower idling speed set too low
●		●								●	●	Valve clearance incorrect
		●										Injection nozzles of injection pipes leaking
			●									Too little fuel in tank
			●									Rev. counter defective
			●				●		●			Injection nozzles defective or carbonized
				●								Engine being asked to do more than it has to
				●								Fuel supply faulty, fuel too warm
				●				●				Oil level in sump too high
				●								Incorrect rated speed setting
					●							Coolant level too low
					●							Air in coolant circuit

Fault												
Engine does not start, or starts only with difficulty												
	Engine starts but does not reach full speed or stalls											
		Engine idles out of true when warm, misfiring										
			Engine speed fluctuates during operation									
				Power output unsatisfactory								
					Coolant temperature too high, coolant being lost							
						Lube oil pressure too low						
							Lube oil pressure too high					
								Black smoke accompanied by loss of power				
									Blue smoke			
										White smoke		
											Knocking in the engine	
												Engine “too loud”
												Reason
					●							Tension of water-pump V-belts incorrect (slip)
					●							Cap with working valves on expansion tank / radiator defective or leaking
					●							Temperature gauge defective
					●							Coolant pipes leaking, blocked or twisted
						●						Oil level in sump too low
						●						Engine temperature too high
						●						Oil filter clogged
						●	●					Oil pressure gauge defective
						●	●					Selected oil viscosity not suitable for ambient temperature (oil too thin)
						●						Oil in sump too thin (mixed with condensation or fuel)
							●					Engine cold
									●	●		Engine, coolant or intake air still to cold
									●			Lube oil getting into combustion chamber (piston worn, piston rings worn or broken)
									●			Overpressure in crankcase (crankcase breather clogged)
									●			long operation under a low load
										●		Coolant getting into combustion chamber (cylinder head / gasket leaking)
											●	Engine operating temperature incorrect
												Intake or exhaust pipe leaking

MAN Nutzfahrzeuge AG
Geschäftseinheit Motoren
Vogelweiherstraße 33
D-90441 Nürnberg

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