

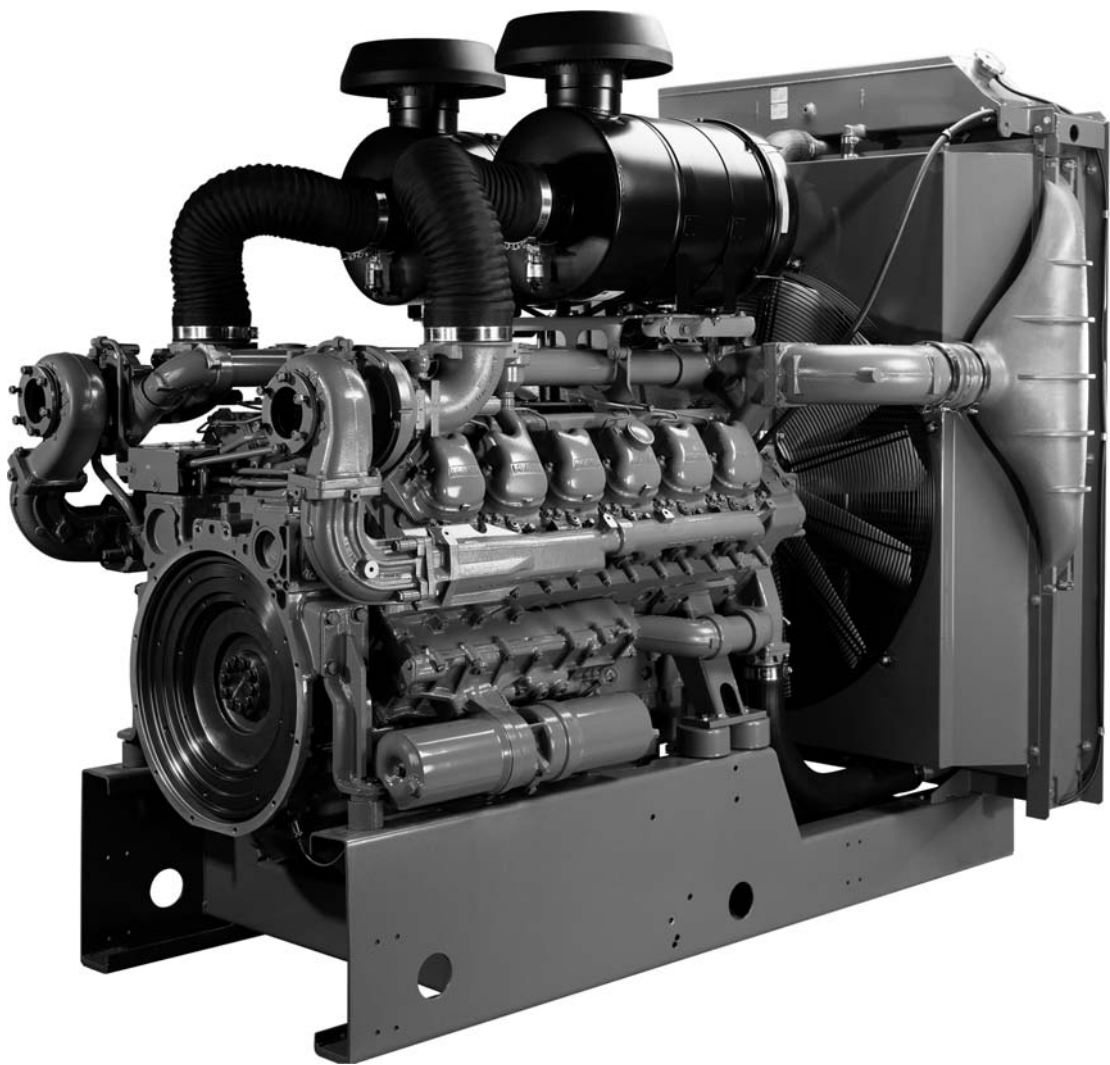
Operating Instructions

MAN Industrial Diesel Engines

D2848 LE201/203/211/213

D2840 LE201/203/211/213

D2842 LE201/203/211/213





Subject to technical alterations in the interests of further development.

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1 Preface

1.1 Information about Operating Instructions

These Operating Instructions provide important information on dealing with engines. Prerequisite for safe operation is the compliance with all safety and handling instructions.

Furthermore, the local accident prevention regulations valid for the engine's area of application and the general safety regulations must be observed.

Timely and proper maintenance and care of the engines according to the set maintenance intervals ensure and maintain the operational safety and the reliable application of these engines.

Use only genuine MAN spare parts and accessories or those approved by MAN.

Only MAN approved genuine spare parts have been tested by us and thus suitable for use in our engines.

A particular concern of MAN is to improve environmental protection. This begins with the development and design of our engines. We make sure that no environmentally hazardous materials are used and, for example, that the emissions fulfil the highest requirements.

Economical operation helps to conserve our resources and our environment.

1.1.1 Publications belonging to the Operating Instructions

The following publications belong to the Operating Instructions

- Fluids and Lubricants for MAN Diesel Engines
- Maintenance Record
- Assembly Instructions

All publications are considered "parts of the product" and should always be kept in the immediate vicinity of the engine for the personnel.

Carefully read the Operating Instructions before starting any work! This is especially valid for the chapter on General Safety Instructions and the safety instructions in each of the chapters.

Failure to observe these Operating Instructions and any accompanying supplier operating instructions leads to the loss of warranty claims.

1.1.2 Additional Publications for the Engines

The following instructions supplement the Operating Instructions for the engines:

For the operator, maintenance and service personnel

- Spare Parts Catalogue (included)

For the service personnel

- Repair Instructions

Foreword

1.2 Key to Symbols

Warnings

Warnings are identified in these Operating Instructions with symbols. These warnings are preceded by signal words that express the magnitude of the risk.

Always heed these warnings and act prudently to prevent accidents, injuries and property damage.



DANGER!

... indicates an imminently hazardous situation, which leads to death or serious injuries if not avoided.



WARNING!

... indicates a possible hazardous situation, which can lead to death or serious injuries if not avoided.



CAUTION!

... indicates a possible hazardous situation, which can lead to minor or light injuries if not avoided.



IMPORTANT!

indicates a possible dangerous situation that can lead to property damage if it is not avoided.

Tips and Recommendations



NOTE!

highlights useful tips and recommendations as well as information for efficient and smooth operation.

General Information

- This symbol indicates a list at the first level.
- This symbol indicates a list at the second level.
- 1. This symbol indicates a sequence of actions.
- (1) In the text, this symbol indicates a position in a graphic.

1.3 Limitation of Liability

All of the information in these instructions have been prepared while taking into account the valid standards and regulations, the state of the art, as well as our many years of experience and knowledge.

MAN is not liable for damages resulting from:

- Failure to follow these instructions
- Improper use
- Use of untrained personnel
- Customer conversions
- Technical modifications
- Use of non-approved spare parts and fluids and lubricants

The actual scope of delivery for special versions, additional ordering options or technical modifications may deviate from what is described and illustrated in these instructions.

Valid are the commitments agreed upon in the delivery contract and the General Terms and Conditions of MAN and the law applicable at the time of contracting arrangements.

1.4 Copyright

Please handle these Operating Instructions as confidential. They are only to be used by the persons working with the engine. Transfer to a third party without explicit written permission from MAN is strictly prohibited.



NOTE!

The information, texts, drawings, illustrations and other depictions are all protected by copyright and are subject to industrial property rights. Any improper use is punishable by law.

1.5 Other Applicable Documents

Supplier components are installed in the engine (e.g. injection system). Risk assessments have been carried out on these parts by the suppliers.

The compliance of construction with the existing European and national legislation has been declared by the respective suppliers of the components.

Foreword

1.6 Spare Parts

Use only genuine MAN spare parts and accessories or those approved by MAN.

Only MAN approved genuine spare parts have been tested by us and thus suitable for use in our engines.

Spare parts and accessories must either be MAN genuine parts or parts that have been specifically approved by MAN. The reliability, safety and suitability of these parts have been established specifically for the engines. We cannot assess and vouch for other non-MAN products, despite ongoing market observations.



WARNING!

Risk of injury from incorrect spare parts!

Incorrect or faulty spare parts can lead to damage, malfunctions or total failures and interfere with safety.

For this reason:

- Only use MAN genuine parts



NOTE!

Please always specify the engine model, engine number and order number when corresponding with MAN, see page 25.

Order spare parts through an authorised dealer or directly from MAN.

For addresses, see page 2.

1.7 Disposal

Dispose in accordance with national regulations.

If no return or disposal agreement has been made, recycle the disassembled components as follows:

- Sort metals before scrapping
- Recycle plastic parts
- Dispose of all other parts according to their material composition

1.8 Warranty Terms

Valid are the commitments agreed upon in the delivery contract and the General Terms and Conditions of MAN and the law applicable at the time of contracting arrangements.

Failure to observe these Operating Instructions and any accompanying supplier operating instructions leads to the loss of warranty claims.

The use of non-approved parts leads to the loss of warranty claims.

We recommend to use genuine parts even after the warranty period has passed. This will ensure the continuous performance of the engine.

1.9 Service

Our MAN product support is available for technical information.



NOTE!

Please always specify the engine model, engine number and order number when corresponding with MAN, see page 25.

Information about contact persons can always be called up by telephone, fax, email or over the Internet. For addresses see page 2.

2 General Safety Instructions

This chapter provides information on residual risks and hazards during proper use of the engine. The generally valid safety instructions to be observed are listed here. They provide optimum protection for personnel and for the safe and smooth operation of the engine.

In the following, specific, action and situation-related safety information is placed before the corresponding step, or in the chapter described.

Failure to observe the Operating Instructions and Safety Instructions in this document can result in significant hazards.

2.1 Intended Use

This engine is built solely to drive power generators on land.

Any other use is considered as "not intended".

MAN is not liable for any damage resulting from use that is not intended. The risk is entirely borne by the operator.

Intended use also includes compliance with the prescribed operating, maintenance and repair work.

The engine may only be used, maintained and repaired by persons who are familiar with the engine and have been informed of the hazards.

Unauthorised modifications to the engine shall void any liability for any resulting property damage and personal injury.

Likewise, the manipulation of the injection and control system could affect the performance and emission characteristics of the engine. Compliance with the statutory environmental requirements can therefore no longer be guaranteed.



DANGER!

Danger from not using the product as intended!

Any use that exceeds the intended use and/or any different use of the engine can lead to dangerous situations which will invalidate the operating permit.

For this reason:

- Use the engine for its intended purpose only.
- Use the engine outside of hazardous areas where there is a risk of explosion.
- Use the engine with an overspeed limiting device installed.



NOTE!

Observe the following information when operating the engine:

- The safety information in these Operating Instructions and in the supplier's operating instructions.
- The "Technical Data" chapter in these Operating Instructions and in the supplier's operating instructions.
- Country-specific regulations.

General Safety Instructions

2.2 Contents of the Operating Instructions

Any person who is instructed to perform work on or with the engine, must have read and understood these Operating Instructions before starting any work. This also applies if the person has worked with such an engine or a similar engine, or has already been trained by MAN.

Reading and understanding the Operating Instructions is thus mandatory.

2.3 Modifications and Conversions to the Engine

In order to avoid hazards and to ensure optimum performance, no modifications or conversions to the engine may be made which are not expressly approved by MAN.

If changes are made without the written consent of MAN, the guarantee or warranty obligation for MAN is not longer valid for damage and defects, which are based on these unauthorised changes. Furthermore MAN assumes no liability for any damage caused as a result of unauthorised changes.

2.4 Responsibility of the Operator

The operator of the motor is subject to the statutory requirements for workplace safety.

In addition to the Safety Instructions in these Operating Instructions, the safety regulations, accident prevention regulations and environmental protection regulations valid for the application area of this engine must also be observed.

In particular:

- The operator must be knowledgeable about the valid occupational health and safety regulations and be able to assess, in a risk analysis, the dangers that are present in the specific working conditions at the operating site of the engine. He must then implement these safety regulations in the form of operating instructions for the operation of the engine.
- During the entire period of operation of the engine the operator must check whether the operating instructions he created meet the most current standards for regulations and revise them if necessary.
- The operator must clearly define and regulate the responsibilities for installation, operation, maintenance and cleaning of the product.
- The operator must ensure that all staff who deal with the engine have read and understood the Operating Instructions.

In addition, the operator must periodically train the staff and inform them about hazards.

- The operator must provide the personnel with the necessary protective equipment.
- These operating instructions must be kept in the immediate vicinity of the engine and be readily accessible at any time to those persons working on and with the engine.

The operator is responsible for ensuring that the engine is always operated in perfect working condition and working order.

In particular:

- Maintenance work such as that described in the Maintenance Instructions are to be completely performed within the prescribed time intervals or are to be performed by a MAN service workshop/MAN contract partner.
- The operator must have all safety equipment checked regularly for function and integrity.
- The instructions in the Operating Instructions are to be followed completely and fully!

2.5 Personnel Requirements

2.5.1 Qualifications



WARNING!

Risk of injury caused by insufficient qualifications!

Improper handling can result in significant personal injury and property damage

For this reason:

- Specific activities must only be performed by those persons who are named in the respective chapters in these Operating Instructions.

The following qualifications will be designated in the Operating Instructions for various task areas.

- **Instructed Persons**

Have been instructed in a briefing about the possible dangers of improper handling in their tasks.

- **Qualified Personnel**

Due to their technical training, knowledge and experience and knowledge of the relevant regulations they can properly perform the tasks assigned to them.

- **Electric Specialist**

Is capable of performing work on electrical systems due to his/her technical education/training, knowledge and experiences as well as knowledge of the respective standards and regulations and can recognise and avoid any possible dangers.

The electric specialist is trained for the specific operating site in which he/she works and knows the relevant standards and regulations.

Only those people who can perform their work reliably should be considered as authorised personnel. Individuals whose responsiveness is influenced, for example, by alcohol or drugs, are not permitted.

- When selecting personnel, observe the regulations regarding age and profession valid at the operating site.

2.5.2 Unauthorised Persons



WARNING!

Danger for unauthorised persons!

Unauthorised persons who do not fulfil the requirements described here do not realise the dangers that exist in the working area.

For this reason:

- Keep unauthorised persons out of the working area.
- In case of doubt, address the person and remove him/her from the working area if necessary.
- Interrupt the work until all unauthorised persons are out of the working area.

2.5.3 Instructions

Personnel must be instructed on regular basis and this should be documented in a log to keep better track of who and when.

General Safety Instructions

2.6 Personal Protective Equipment

Wearing personal protective equipment is necessary to minimise the health risks when working.

- The required personal protective equipment for the relevant job must always be worn while working.
- All signs pertaining to personal protective equipment in the working area must be followed.



Protective Clothing

Close-fitting clothing with low initial tear strength, with narrow sleeves and with no protruding parts. It is used primarily to protect against injury, weather and dirt.

No rings, bracelets, necklaces and other jewellery are to be worn while working.



Protective Helmet

To protect the head from falling or flying objects.



Safety Shoes

To protect the feet from heavy falling objects and from slipping on slick surfaces.



Safety Gloves

To protect the hands from friction, scraping, punctures or deep injuries and to protect from hot or caustic parts or fluids

To be worn when performing specific types of work

When performing certain types of work, special protective equipment is required. These will be specifically mentioned in the relevant chapters.



Safety Glasses

To protect the eyes from flying objects and spraying fluids.



Hearing Protection

To protect the ears from damage by loud noises.

2.7 Specific Dangers

The following section describes residual risks which have been identified.

- Observe the safety instructions listed here and the warnings in the other chapters of these instructions in order to reduce health hazards and avoid dangerous situations.

Electrical Current



DANGER!

Risk of death caused by electrical current!

There is a risk of death when coming into contact with parts conducting electrical currents. Damaged insulation or components can be life threatening.

For this reason:

- If the insulation is damaged, immediately switch off the power supply and get the insulation repaired.
- Any work performed on the electrical system may only be made by a qualified electrician.
- When working on the electrical system the power supply must be switched off and then properly checked to ensure no electrical current is present.
- Before starting any maintenance, cleaning or repair work the power supply must be switched off and secured from being accidentally switched back on.
- Do not bridge or bypass any fuses. When replacing fuses, ensure to use the correct amperage.
- Keep moisture clear of parts conducting electrical current. This could cause a short-circuit.

Moving Parts



WARNING!

Risk of injury caused by moving parts!

Rotating or linear moving parts can cause serious injuries.

For this reason:

- During operation do not reach into or tamper with moving parts.
- Do not open the covers during operation.
- Observe the run-on time: before opening any covers ensure that no parts are still moving.
- Wear close-fitting clothing in the hazard area.

Multi-engine plants



WARNING!

Risk of injury caused by engines!

Persons in the operating room are at a risk if engine damage occurs.

For this reason:

- Limit the time spent in the operating room to the absolute minimum.
- Set up protective partitions to isolate running engines.
- Access to the operating room may only be made when engine is running at a light load.

General Safety Instructions

Exhaust gases



WARNING!

Risk of health hazard caused by exhaust gases!

Leaks in the exhaust system can cause dangerous exhaust gases to leak into the engine room.

For this reason:

- Ensure sufficient ventilation.
- Immediately shut down engines with exhaust leaks.

Highly Flammable Substances - Diesel Fuel, Oils and Grease



WARNING!

Risk of fire caused by highly flammable substances!

Highly flammable substances, fluids or gases can catch on fire and cause serious or deadly injuries.

For this reason:

- Do not smoke in the hazard area or in the vicinity.
No open fires or sources of ignition.
- Keep fire extinguishers at hand.
- Immediately report any suspicious substances, fluids or gases to the person in charge.
- In the case of fire, immediately stop working. Leave hazard area until the danger is over.

Coolants - Antifreeze, Anticorrosion Agents



WARNING!

Risk of injury caused by coolants that are hazardous to health

Coolants contain substances that are hazardous to your health. Contact with these substances can lead to serious poisoning, allergies, skin irritations and damage to eyes.

For this reason:

- Observe the safety sheets from the manufacturer.
- Always wear protective clothing, chemical-resistant protective gloves and safety glasses.
- Avoid spilling or spraying these substances.

Hot Fluids and Lubricants



WARNING!

Risk of burns caused by hot fluids and lubricants!

Fluids and lubricants can reach high temperature while in operation and cause burns when coming into contact with them.

For this reason:

- Before handling any fluids and lubricants, check whether they are hot. If necessary, let them cool down first.

Hot Surfaces

**CAUTION!****Risk of burns caused by hot surfaces!**

Contact with hot components can cause burns.

For this reason:

- When performing any work in the vicinity of hot components always wear protective clothing and protective gloves.
- Before starting any work ensure that all components have cooled down to ambient temperature.

Noise

**WARNING!****Risk of hearing damage caused by noise!**

The level of noise occurring in the working area can cause serious damage to hearing.

For this reason:

- Always wear hearing protection when working.
- Do not unnecessarily remain in the hazard area. Leave hazard area when work is finished.

Sharp Edges and Corners

**CAUTION!****Risk of injury cause by sharp edges and corners!**

Sharp edges and corners can cause cuts and scrapes to the skin.

For this reason:

- Always work carefully and with caution in the vicinity of sharp edges and corners.
- In cases of doubt, wear protective gloves.

Dirt and Objects

**CAUTION!****Risk of tripping caused by dirt and objects!**

Dirt and objects can cause a person to slip or trip which can cause considerable injuries.

For this reason:

- Always keep the work area clean.
- Remove any objects that are no longer necessary.
- Mark areas where there is a danger of tripping with yellow and black striped tape.

General Safety Instructions

2.8 Safety Equipment

The operator must have the following safety equipment in place:

Before the engine is placed into operation, install the emergency-off equipment and connect it into the safety chain of the system.

Connect the emergency-off equipment so that dangerous situations to people and property are avoided in case the its power supply is interrupted or is turned back on after an interruption.

The emergency-off equipment must always be freely accessible.



WARNING!

Risk of death caused by non-operational safety equipment!

Safety equipment ensures maximum safety during operation. Even if they may make working more complicated, they must not be overridden. Safety can only be guaranteed if the safety equipment is intact and operational.

For this reason:

- Before starting any work, check whether all of the safety equipment is correctly installed and in good operating order.
- Before starting the engine, check whether all of the safety equipment is correctly installed and in good operating order.

2.9 Conduct in Dangerous Situations and When Accidents Occur

Preventative Measures

- Always be prepared for an accident!
- Keep first aid equipment (first aid kit, blankets, etc.) and fire extinguishers at hand.
- Check first aid equipment and fire extinguishers regularly for completeness and proper operation.
- Familiarise the personnel with the emergency, first aid and rescue equipment.
- Instruct the personnel on safety on a regular basis.
- Always keep access lanes for rescue vehicles free of any obstructions.

In the case of an accident: Act accordingly

- Remain calm.
- Immediately shut down engine using the emergency-off button.
- Start first aid measures.
- Alert rescue services and/or fire department.
- Move people out of the danger zone.
- Clear access lanes for rescue vehicles.
- Inform the person in charge.



CAUTION!

Accidents despite preventative measures

If an accident occurs, e.g. from one of the listed points below, despite all of the preventative measures, contact a physician immediately.

- Contact with caustic acids.
- Penetration of fuel into the skin.
- Scalding by hot oil or coolant.
- Antifreeze sprayed into the eyes, etc..

General Safety Instructions

2.10 Signs

The following symbols should be installed in the immediate vicinity of the hazard area.



WARNING!

Risk of injury caused by illegible symbols!

Stickers and symbols can become dirty or made otherwise illegible in the course of time!

For this reason:

- Always keep the safety, warning and operational signs in good legible condition.
- Clean or replace illegible safety, warning and operational signs.



Electric Voltage

Rooms marked with this symbol may only be accessed by qualified electricians.

Unauthorised persons may not enter these rooms.



Hot Surfaces

Hot surfaces such as hot engines and hot fluids may not always be recognisable. Do not touch these surfaces without protective gloves.

2.11 Environmental Protection



CAUTION!

Environmental hazard caused by incorrect handling!

Incorrect handling of environmentally hazardous substances, especially when incorrectly disposed of, can cause considerable damage to the environment.

For this reason:

- Always heed the information below.
- If environmentally hazardous substances are accidentally released into the environment, immediately take suitable measures to minimise this. If in doubt, inform the responsible local authorities.

The following environmentally hazardous substances are used:

Lubricants

Lubricants such as grease and oils contain poisons and environmentally hazardous substances. They must not be allowed to be released into the environment. Disposal must be performed by a qualified disposal company.

Diesel Fuel

Diesel fuel contains poisons and environmentally hazardous substances. They must not be allowed to be released into the environment. Disposal must be performed by a qualified disposal company.

Coolants

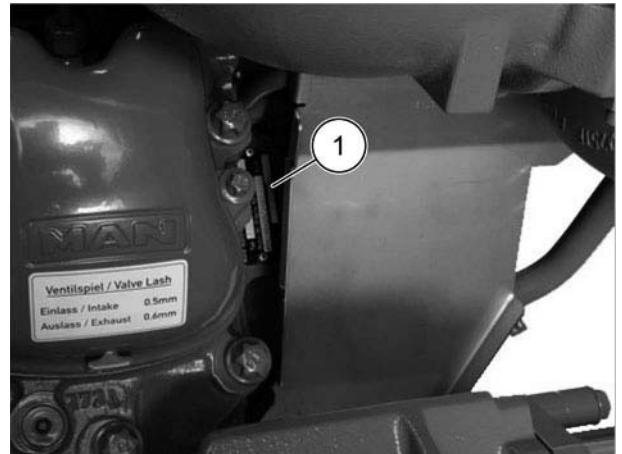
Coolants can contain poisons and environmentally hazardous substances. They must not be allowed to be released into the environment. Disposal must be performed by a qualified disposal company.

3 Engine Model Plate

For all communications please always give the engine model (3), engine number (4) and work number/job number (5).

For this reason before the engine is commissioned, read off and enter in the data from the engine model plates below.

The engine model plates (1) and (2) are mounted to the crankcase.



MAN Nutzfahrzeuge Aktiengesellschaft

Typ

Motor-Nr. / Engine No. NI/II

Model (3)

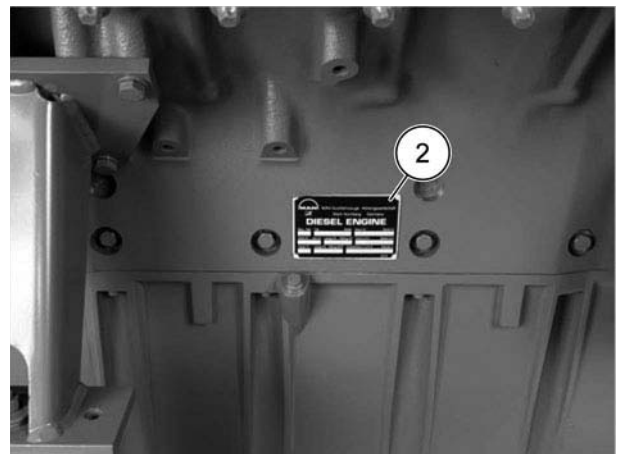
.....

Engine number (4)

.....

Work number/Job number (5)

.....



Bauj. Year		Typ	Model	Motor-Nr.	Serial No
Werk-Nr.	Job No	Leistung kW	Rating kW	Drehz. 1/min	Speed rpm
Temp° C	Leistung PS	Rating BHP	Aufstellhöhe m	uNN Altitude m	

-0219

Engine Model Plate

3.1 Explanation of the Motor-Nr./Engine-No. (Engine Identification Number)

Motor-Nr./Engine-No.	Class identifier (assignment)
711	Model number according to index of model codes
1234	Day of assembly (plant internal)
547	Assembly order (sequence number on day of assembly)

3.2 Explanation of Model Designation

Model designation	Explanation	Example
D	Fuel type	Diesel
28	Figure + 100	128 mm bore
4	Stroke figure (rounded)	142 mm stroke
8 / 0 / 2	Number of cylinders	8, 10, 12 cylinders
L	Charging	With charger and intercooling
E	Engine installation	Installation engine
201/203/211/213	Model designation identification	Development number

4 Design and Function

4.1 Engine, General

The 8, 10 and 12-cylinder engines described here are liquid-cooled, 4-cycle diesel engines with turbocharging and charge air cooling.

Engine Monitoring

Monitoring of the engine is made through various sensors. The sensors are designed, for example, as rpm and temperature sensors, which report the various operating conditions of the engine to the engine control unit. The engine control unit operates according to the EVA principle:

E = Eingang (Input)

V = Verarbeitung (Processing)

A = Ausgang (Output)

The engine control units process the information received from the sensors and control the output signals which are sent to the actuators. The actuators convert the signals into mechanical factors.

Engine Lubrication

Pressure feed lubrication with one lube-oil pump for the bearings of the crankshaft, connecting rods and camshafts as well as piston pin sockets, roller tappets and rocker arms.

Oil is filtered through a filter module with an integrated oil cooler and a crankcase breather in the main flow. Ancillary assemblies such as high-pressure pump, turbocharger and PTOs are connected to the engine oil circuit.

Cooling System

The cooling circuit is a thermostat controlled forced circulation cooling system. The maintenance-free coolant pump is mounted to front side on the crankcase and is belt driven. The thermostats are located on the coolant pump and are made with changeable disks.

Intake and Exhaust System

The dry exhaust pipes are mounted to the cylinder heads. The exhaust is routed to the turbocharger from the high-pressure stage.

Control of the wastegate valves is made directly by the boost pressure. The engine's main-flow oil circuit supplies the lubrication for the turbocharger and is connected at the oil pressure connections on the turbochargers.

The intake air is routed through the air filter to the turbochargers. The pre-compressed charge air is then routed to the engine.

Fuel System, General

The fuel system is divided into a low-pressure and a high-pressure system.

The fuel lines, manual pump and the fuel filters are all part of the low-pressure system.

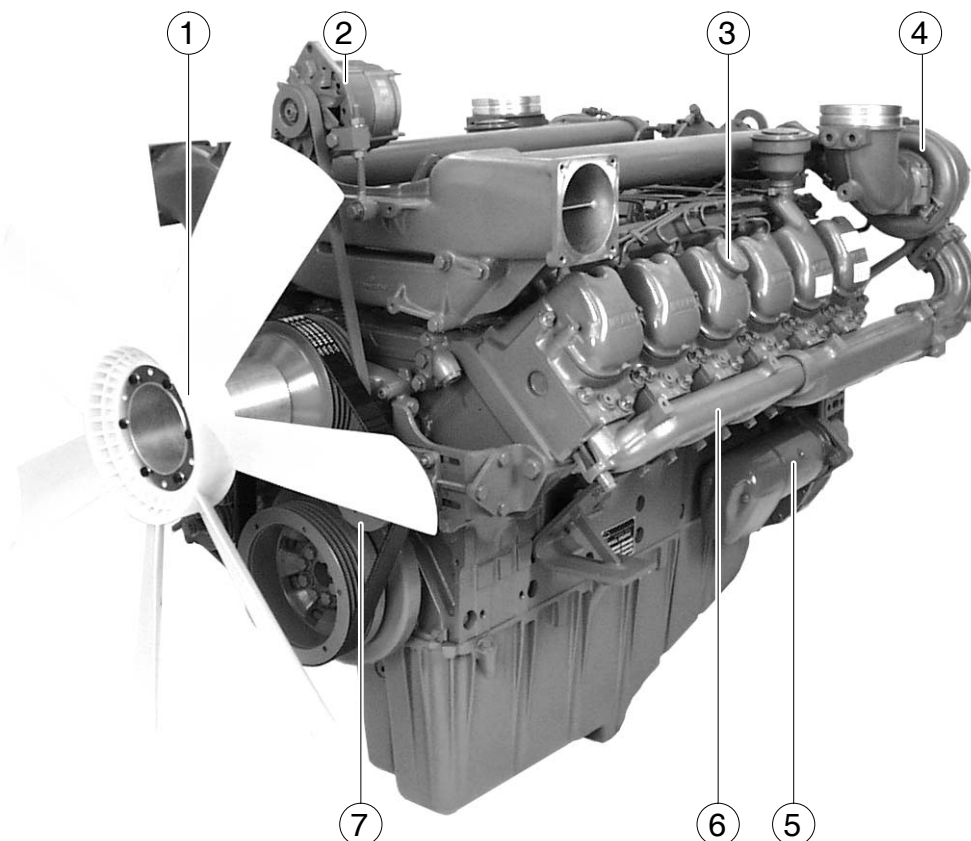
The fuel feed pumps that are flange-mounted to the high-pressure pump act as the interface to the high-pressure system.

The high-pressure system consist of the high-pressure pump which is fed by the flange-mounted delivery pumps and the high-pressure lines and injection nozzles.

Design and Function

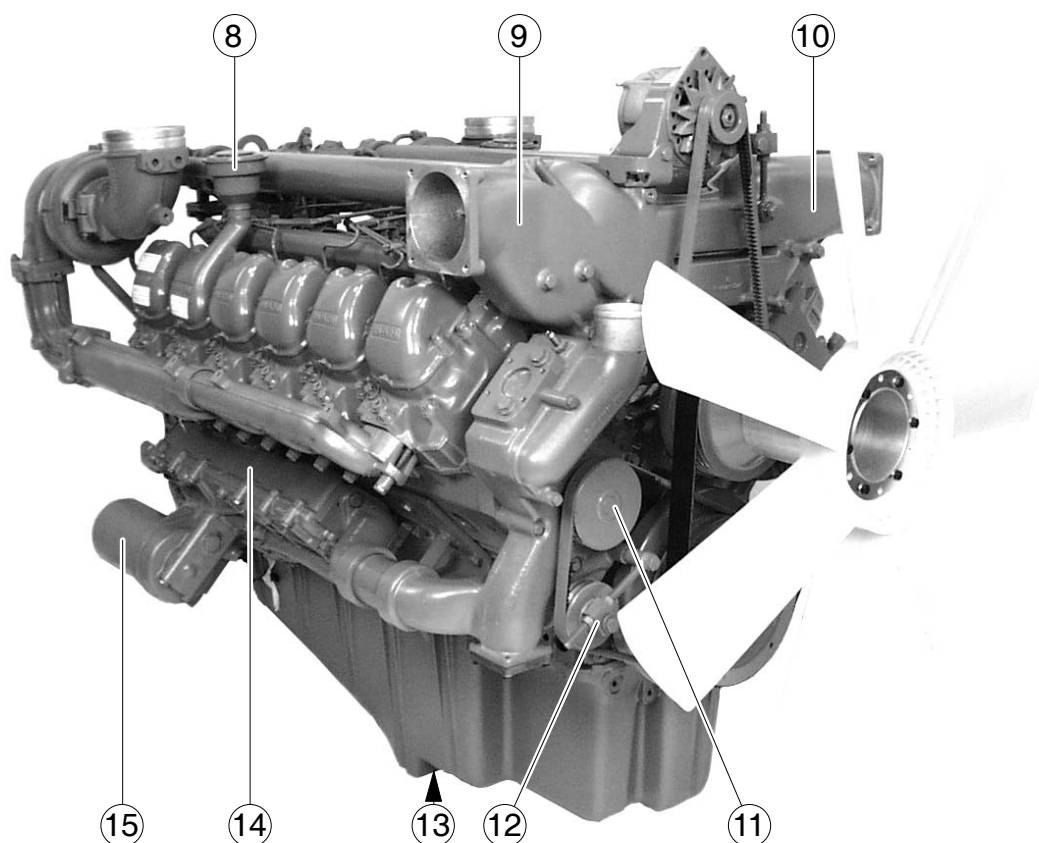
4.2 Engine Views

4.2.1 Front Left View



- (1) Fan
- (2) Alternator
- (3) Oil filler neck
- (4) Turbocharger
- (5) Starter
- (6) Exhaust pipe
- (7) Tensioning pulley

4.2.2 Rear Right View



- (8) Crankcase breather
- (9) Combustion air line from charge air cooler
- (10) Combustion air line to charge air cooler
- (11) Coolant pump
- (12) Tensioning pulley
- (13) Oil drain plug
- (14) Oil cooler
- (15) Oil filter

5 Transport, Packaging and Storage

It is absolutely necessary to observe the “Assembly Instructions” for the installation and commissioning of a new or reconditioned engine.



NOTE!

Installation and commissioning is only to be made by the employees of the manufacturer of the entire system or by manufacturer authorised personnel.

Nevertheless, as part of the installation and the use of the engine, situations will occur where the operator or his maintenance personnel will have to be familiar with the handling of packages. In these situations it is absolutely necessary to observe the following information.

5.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.

Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Protective Helmet
- Safety Shoes
- Safety Gloves

5.2 Safety Instructions

Heavy Suspended Loads



WARNING!

Risk of death caused by heavy suspended loads!

During lifting operations, loads can swing out and fall down. This can cause serious injury and even death.

For this reason:

- Do not stand under or remain in the swivel range of the suspended load.
- Only move the load under supervision.
- Only use approved lifting equipment and accessories with sufficient load capacity.
- Never use torn or scuffed lifting equipment such as ropes or straps.
- Do not let lifting equipment such as rope or straps come into contact with sharp edges and corners and do not twist or knot them.
- The „crane lifting lugs“ on the engine are to be only used to transport the engine with no ancillary assemblies attached.
- Before leaving the work area, lower load to ground.

Transport, Packaging and Storage

Off-Centre Point of Gravity



WARNING!

Risk of injury caused by falling or tipping packages!

Packages can have a centre of gravity that is off-centre. If the lifting equipment is not hooked up properly, these packages could tip over and fall causing serious injuries.

For this reason:

- Observe the information and markings on the package concerning centre of gravity.
- When transporting with a crane, the hook must be placed so that it is directly above the package's centre of gravity.
- Carefully raise the package and observe its movement. If necessary, change the position of the lifting equipment.

Swingout of Packages being Transported



WARNING!

Risk of injury caused by packages swing out during transportation!

When transporting the packages with a crane, the packages can swing out and cause serious injuries and significant property damage.

For this reason:

- Ensure that during the transport of packages, no persons, objects or obstacles are in the swivel range of the packages being transported.

Unauthorised Transport



IMPORTANT!

Risk of property damage if packages are transported by untrained personnel!

Unauthorised transport by untrained personnel can cause packages to fall or tip over. This could cause considerable property damage.

For this reason:

- Unloading of packages during delivery and their in-house transport are only to be performed by trained personnel under the supervision of the manufacturer's employees.
- Refrain from any unauthorised transportation or removal of the transportation aids.
- No unauthorised removal of packaging permitted.

Improper Transport



IMPORTANT!

Risk of property damage caused by improper transport!

Improper transport can cause packages to fall or tip over. This could cause considerable property damage.

For this reason:

- Carefully handle the packages when unloading during delivery and when transporting them within the company. Observe the symbols and instructions on the packages.
- Only use the prescribed lifting points.

5.3 Transport Inspection

Check the delivery for missing items and for damage from transport.

If external signs of transport damage are apparent:

- Do not accept delivery or only accept under written protest.
- List scope of damage on the transport documents or on the transportation company's packaging slip.
- Initiate a claims process.



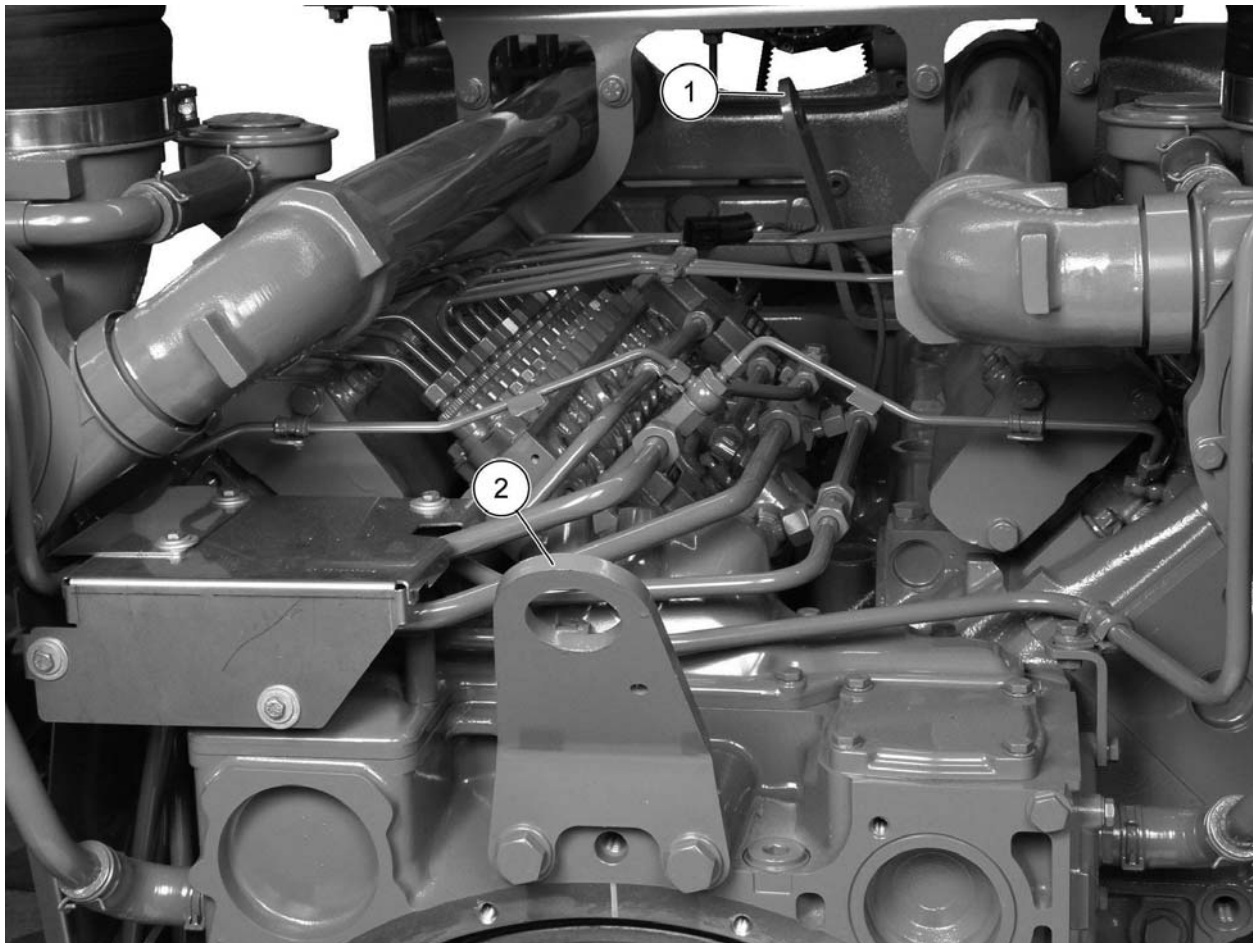
NOTE!

Make sure to claim each damage case as soon as it is discovered. Damage claims can only be claimed within the applicable time limits.

Transport, Packaging and Storage

5.4 Transport

Lifting Points



There are 2 lifting lugs (1) and (2) for the crane installed on the engine.



WARNING!

Risk of death caused by the load falling!

During lifting operations, loads can fall down. This can cause serious injury and even death.

For this reason:

- The „crane lifting lugs“ are only to be used to transport the engine with no ancillary assemblies attached.

Transport with Crane

The engine can be transported with a crane under the following conditions.

- The crane and the lifting equipment must be designed for the weight of the engine.
 - The operator must be qualified for operating the crane.
1. Attach the ropes, straps or multipoint lifting equipment according to the picture.
 2. Ensure that the package is hanging straight or compensate for the off-centre point of gravity.
 3. Start the transport.

Transport with Forklift

The engine can be transported using a forklift under the following conditions.

- The forklift must be designed for the weight of the engine.
 - The engine must be securely mounted to the pallet.
 - The forklift operator must be qualified and authorised to operate the forklift.
1. Insert the fork of the forklift between or under the pallet's struts.
 2. The fork must be inserted into the pallet until it protrudes from the other side.
 3. Ensure that the pallet cannot tip over if the centre of gravity is off-centre.
 4. Lift the pallet and transport it to the desired location.

Transport, Packaging and Storage

5.5 Packaging

Packaging

The individual packages are packed in accordance with the expected conditions of transport.

The purpose of the packaging is to protect the components from transport damage, corrosion and other damage. For this reason do not unpack components until shortly before they are to be assembled.

Handling Packing Material

Dispose of packing material according to the valid local and statutory regulations.



IMPORTANT!

Risk of hazard to the environment caused by incorrect disposal!

Packaging materials are valuable raw materials and can in many cases continue to be used or can be processed and recycled. Incorrect disposal of packaging materials may cause an environmental hazard.

For this reason:

- Dispose of packing materials in an environmentally friendly manner.
- Observe the valid local regulations. If necessary, contact a professional disposal company.

5.6 Storage

Storage of packages

Store packages under the following conditions:

- Do not store in the open.
- Store in a dry and dust-free environment.
- Do not expose to damaging chemicals.
- Protect from sun light.
- Avoid any physical shocks.
- Storage temperature: 15 to 35 °C.
- Relative humidity: max. 60 %.
- If stored for more than 3 months, regularly check the condition of the packaging. If necessary, renew or replace the preservation.



NOTE!

Some of the packages may have information printed on them regarding their proper storage. Please observe this information.

6 Installation and Commissioning

6.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.

Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Safety Shoes
- Safety Gloves

6.2 Safety Instructions

Personnel

- The installation and commissioning may only be performed by MAN employees or by MAN-trained qualified personnel.



WARNING!

Danger caused by faulty installation and commissioning!

Installation and commissioning require trained qualified personnel with sufficient experience. Faulty installation can cause life threatening situations and considerable property damage.

For this reason:

- Installation and commissioning are only to be performed by MAN employees.
- Installation and commissioning by MAN trained qualified personnel may only be performed with approval from MAN.

Ground Rules



WARNING!

Risk of injury caused by improper installation and commissioning!

Improper installation and commissioning can cause serious personal injury or considerable property damage.

For this reason:

- Ensure adequate work space before starting any work.
- Be careful when working with exposed parts with sharp edges.
- Make sure work space is kept clean and orderly!
- Install components in a correct manner.
- Observe the prescribed tightening torques.
- Secure components so that they do not fall or tip over.

- Before commissioning the engine, carefully read the Operating Instructions and familiarise yourself with the "critical" subjects.

SAVANTECH
The Source of Energy Generators

It is absolutely necessary to observe the "Assembly Instructions" for the installation and commissioning of a new or reconditioned engine.

An Engineering and Technology Company

Carefully read the Operating Instructions before starting any work!
This is especially valid for the chapter on General Safety Instructions
and the safety instructions in each of the chapters.



Installation and Commissioning

- For safety reasons we recommend placing an off limits sign on the door to the engine room and to instruct the operating personnel that they are responsible for the safety of people who enter the engine room.

6.3 Installation - Engine

The installation of the engine, i.e. connection to the power supply, connection of the cooling system, are to be performed in accordance with the manufacturer's instructions for the entire system and with the help of the "Assembly Instructions" and the "Installation Instructions."

6.3.1 Safety Equipment



WARNING!

Risk of death caused by the absence of safety equipment!

An emergency-off button, for shutting down the system or engine in an emergency, must be installed for each engine.

For this reason:

- Install an emergency stop button to shut down the system in an emergency.
- Check whether all of the safety equipment is correctly installed and in good operating order.



WARNING!

Risk of death caused by faulty operation!

At excessive loads or if malfunctions occur the engine can overheat and suddenly seize.

For this reason:

- The sensors which monitor the engine parameters must be connected to and evaluated by the module manufacturer's monitoring equipment.
- If sensor values go outside the permissible limits or if there is a power loss, the engine must be able to be immediately shut off by the monitoring equipment.

6.3.2 Engine Model Plate Data

Please always specify the engine model, engine number and order number when corresponding with MAN, see page.

For this reason, before commissioning the engine, read off the data from the engine model plate and enter it into the Engine Model Plate chapter, see page 25.



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6.4 Commissioning

Do not run new or reconditioned engines during the first operating hours above 3/4 load. However, make sure to vary the engine speed.

After this time period the engine can be slowly brought up to full power.



IMPORTANT!

Termination of liability for material defects by use of non-approved fluids and lubricants!

Liability of material defects is terminated if non-approved fluids and lubricants are used.

For this reason:

- Only use approved fluids and lubricants (see "Fluids and Lubricants ..." publication).

6.4.1 Filling Diesel Fuel



DANGER!

Risk of fire caused by diesel fuel!

Diesel fuel is highly flammable.

For this reason:

- No smoking and no open fires when handling fuels.
- Only refuel with engine off.
- Ensure cleanliness.
- Do not let fuel drip or leak out.



IMPORTANT!

Component damage to injection system caused by water in diesel fuel!

Absolutely prevent any ingress of water.

For this reason:

- Install a prefilter and a water separator into the fuel supply.

1. Fill diesel fuel according to the instructions of the manufacturer of the entire system.
2. Open fuel shutoff valve.

Installation and Commissioning

6.4.2 Filling Coolant



NOTE!

Do not let coolant drip or leak out while filling. Do not let coolant leak out onto the ground or into bodies of water. Otherwise, the environment will be damaged.

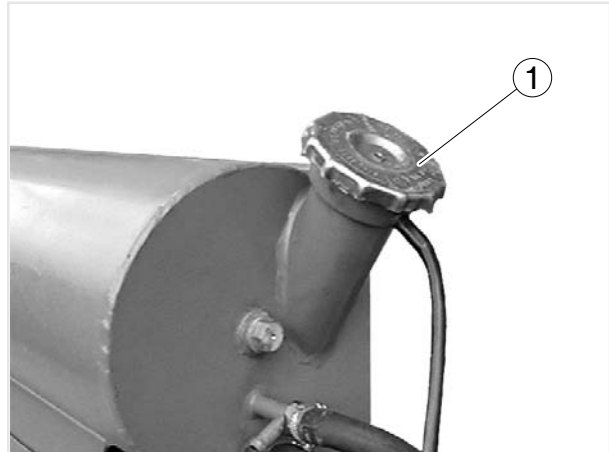
Fill the cooling system of the engine with a mixture of tap water and ethylene glycol antifreeze agent or anticorrosion agent.

Only use approved fluids and lubricants (see "Fluids and Lubricants ..." publication).

1. Remove cap (1).
2. Slowly fill in coolant up to the lower edge of the filler neck.

For coolant filling capacity, see "Technical Data" page 82.

3. Reinstall cap (1).



6.4.3 Filling Engine Oil



IMPORTANT!

Termination of liability for material defects by use of non-approved fluids and lubricants!

Liability of material defects is terminated if non-approved fluids and lubricants are used.

For this reason:

- Only use approved fluids and lubricants (see "Fluids and Lubricants ..." publication).



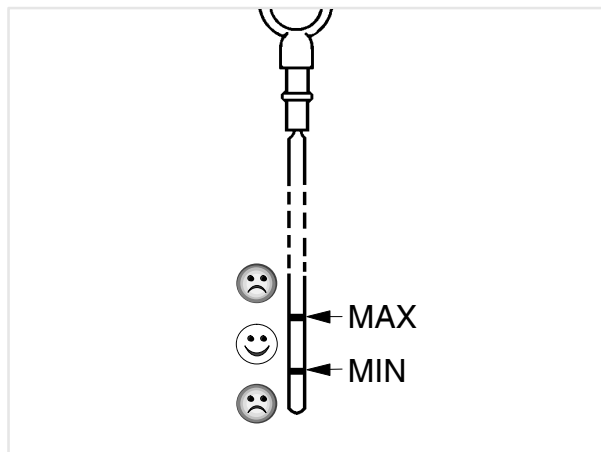
IMPORTANT!

Component damage caused by over filling!

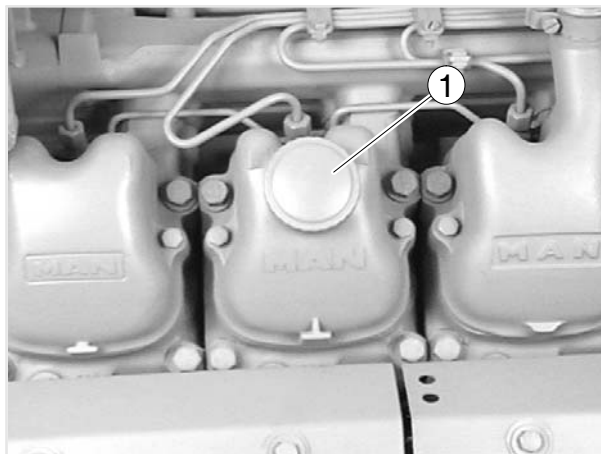
Engine damage can occur if engine oil is filled to above the max. mark on the oil dipstick.

For this reason:

- Do not fill engine oil above the max. mark on the oil dipstick



1. Remove cap (1).
 2. Slowly fill engine oil into the filler neck.
- For oil filling capacity, see "Technical Data" page 82.
3. Reinstall cap (1).



7 Operation

7.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.

Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Safety Shoes
- Safety Gloves

7.2 Safety Instructions

Personnel

- Operation of the engine may only be performed by instructed personnel or by trained qualified personnel.

Ground Rules



WARNING!

Danger caused by faulty operation!

Improper operation can cause serious personal injury or considerable property damage.

For this reason:

- Perform all operating steps in accordance with the instructions in these Operating Instructions.
- Before starting any work ensure that all covers and protective equipment have been installed and are operating properly.
- Never shut off any safety equipment while in operation.
- Make sure work space is kept clean and orderly! Any unused parts or components lying around are potential sources of accidents.



WARNING!

Risk of injury caused by vapours!

In the first operating hours of the engine the paint on hot engine parts will burn off producing vapours that are hazardous to health.

For this reason:

- Ensure sufficient ventilation.
- Limit time spent in the engine area to the absolute minimum.

Operation

7.3 Preparations before Operation



DANGER!

Danger caused by damaged engines!

Damaged engines can be dangerous to persons.

For this reason:

- Check engine for damage and leaks before each operation.
- Do not operate engine if damage is found.

Before operation, check fuel supply, level of coolant and oil in the engine.

If necessary, refill diesel fuel, coolant and oil.



IMPORTANT!

Termination of liability for material defects by use of non-approved fluids and lubricants!

Liability of material defects is terminated if non-approved fluids and lubricants are used.

For this reason:

- Only use approved fluids and lubricants (see "Fluids and Lubricants ..." publication).

7.3.1 Checking and Refilling Fuel Supply



DANGER!

Risk of fire caused by diesel fuel!

Diesel fuel is highly flammable.

For this reason:

- No smoking and no open fires when handling fuels.
- Only refuel with engine off.
- Ensure cleanliness.
- Do not let fuel drip or leak out.

1. Check fuel supply and refuel in accordance with the instructions of the manufacturer of the entire system.
2. Open fuel shutoff valve.

7.3.2 Checking Coolant

**WARNING!****Risk of scalding!**

The cooling system is under pressure and the coolant is hot.

For this reason:

- Let engine cool down first

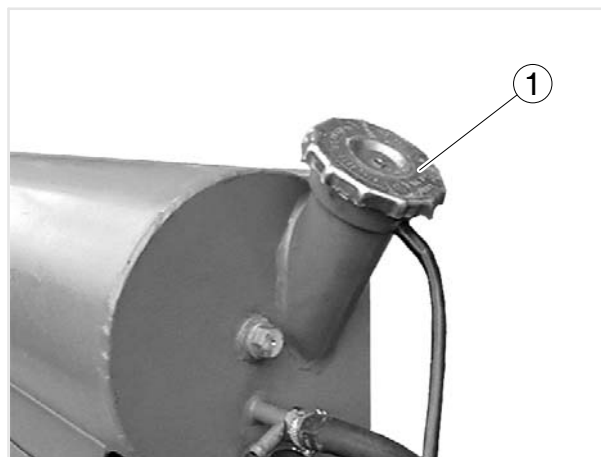
1. Remove cap (1).

2. Check coolant level.

The normal coolant level is at the bottom edge of the filler neck.

3. Reinstall cap (1).

If the coolant is too low, refill with coolant.



Operation

7.3.3 Refilling Coolant



NOTE!

Do not let coolant drip or leak out while refilling. Do not let coolant leak out onto the ground or into bodies of water otherwise this will cause damage to the environment.



IMPORTANT!

Engine damage caused by excessive temperature difference!

When refilling with cold coolant in an engine at operating temperature there is a risk of engine damage caused by excessive temperature difference.

For this reason:

- Do not fill with cold coolant.

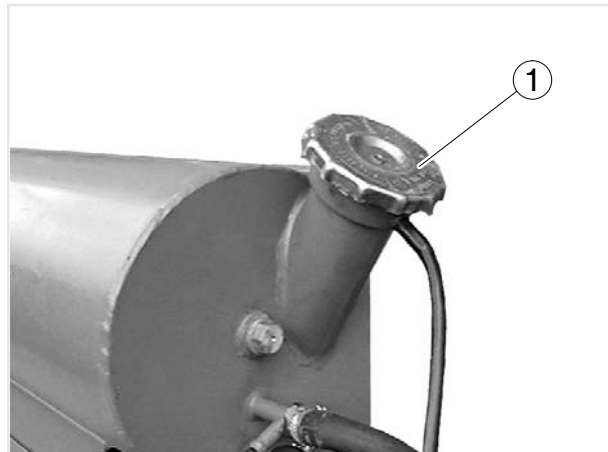
Fill the cooling system of the engine with a mixture of tap water and ethylene glycol antifreeze agent or anticorrosion agent.

Only use approved fluids and lubricants (see "Fluids and Lubricants ..." publication).

1. Remove cap (1).
2. Slowly fill in coolant up to the lower edge of the filler neck.

Ensure that the ratio of "water to antifreeze" is correct.

3. Reinstall cap (1).
4. Let engine run for a short period and then recheck coolant level.



7.3.4 Checking Engine Oil Level



NOTE!

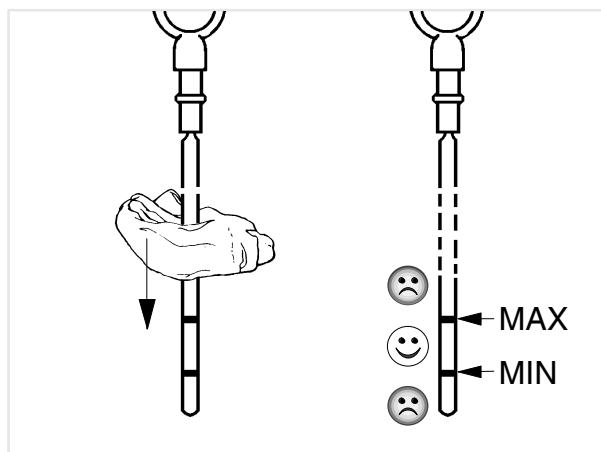
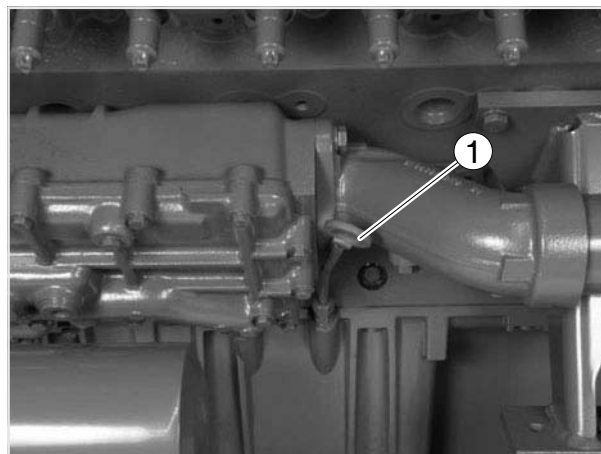
Check the oil level when the engine is horizontal and only after at least 20 minutes have passed since the engine was switched off.

1. Pull out oil dipstick (1).
2. Wipe off oil dipstick with a lint-free cloth.
3. Reinsert oil dipstick all the way.
4. Pull out oil dipstick again and check oil level.

The oil level should be between both of the marks on the dipstick and should never drop below the lower mark.

5. Reinsert the oil dipstick (1) all the way.

If the oil level is too low, refill with new oil.



Operation

7.3.5 Refilling Engine Oil



IMPORTANT!

Termination of liability for material defects by use of non-approved fluids and lubricants!

Liability of material defects is terminated if non-approved fluids and lubricants are used.

For this reason:

- Only use approved fluids and lubricants (see "Fluids and Lubricants ..." publication).



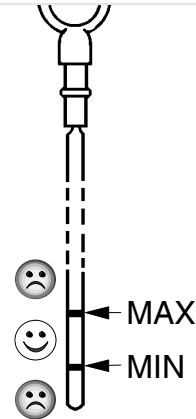
IMPORTANT!

Component damage caused by over filling!

Engine damage can occur if engine oil is filled to above the max. mark on the oil dipstick.

For this reason:

- Do not fill engine oil above the max. mark on the oil dipstick



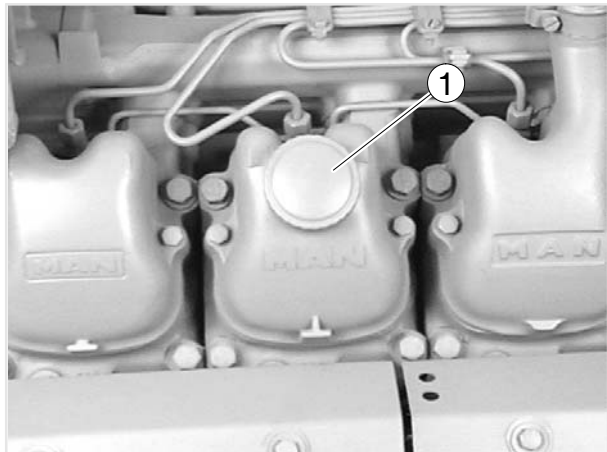
1. Remove cap (1).

2. Slowly fill engine oil into the filler neck.

The oil level should be between both marks on the dipstick.

3. Reinstall cap (1).

4. Check engine oil level.



7.4 Operation

7.4.1 Monitoring Operation

**IMPORTANT!**

Do not overload engine.

If faults occur, investigate and solve them immediately to prevent major damage from occurring!

The engine oil pressure is monitored during its operation.

If a fall in oil pressure is reported by the monitor, immediately shut down engine.

7.4.2 Stopping in an Emergency

An emergency-off button, for shutting down the system in an emergency, must be installed for each engine.



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8 Maintenance and Care

8.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.

Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Safety Shoes
- Safety Gloves

8.2 Safety Instructions

Personnel

- The engine maintenance items described in the Operating Instructions may only be performed by trained qualified personnel.

Ground rules



WARNING!

Risk of injury caused by improperly performed maintenance!

Improper maintenance can cause serious injuries or considerable property damage.

For this reason:

- Ensure that the engine cannot be started by unauthorised persons.
- Perform all maintenance steps in accordance with the instructions in these Operating Instructions.
- Ensure adequate work space before starting any work.
- Make sure work space is kept clean and orderly! Any unused parts or components lying around are potential sources of accidents.



WARNING!

Risk of injury caused by maintenance work!

Before performing any maintenance work the engine must be set into the maintenance position if nothing else is explicitly stated.

For this reason:

- The engine must be shut down.
- The engine must have cooled off.
- The battery main switch must be switched off and the ignition key removed.

Maintenance and Care



IMPORTANT!

Termination of liability for material defects by use of non-approved fluids and lubricants!

Liability of material defects is terminated if non-approved fluids and lubricants are used.

For this reason:

- Only use approved fluids and lubricants (see "Fluids and Lubricants ..." publication).



NOTE!

Coolant

- Antifreeze and mixtures of antifreeze and water are to be handled as special wastes. When disposing of used coolant observe the regulations of the local authorities.

Engine Oil

- Make absolutely sure that no oil gets into the sewage system or soaks into the ground – Risk of contaminating drinking water!
Carefully collect used oil and properly recycle.
When handling used oil, observe the safety measures to protect your health.

Filter Elements

- Filter elements such as for oil and fuel must be handled as special wastes and properly disposed of. Observe the regulations of the local authorities.

Batteries

- Used batteries contain hazardous substances. Batteries must be taken back by the distributor and properly disposed of or be taken to a place of collection. Never dispose of used batteries in the household refuse.
Please also observe the country-specific regulations.

8.3 Maintenance Schedule

Maintenance record

All of the maintenance work listed in the Operating Instructions are to be performed according to the intervals stated in the maintenance schedule in the "Maintenance Record" publication.

The maintenance schedule also contains work that is not listed in these Operating Instructions. These are listed in the Repair Instructions for this engine. This work may only be performed by specially trained qualified personnel.



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8.4 Maintenance Work

8.4.1 Engine Oil Change



WARNING!

Risk of scalding!

Engine oil is hot.

For this reason:

- Only touch the oil drain screws using protective gloves



NOTE!

The oil filter elements are to be changed out at every engine oil change.

Drain engine oil - without hand vane pump

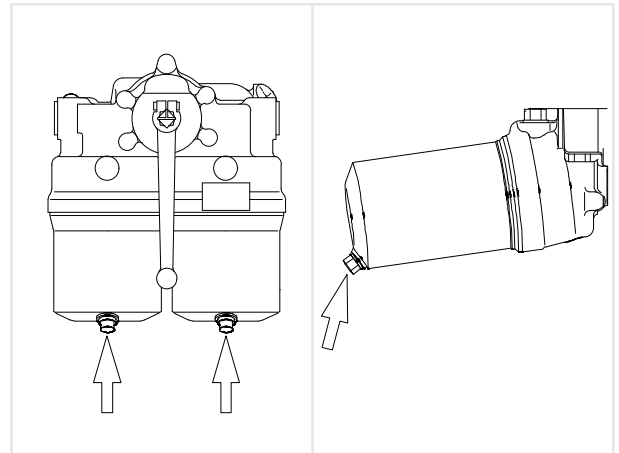
Drain engine oil with engine at operating temperature.



NOTE!

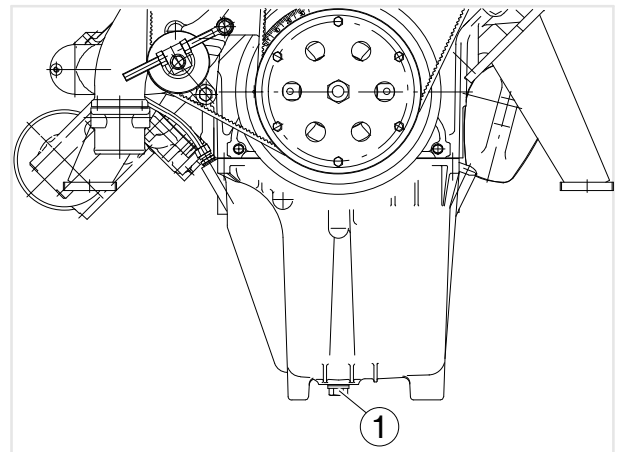
Use a container with sufficient capacity to change oil (at least 100 litres). This ensures that oil will not overflow.

1. Remove oil drain screw from oil filter bowl (arrow) and completely drain oil.



2. Position container under the drain screw.
3. Remove oil drain screw (1) from oil pan and completely drain all engine oil.
4. Install oil screw (1) with a new sealing ring and tighten.

Tightening torque 80 Nm



Maintenance and Care

Drain engine oil - with hand vane pump

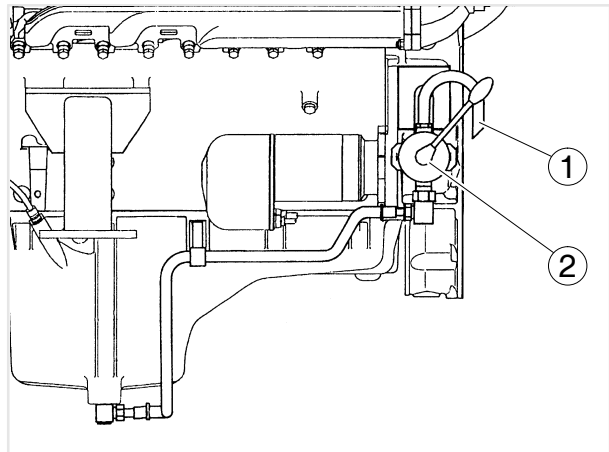
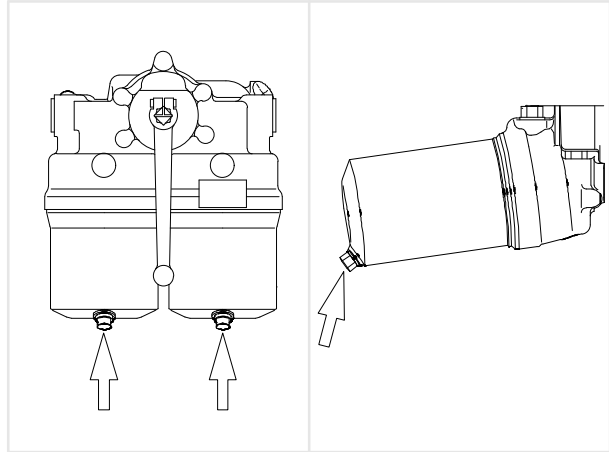
Drain engine oil with engine at operating temperature.



NOTE!

Use a container with sufficient capacity to change oil (at least 100 litres). This ensures that oil will not overflow.

1. Remove oil drain screw from oil filter bowl (arrow) and completely drain oil.
2. Place container under drain (1). If necessary use an extension hose.
3. Operate hand vane pump (2) and pump off engine oil.



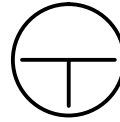
Change oil filter elements - on switchable oil filters**IMPORTANT!****Engine damage!**

Danger of blocked oil supply.

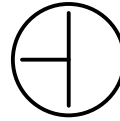
For this reason:

- Leave the oil flow lever set to continuous operation

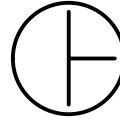
For continuous operation, set the oil flow lever so that both halves of the filter are in operation. Observe the position of the oil flow lever!



A continuous operation
(both halves of the filter
switched on)



Right side
shut off

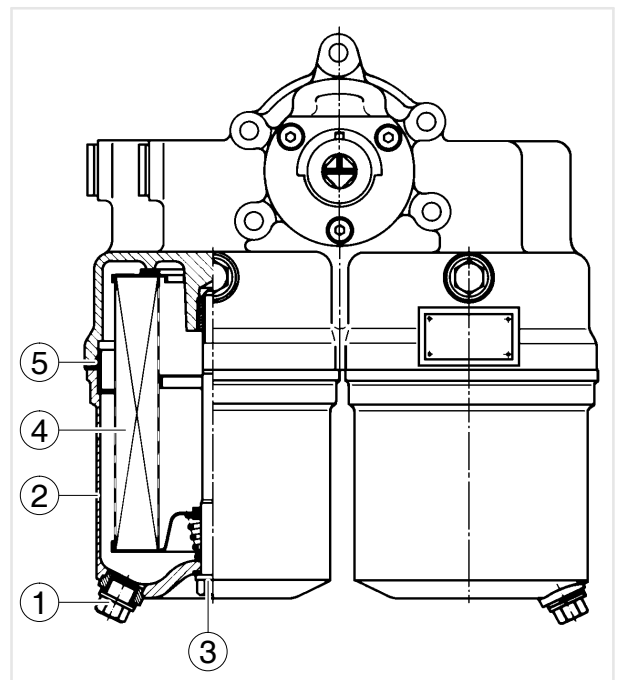


Left side
shut off

**NOTE!**

Use a container with sufficient capacity to change oil (at least 10 litres). This ensures that oil will not overflow.

1. Remove oil drain screw (1) from oil filter bowl (2) and completely drain engine oil.
2. Loosen mounting bolt (3) of filter bowl (2) .
3. Remove filter bowl (2) along with filter element (4).
4. Remove filter element (4) from filter bowl (2).
5. Clean filter bowl(2).
6. Insert new filter element (4) and install filter bowl (2) with new seal (5).

**NOTE!**

To prevent the sealing ring (4) from turning, hold filter bowl (3) while tightening the mounting bolt (2).

7. Insert and tighten mounting bolt (3) of filter bowl (2).

Tightening torque 50 Nm

8. Install oil screw (1) with a new sealing ring and tighten.

Tightening torque 40 Nm

The second filter element is changed in the same way.

Maintenance and Care

Change oil filter elements - on dual horizontal oil filters



NOTE!

Use a container with sufficient capacity to change oil (at least 10 litres). This ensures that oil will not overflow.

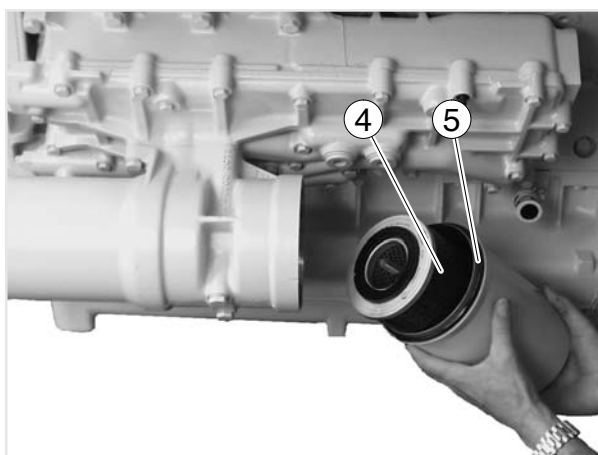
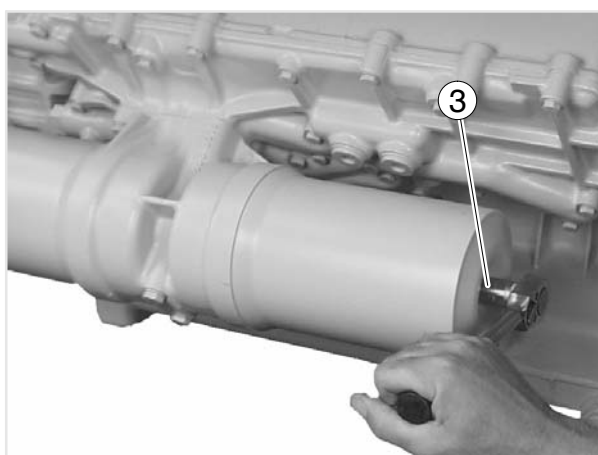
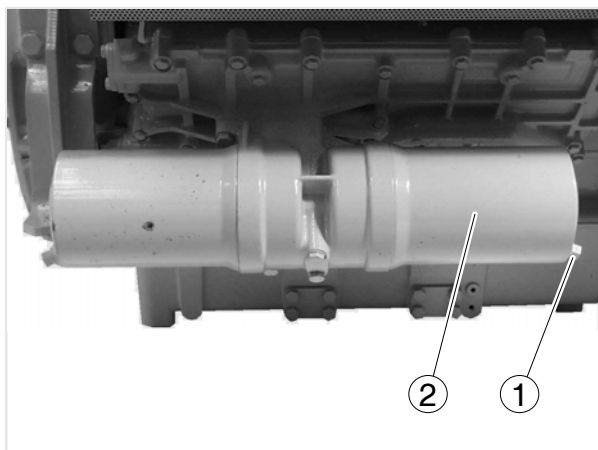
1. Remove oil drain screw (1) from oil filter bowl (2) and completely drain engine oil.
2. Loosen mounting bolt (3) of filter bowl (2) .
3. Remove filter bowl (2) along with filter element (4).
4. Remove filter element (4) from filter bowl (2).
5. Clean filter bowl(2).
6. Insert new filter element (4) and install filter bowl (2) with new seal (5).
7. Insert and tighten mounting bolt (3) of filter bowl (2).

Tightening torque 50 Nm

8. Install oil screw (1) with a new sealing ring and tighten.

Tightening torque 40 Nm

The second filter element is changed in the same way.



Change oil filter elements - on dual vertical oil filters

**NOTE!**

Use a container with sufficient capacity to change oil (at least 10 litres). This ensures that oil will not overflow.

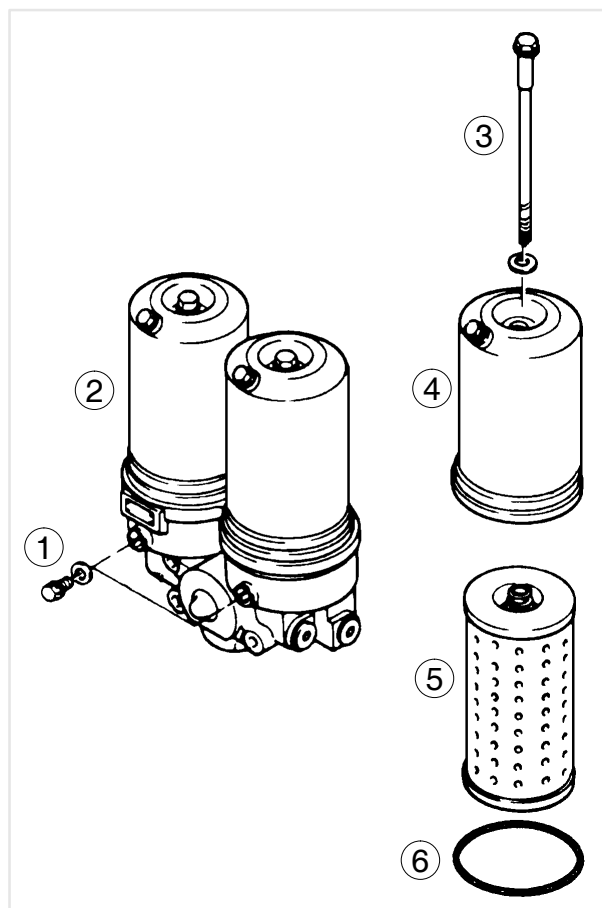
1. Remove oil drain screw (1) from oil filter (2) and completely drain engine oil.
2. Loosen mounting bolt (3) of filter bowl (4) .
3. Remove filter bowl (4) along with filter element (5).
4. Remove filter element (5) from filter bowl (4).
5. Clean filter bowl(4).
6. Insert new filter element (5) and install filter bowl (4) with new seal (6).
7. Insert and tighten mounting bolt (3) of filter bowl (4).

Tightening torque 50 Nm

8. Install oil screw (1) with a new sealing ring and tighten.

Tightening torque 40 Nm

The second filter element is changed in the same way.



Maintenance and Care

Change oil filter elements - single oil filter



NOTE!

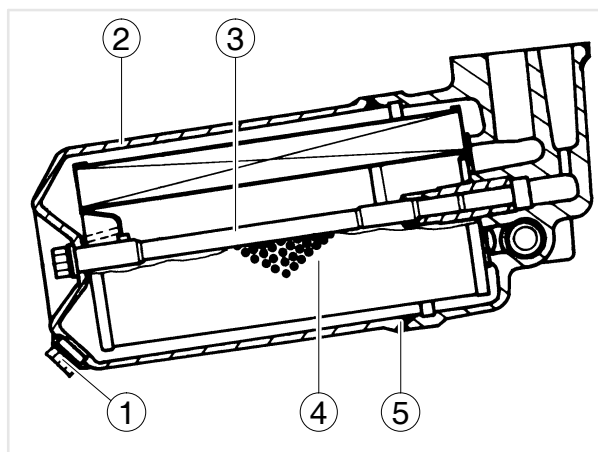
Use a container with sufficient capacity to change oil (at least 10 litres). This ensures that oil will not overflow.

1. Remove oil drain screw (1) from oil filter bowl (2) and completely drain engine oil.
2. Loosen mounting bolt (3) of filter bowl (2) .
3. Remove filter bowl (2) along with filter element (4).
4. Remove filter element (4) from filter bowl (2).
5. Clean filter bowl(2).
6. Insert new filter element (4) and install filter bowl (2) with new seal (5).
7. Insert and tighten mounting bolt (3) of filter bowl (2).

Tightening torque 50 Nm

8. Install oil screw (1) with a new sealing ring and tighten.

Tightening torque 40 Nm



Filling Engine Oil

**IMPORTANT!****Termination of liability for material defects by use of non-approved fluids and lubricants!**

Liability of material defects is terminated if non-approved fluids and lubricants are used.

For this reason:

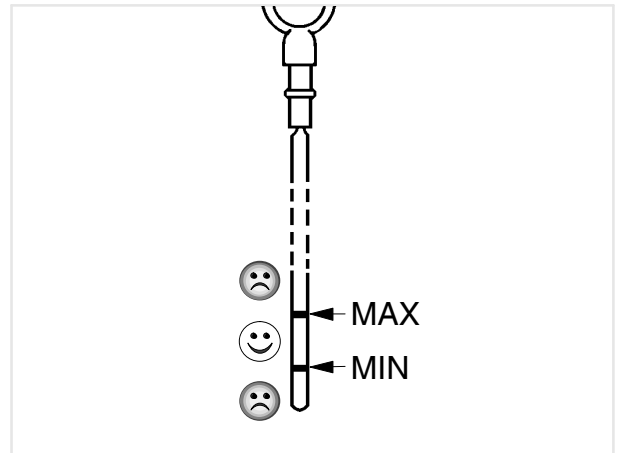
- Only use approved fluids and lubricants (see "Fluids and Lubricants ..." publication).

**IMPORTANT!****Component damage caused by over filling!**

Engine damage can occur if engine oil is filled to above the max. mark on the oil dipstick.

For this reason:

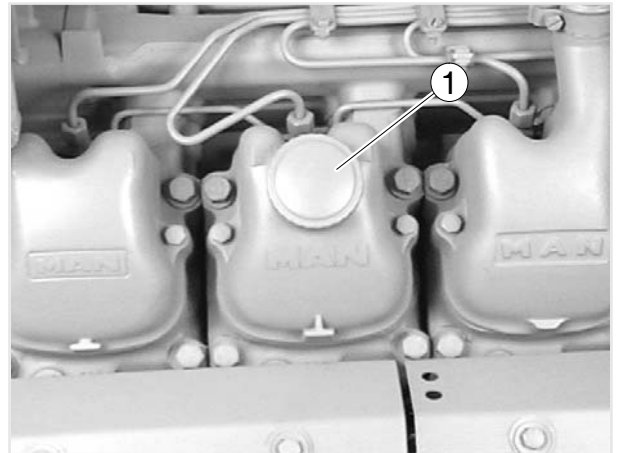
- Do not fill engine oil above the max. mark on the oil dipstick



1. Remove cap (1).
2. Slowly fill engine oil into the filler neck.

For oil filling capacity, see "Technical Data" page 82.

3. Reinstall cap (1).

**IMPORTANT!****Components can be damaged due to no oil pressure!**

Oil pressure must have built up after 10 seconds of engine running.

For this reason:

- Observe oil pressure indicator.
- Check oil pressure and check for leaks.
- If no oil pressure builds up, immediately shut down engine.
- Determine cause and rectify problem.

4. Start engine and let it run for a few minutes at low speed.
5. Shut down the engine.
6. Check engine oil level after 20 minutes.

Maintenance and Care

Check Engine Oil Level



NOTE!

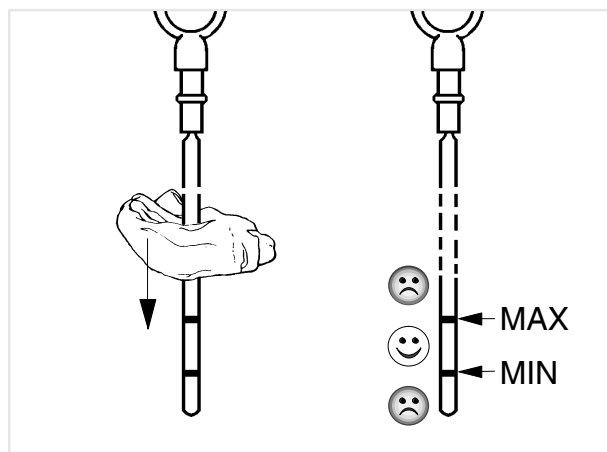
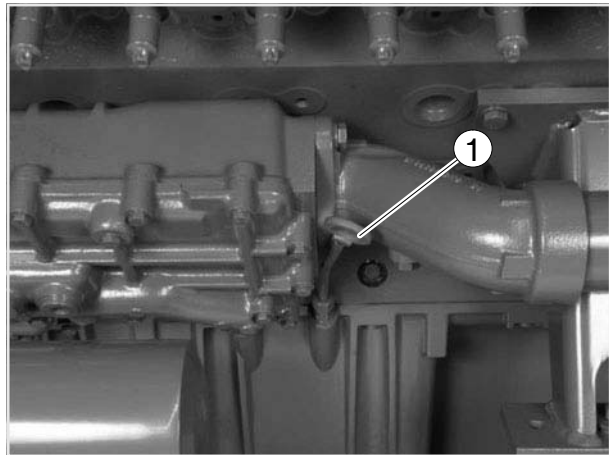
Check the oil level when the engine is horizontal and only after at least 20 minutes have passed since the engine was switched off.

1. Pull out oil dipstick (1).
2. Wipe off oil dipstick with a lint-free cloth.
3. Reinsert oil dipstick all the way.
4. Pull out oil dipstick again and check oil level.

The oil level should be between both of the marks on the dipstick and should never drop below the lower mark.

5. Reinsert the oil dipstick (1) all the way.

If the oil level is too low, refill with new oil.



8.4.2 Cleaning Fuel Prefilter



DANGER!

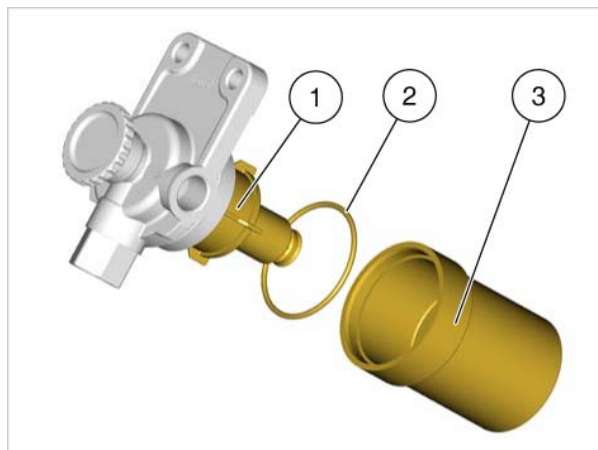
Fire hazard caused by uncontrolled fuel leakage

When opening the fuel system, fuel can leak out uncontrolled.

For this reason:

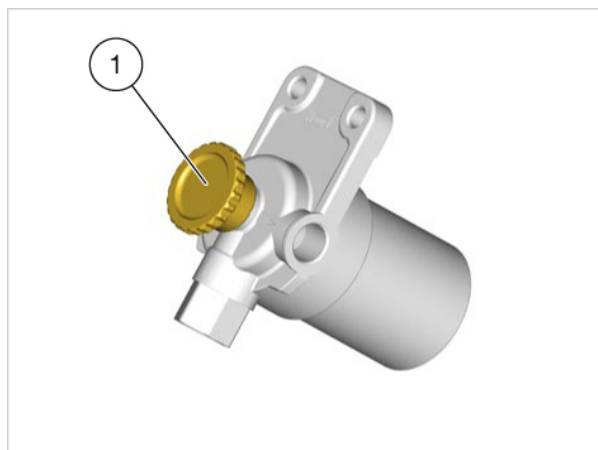
- Work carefully.
- Do not spill any fuel.

- 1 Close shutoff valves between engine and tank.
 2. Remove filter housing (3).
 3. Take off O-ring (2) from filter housing (3).
 4. Wash filter housing (3) and fine-mesh filter (1) in clean diesel fuel and blow off with compressed air.
 5. Screw filter housing (3) with fine-mesh filter (1) and new O-ring (2) onto the fuel prefilter housing.
 6. Tighten filter housing (3).
- Tightening torque 10 Nm
7. Bleed fuel prefilter.



Bleed Fuel Prefilter

1. Open shutoff valve between engine and tank.
2. Unscrew plunger (1) of hand pump.
3. Operate plunger (1) of hand pump until overflow valve audibly opens.
4. Screw on plunger (1) of hand pump again and tighten.
5. Check fuel prefilter for leaks.



Maintenance and Care

8.4.4 Changing Fuel Filter



DANGER!

Fire hazard caused by uncontrolled fuel leakage

When opening the fuel system, fuel can leak out uncontrolled.

For this reason:

- Work carefully.
- Do not spill any fuel.

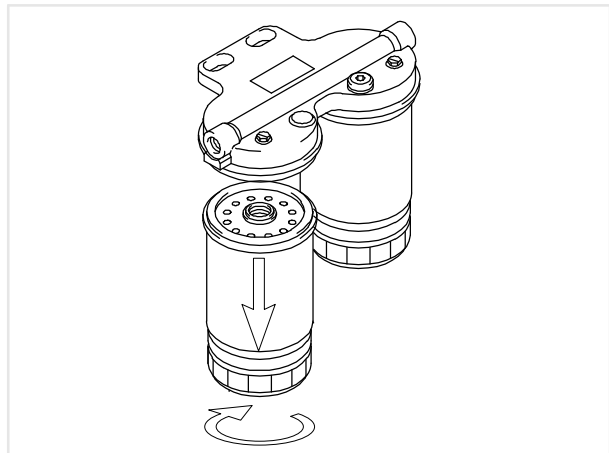
Fuel filter - Dual filter

- 1 Close shutoff valves between engine and tank.
2. Loosen filter cartridge using a strap wrench and remove
3. Apply fuel to seals of new filter cartridge
4. Install filter cartridge and tighten by hand

Tightening torque 25 Nm

The second filter element is changed in the same way.

5. Bleed fuel system, see page 64.



Fuel filter - dual filter, switchable**IMPORTANT!****Engine failure!**

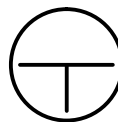
Danger of fuel supply blockage.

For this reason:

- Leave the oil flow lever set to continuous operation

For continuous operation, set the oil flow lever so that both halves of the filter are in operation. Observe the position of the oil flow lever!

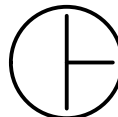
- 1 Close shutoff valves between engine and tank.
 - 2 Loosen filter cartridge using a strap wrench and remove
 - 3 Apply fuel to seals of new filter cartridge
 - 4 Install filter cartridge and tighten by hand
- Tightening torque 25 Nm
- The second filter element is changed in the same way.
- 5 Bleed fuel system, see page 64.



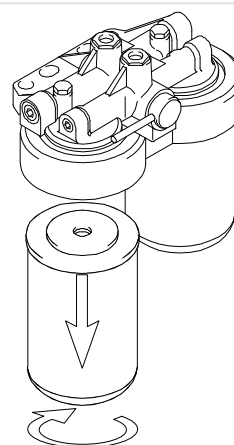
A continuous operation
(both halves of the filter
switched on)



Right side
shut off



Left side
shut off



Maintenance and Care

8.4.7 Bleeding the Fuel System



DANGER!

Fire hazard caused by uncontrolled fuel leakage

When opening the fuel system, fuel can leak out uncontrolled.

For this reason:

- Work carefully.
- Do not spill any fuel.

The filter head has an arrow marking the direction of fuel flow.

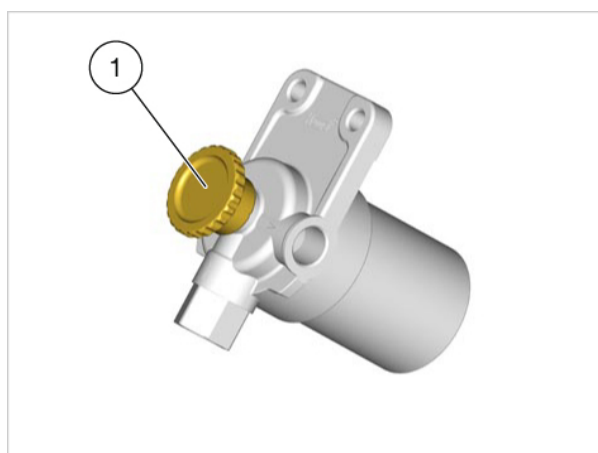
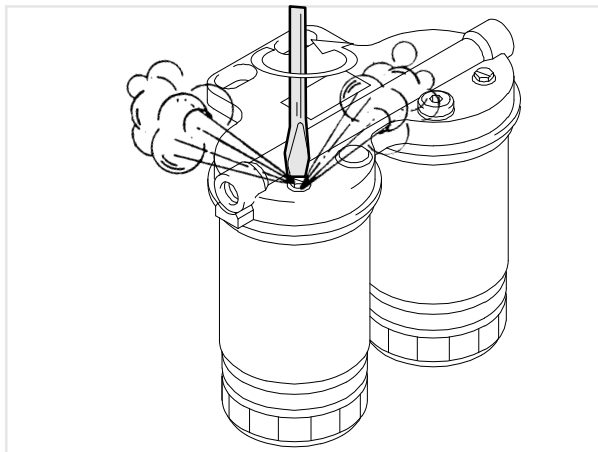
1. Switch on ignition.
2. Unscrew bleed screw of first filter in the direction of flow by two turns.
3. Unscrew plunger (1) of hand pump.
4. Operate plunger (1) of hand pump until fuel exits from the bleed screw with no bubbles.
5. Tighten bleed screw.

Tightening torque 25 Nm

6. Unscrew bleed screw of second filter in the direction of flow by two turns.

Repeat steps 3-5 for second filter.

7. Screw on plunger (1) of hand pump again and tighten.
8. Check fuel system for leaks.



8.4.8 Changing Coolant

Drain coolant



WARNING!

Risk of scalding!

The cooling system is under pressure and the coolant is hot.

For this reason:

- Let engine cool down first



NOTE!

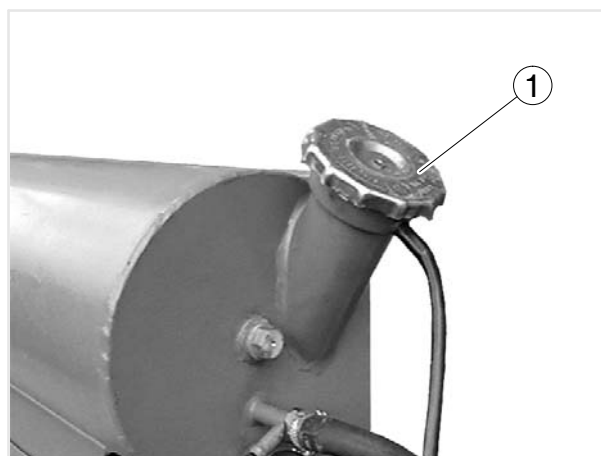
Do not let coolant spill while draining. Do not let coolant leak out onto the ground or into bodies of water otherwise this will damage the environment.



NOTE!

Repeat steps for other side.

1. Open cap (1) at filler neck of expansion reservoir.



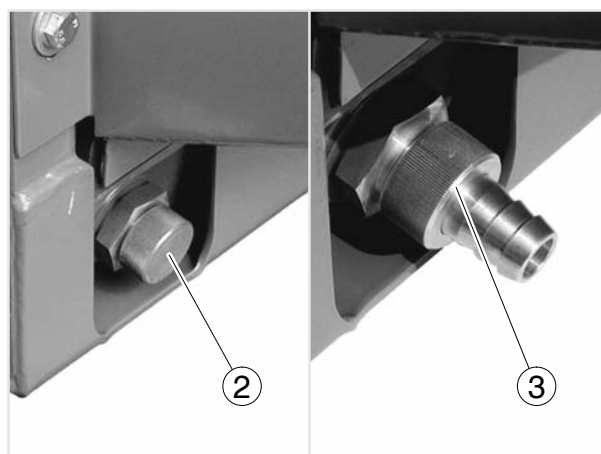
2. Remove protective cap (2) at the left on the bottom of the radiator tank.



NOTE!

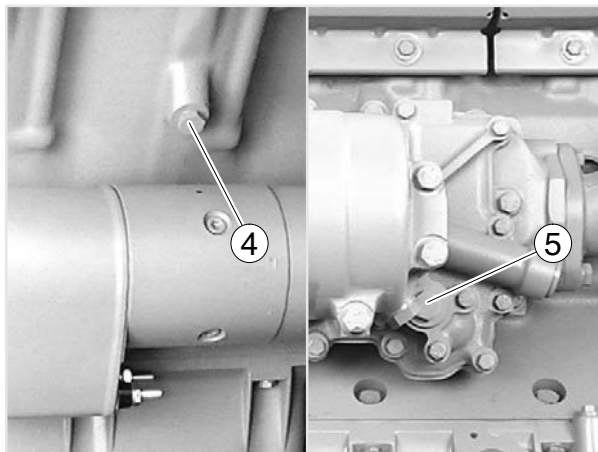
Use a container with sufficient capacity to drain coolant (at least 100 litres). This ensures that coolant will not overflow.

3. Install the supplied adapter (3). The sealing cone will open in the radiator and coolant can be drained through the adapter using a hose (inside diameter 20 mm).



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4. Open drain screw in crankcase (4) and in oil cooler housing (5).
5. Drain coolant.
6. Reinstall screw plug.
7. Fill/bleed cooling system.



Refilling Coolant



NOTE!

Do not let coolant spill while refilling. Do not let coolant leak out onto the ground or into bodies of water otherwise this will damage the environment.



IMPORTANT!

Engine damage caused by excessive temperature difference!

When refilling with cold coolant in an engine at operating temperature there is a risk of engine damage caused by excessive temperature difference.

For this reason:

- Do not fill with cold coolant.

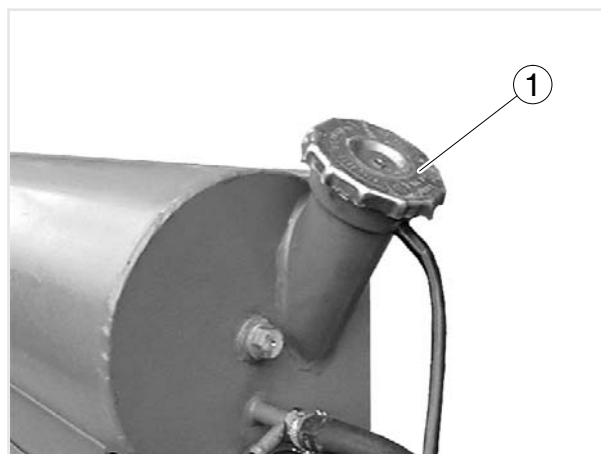
Fill the cooling system of the engine with a mixture of tap water and ethylene glycol antifreeze agent or anticorrosion agent.

Only use approved fluids and lubricants (see "Fluids and Lubricants ..." publication).

1. Remove cap (1) from expansion reservoir.
2. Slowly fill in coolant up to the lower edge of the filler neck.

Ensure that the ratio of "water to antifreeze" is correct.

3. Reinstall cap.
4. Let engine run for a short period and then recheck coolant level.



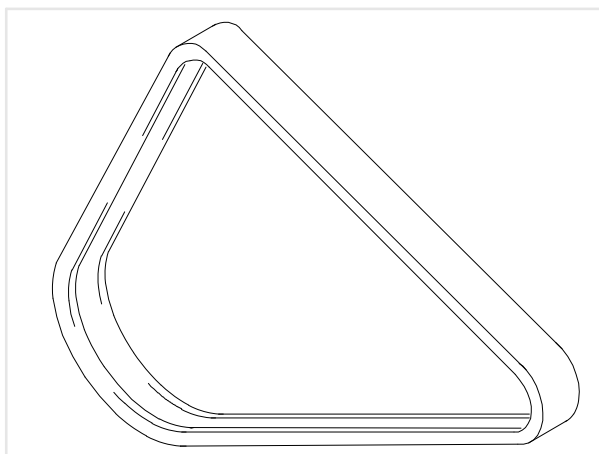
Maintenance and Care

8.4.9 Changing V-Belt

Check condition of V-belt

If any wear is detected or if, on multi-belt systems, the belts have different tensions, the entire poly-V-belt set is always to be exchanged.

1. Check V-belts for cracks, oil fouling, overheating and wear
2. Replace damaged V-belts.



Check V-belt tension

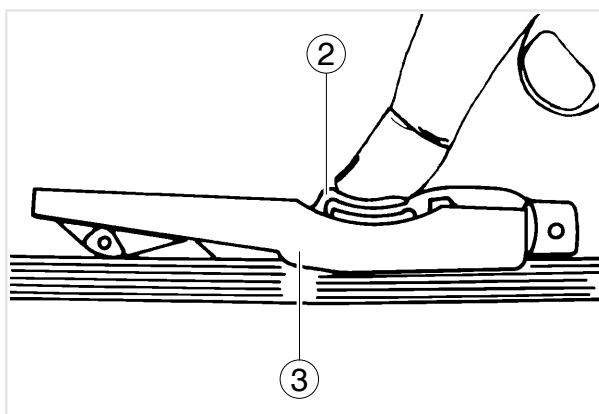
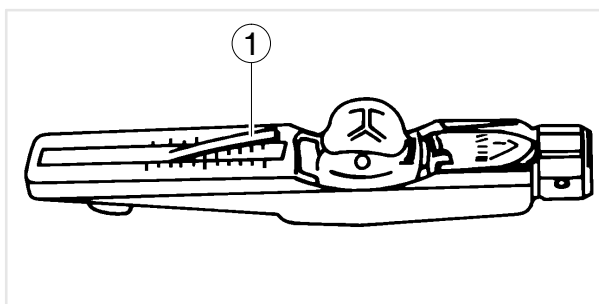
Use a poly-V-belt tension gauge to check the tension of the poly-V-belts.

1. Push pointer (1) down into the scale.
2. Place tension gauge in the middle between the two belt pulleys so that the edge of the contact surface (3) is flush with the V-belt.
3. Slowly press vertically down on the tab (2) until the spring audibly snaps out. The pointer will move to the top.

Do not press any further after the spring snaps out, otherwise a false reading will be given!

4. Read off the tension measurement where the top side of the pointer (1) overlaps the scale.
5. Make sure that the pointer remains in its position before reading off.

If the measurement does not match the prescribed adjustment value, the belt tension must be corrected.

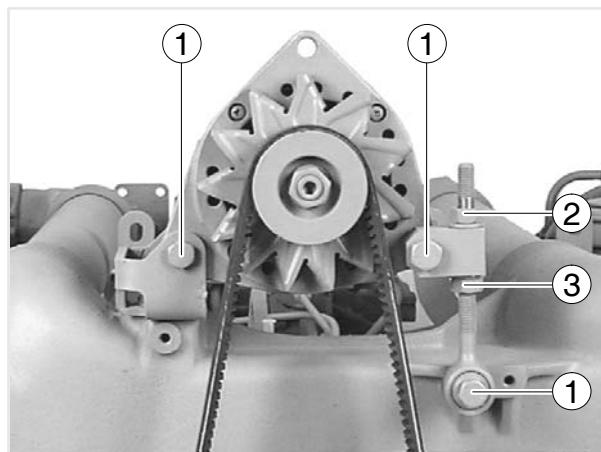


Tension forces in a cold state with a kg scale on gauge			
Belt width		2/3VX	4/3VX
For new installation	For installation	90-100	180-200
	After a 10 min. runtime	70-80	140-160
For maintenance	after a long runtime	60	120

Set tension and change V-belts**Alternator - top**

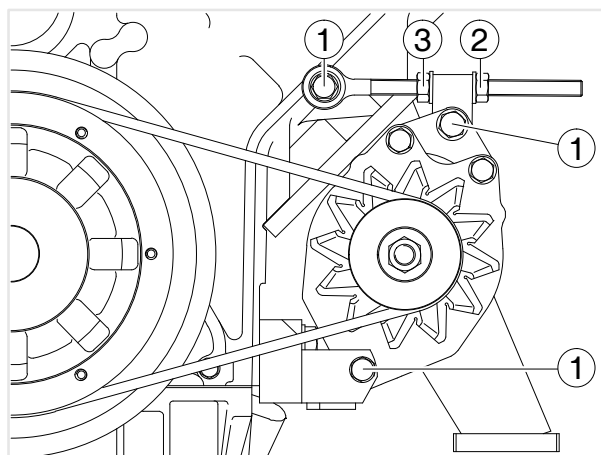
1. Loosen mounting bolt (1)
2. Loosen jam nut (2)
3. Set adjustment nut (3) until belt has the correct tension
4. Retighten jam nut and mounting bolt

To change belt loosen adjustment nut (3) and swivel alternator to the inside.

**Alternator - lower right**

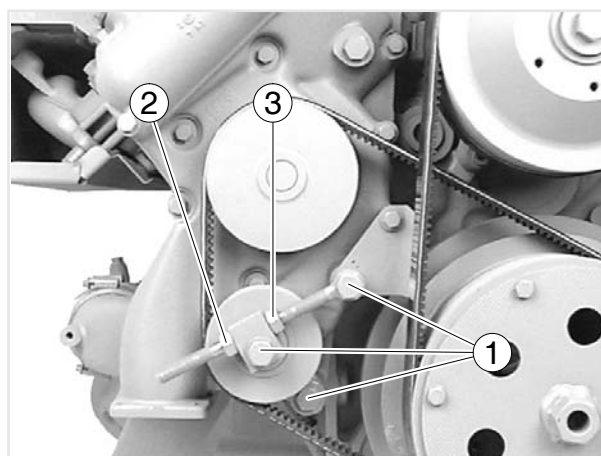
1. Loosen mounting bolt (1)
2. Loosen jam nut (2)
3. Set adjustment nut (3) until belt has the correct tension
4. Retighten jam nut and mounting bolt

To change belt remove fan, loosen adjustment nut (3) and swivel alternator to the inside.

**Crankshaft - Coolant pump - Tensioner pulley**

1. Loosen mounting bolt (1).
2. Loosen jam nut (2).
3. Set adjustment nut (3) until belt has the correct tension.
4. Retighten jam nut and mounting bolt.

To change belt remove fan, loosen adjustment nut (3) and swivel tensioner pulley to the inside.



Maintenance and Care

Crankshaft - Coolant pump - Tensioner pulley

1. Loosen mounting bolt (1).
2. Turn adjustment screw (2) clockwise until belt has the correct tension
- 3 Retighten mounting nuts (1)

To change the belt, turn adjustment screw (2) counter clockwise.



9 Faults

The following chapter describes the possible faults which can occur and the work to correct them.

For those faults that cannot be rectified by the following information, contact the manufacturer of the entire system or MAN.

9.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.

Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

9.2 Safety Instructions

Personnel

- Engine faults may only be rectified by specially trained qualified personnel or by the manufacturer.

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Safety Shoes
- Safety Gloves

Ground rules



WARNING!

Risk of injury caused by improper rectification of faults!

Improper rectification of faults can cause serious injuries or considerable property damage.

For this reason:

- Ensure that the engine cannot be started by unauthorised persons.
- Ensure adequate work space before starting any work.
- Make sure work space is kept clean and orderly! Any unused parts or components lying around are potential sources of accidents.

9.3 Fault Table

The "Remedy" column is only filled in when it is not clear from the "probable cause" what needs to be done.

Fault	Possible cause	Remedy
Engine does not start	- Fuel tank empty - Fuel valve shut off - Air in fuel system - Fuel lines leak, broken or clogged - Fuel filter/prefilter clogged - Condensation in fuel - Air filter clogged - Exhaust clogged (exhaust back pressure too high) - Electric circuit interrupted - Battery dead - Starter/solenoid switch faulty - Injectors clogged - Valves do not close or are stuck - Crank assembly is externally blocked - Inner engine damage (piston seizure, possibly caused by water in fuel)	- Drain water from fuel filter and tank - Set main switch to "on" - Set transmission shift lever to "N" - Replace faulty fuses - Repair any loose, corroded and broken wires and contacts - See information at "Starter" - Remove objects that interfere with the movement of the fan, power output, alternator, etc.
Engine starts but does not reach idle speed or stalls	- Power take-off is on - Fuel filter clogged - Fuel grade does not meet the specifications or is contaminated - Air filter clogged	See "Fluids and Lubricants...."
Engine does not start or poorly starts in warmed up condition	- Engine shutoff faulty - Insufficient compression in cylinder or more than 3-4 bar pressure difference between the cylinders	
Engine does not start or poorly starts in cold condition	Fuel filter clogged with paraffin	Replace filter.
Rough idle with engine warm, misfires	- Air in fuel system - Fuel lines leak, broken or clogged - Fuel filter clogged - Lower idle speed is set too low - Valve clearance not OK - Injectors or injection lines leak - Turbocharger faulty - Insufficient compression in cylinder or more than 3-4 bar pressure difference between the cylinders	Help from the manufacturer service

Fault	Possible cause	Remedy
Engine speed fluctuations during operation	● Not enough fuel in tank ● Air in fuel system ● Tachometer faulty ● Injectors faulty	
Poor performance	● Too much power is demanded from the engine than it can produce ● Air in fuel system ● Fuel filter/air filter clogged ● Fuel grade does not meet the regulations ● Insufficient fuel supply ● Oil level in oil pan too high ● Exhaust pipe clogged ● Air intake pipe leaks ● Turbocharger leaks or faulty ● Insufficient compression in cylinder or more than 3-4 bar pressure difference between the cylinders ● Rated speed incorrectly set	● See "Fluids and Lubricants..." ● Fuel feed pump worn or faulty ● Check whether the guide tube is correctly installed and the correct oil dipstick is being used ● If coolant or fuel is discovered in the engine oil, check cylinder head gasket, cylinder liner gasket and piston rings
Coolant temperature too high, loss of coolant	● Coolant level too low ● Air in coolant circuit ● Radiator very dirty, fins clogged ● V-belt for coolant pump not correctly tightened (slips) ● Cap with work valves on expansion reservoir/radiator is faulty or leaks ● Temperature display faulty ● Coolant pump leaks, defective (bearing damage) ● Thermostat faulty, does not open ● Coolant lines leak, clogged or twisted	
Lube-oil pressure too low	● Oil level in oil pan too low ● Engine temperature too high ● Oil filter clogged ● Oil pressure indicator faulty ● Selected oil viscosity is inappropriate for ambient temperature (too thin) ● Oil in oil pan is too thin (contains condensation or fuel) ● Bearing heavily worn ● Oil pump gears heavily worn ● Safety valve in oil circuit faulty (does not close, spring is worn or broken)	● See "Fluids and Lubricants..."

Fault	Possible cause	Remedy
Lube-oil pressure too high	● Engine cold ● Selected oil viscosity is inappropriate for ambient temperature (too thick) ● Oil pressure indicator faulty ● Safety valve in oil circuit faulty (does not open) ● Oil lines/oil ducts clogged	● See "Fluids and Lubricants..."
Lube-oil consumption too high	● Lube-oil quality does not meet the regulations ● Oil level in oil pan too high ● Leaks in lube-oil circuit especially at the turbocharger and oil cooler ● Piston rings heavily worn ● Valve stems heavily worn, bent	● See "Fluids and Lubricants..." ● Check whether the guide tube is correctly installed and the correct oil dipstick is being used ● If coolant or fuel is discovered in the engine oil, check cylinder head gasket, cylinder liner gasket and piston rings
Fuel consumption too high	● Fuel grade does not meet the regulations ● Fuel loss due to leaks in system ● Valve seat leaks	● See "Fluids and Lubricants..."
Black smoke accompanied by loss of power	● Air filter clogged ● Air intake duct leading to turbocharger leaks ● Exhaust clogged (exhaust back pressure too high) ● Turbocharger faulty ● Intercooler leaks, faulty ● Injectors faulty, carbonised	● Help from the manufacturer service
Blue smoke	● Engine/coolant/intake air still too cold ● Lube oil penetrates into combustion chamber (pistons/piston rings worn or piston rings broken) ● Valve stem/guide worn ● Overpressure in crankcase (crankcase ventilation system clogged)	
White smoke	● Engine/coolant/intake air still too cold ● Fuel tank empty ● Air in fuel system ● Fuel lines leak, broken or clogged ● Coolant penetrates into combustion chamber (cylinder head/gasket leaks) ● Fuel filter clogged ● Fuel grade does not meet the regulations ● Injectors faulty	● See "Fluids and Lubricants..."

Fault	Possible cause	Remedy
Engine knocking	● Engine not at correct operating temperature ● Valve clearance not OK ● Valves stick ● Piston pin or crankshaft bearing loose ● Piston ring broken	● Let engine warm to operating temperature before running at full load ● Check thermostat
Engine too "loud"	● Intake or exhaust pipe leaks ● Timing gears worn, gear backlash too large ● Valve clearance too large ● Turbine and compressor impeller in turbocharger dirty (rough running, out of balance) ● Poly-V-belt slips	● Help from the manufacturer service

Starter

Fault	Possible cause	Remedy (This column is only filled in when it is not clear from the "probable cause" what needs to be done)
- Pinion gear does not turn or turns slowly - Pinion gear does not engage - Pinion gear engages, but stops turning - Pinion gear continues to turn after starter switch is released - Pinion gear does not disengage after engine starts	- Battery has insufficient charge - Terminal is loose, oxidised, poor connection to ground - Starter terminal or carbon brushes are short circuited to ground - Carbon brushes stick or have poor contact - Pinion gear or starter ring gear are very dirty or damaged - Solenoid switch faulty - Overrunning clutch slips - Starter switch faulty - Solenoid switch faulty - Starter faulty	To be repaired by a vehicle electrician or by the manufacturer service Immediately shut down engine

10 Decommissioning and Recommissioning

10.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.

Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Safety Shoes
- Safety Gloves

10.2 Safety Instructions

Personnel

- Decommissioning and recommissioning of the engine may only be made by trained and qualified personnel.

Ground Rules



WARNING!

Risk of injury caused by improper work.

Improper work can cause serious injuries or considerable property damage.

For this reason:

- Ensure that the engine cannot be started by unauthorised persons.
- Perform all work steps in accordance with the instructions in these Operating Instructions.
- Ensure adequate work space before starting any work.
- Make sure work space is kept clean and orderly! Any unused parts or components lying around are potential sources of accidents.

Decommissioning and Recommissioning

10.3 Temporary Decommissioning of Engines

Temporary anticorrosion protection according to MAN works norm M 3069 is required for engines which are to be put out of service depending on the duration.

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



NOTE!

A proper and careful recommissioning of new or operated engines has a great impact on the operating safety and remaining life of the engines.

In general the goal is to preserve the decommissioned engines or new engines (after the factory tests).

If the engine was not preserved before decommissioning, there is a risk that the cylinder liners, piston rings and valves will corrode, especially when the intake and exhaust opening are not closed off or when the engine is stored in the open.

Foreign matter, rain water and similar conditions require a complete disassembly of the engine.

10.4 Recommissioning of Decommissioned Engines

10.4.1 Commissioning of Preserved Engines according to MAN-Werknorm M 3059

1. Remove external preservation. Never use a high pressure cleaner for this.
2. Remove caps from intake and exhaust openings.
3. Check cooling system; add antifreeze according to the Fluids and Lubricants list (see "Fluids and Lubricants ..."); check concentration and correct.
4. Check engine oil level and add fresh approved engine oil if necessary.
5. Fill fuel, bleed system.
Check the operation of the monitoring and emergency shut off equipment.
6. Check condition and proper installation of elastic fasteners, such as V-belts, coolant hoses and charge air hoses. Retighten if necessary.
7. Rotate engine with fuel supply turned off until oil pressure builds up. Operate starter no more than 5 seconds for this.
8. Open fuel supply and start engine. After engine is running, operate engine above idle speed to avoid insufficient lubrication of the cylinder liners.
9. Check engine for leaks, unusual noises and observe the oil pressure and all temperatures. Increase engine speed in steps.
10. After a max. of 25 operating hours, drain preservation oil from engine and change oil filter; fill engine with fresh approved engine oil.

10.4.2 Commissioning of Non-Preserved Engines

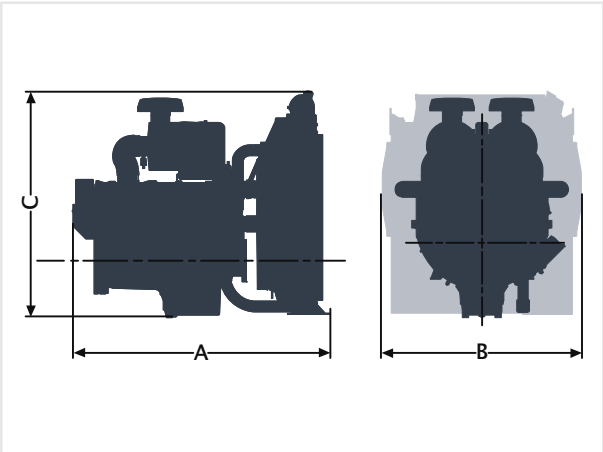
In addition to the work steps for a preserved engine, the commissioning of a non-preserved engine requires the following extra work depending on the possible nonuse damages.

1. Check combustion chambers with an endoscope, to do this, remove/install injectors.
Check valve for easy movement; check valve clearance and adjust if necessary.
Replace any damaged/corroded parts.
2. Drain old oil from engine and change oil filter. Fill engine with fresh approved engine oil.
3. Check cooling system for corrosion; check coolant for proper concentration; if in doubt, change coolant. Before adding new coolant, clean coolant chambers and remove/install coolant pump and thermostat if necessary; replace the slide ring seal of the coolant pump and thermostat elements; pressure test cooling system.
4. Check clean air system, air filter and turbocharger for dirt and corrosion. Clean or repair if necessary.
5. Clean fuel system and drain old fuel if necessary. Clean/check/replace filter.

11 Technical Data

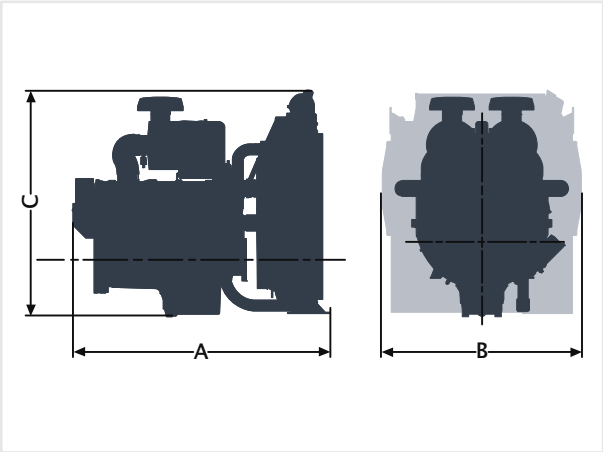
11.1 Dimensions and Weights

11.1.1 D2848 LE201/203/211/213



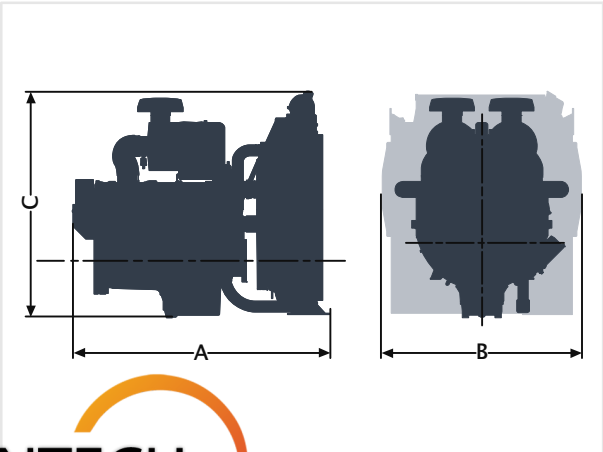
Specification	Value	Unit
Weight (dry)	1250	kg
A	1850	mm
B	1400	mm
C	1700	mm

11.1.2 D2840 LE201/203/211/213



Specification	Value	Unit
Weight (dry)	1480	kg
A	2125	mm
B	1600	mm
C	1826	mm

11.1.3 D2842 LE201/203/211/213



Specification	Value	Unit
Weight (dry)	1770	kg
A	2342	mm
B	1638	mm
C	1845	mm



11.2 Installation Location and Space Requirements

Observe the information in the Assembly Instructions.

Carefully read the Operating Instructions before starting any work!
This is especially valid for the chapter on General Safety Instructions
and the safety instructions in each of the chapters.



11.3 Engine Data

11.3.1 D2848 LE201/203/211/213

Model	D 2848 LE 201 / 203 / 211 / 213	
Design	V 90°	
Operating Principle	4-cycle diesel engine with turbocharging and charge air cooling	
Combustion system	Direct injection	
Charging	Turbocharger with charge air cooling	
Number of cylinders	8	
Bore	128 mm	
Stroke	142 mm	
Displacement	14,620 cm ³	
Compression ratio	15.5 : 1	
Rating	See engine model plate	
Firing order	1-5-7-2-6-3-4-8	
Valve clearance (cold engine)		
Intake	0.50 mm	
Exhaust	0.60 mm	
Valve timing		
Intake opens	24° before TDC	
Intake closes	36° after TDC	
Exhaust opens	63° before TDC	
Exhaust closes	27° after TDC	
Fuel system		
Injection pump	In-line injection pump with saddle mount	
Governor	Electronic rpm governor (GAC)	
Injection nozzles	6-hole nozzles	
Opening pressure of nozzles		
Nozzle holder, new:	295 + 8 bar	
Nozzle holder, worn:	280 + 8 bar	
Start of delivery ± 1° KW before TDC (constant rotational speed = no injection timing device)		
D 2848 LE 201	BE optimised	NO _x optimised
1500 rpm , continuous	14°	10°
1800 rpm, continuous	14°	12°
D 2848 LE 203		
1500 rpm , continuous	12°	12°
1800 rpm, continuous	14°	14°

D 2848 LE 211	
1500 rpm , continuous	12°
1800 rpm, continuous	12°
D 2848 LE 213	
1500 rpm , continuous	12°
1800 rpm, continuous	14°
Engine lubrication	Force feed lubrication
Oil capacity in oil sump (litres)	min. max.
shallow	20 l 24 l
depth	12 l 18 l
Oil change quantity (with filter)	
shallow	27 l
depth	21 l
Lubrication oil pressure during operation (depends on engine speed, oil temperature and engine load)	must be monitored by oil pressure monitors/ gauges
Oil filter	Full-flow filter with paper filter elements
Engine cooling system	Liquid cooling
Coolant temperature	
D 2848 LE 201 / 211	80-90°C, 95°C permissible temporarily
D 2848 LE 203 / 213	90-100°C, 105°C permissible temporarily
Electrical equipment	
Starter	24 V; 6.5 KW
Alternator	28 V; 35 or 55 A

11.3.2 D2840 LE201/203/211/213

Engine model	D 2840 LE 201 / 203 / 211 / 213	
Design	V 90°	
Operating Principle	4-cycle diesel engine with turbocharging and charge air cooling	
Combustion system	Direct injection	
Charging	Turbocharger with charge air cooling	
Number of cylinders	10	
Bore	128 mm	
Stroke	142 mm	
Displacement	18,270 cm ³	
Compression ratio	15.5 : 1	
Rating	See engine model plate	
Firing order	1-6-5-10-2-7-3-8-4-9	
Valve clearance (cold engine)		
Intake	0.50 mm	
Exhaust	0.60 mm	
Valve timing		
Intake opens	24° before TDC	
Intake closes	36° after TDC	
Exhaust opens	63° before TDC	
Exhaust closes	27° after TDC	
Fuel system		
Injection pump	In-line injection pump with saddle mount	
Governor	Electronic rpm governor (GAC)	
Injection nozzles	6-hole nozzles	
Opening pressure of nozzles		
Nozzle holder, new:	295 + 8 bar	
Nozzle holder, worn:	280 + 8 bar	
Start of delivery ± 1° KW before TDC (constant rotational speed = no injection timing device)		
D 2840 LE 201	BE optimised	NO _x optimised
1500 rpm , continuous	15°	7°
1800 rpm, continuous	14°	11°
D 2840 LE 203		
1500 rpm , continuous	15°	12°
1800 rpm, continuous	16°	11°

D 2840 LE 211	
1500 rpm , continuous	12°
1800 rpm, continuous	14°
D 2840 LE 213	
1500 rpm , continuous	12°
1800 rpm, continuous	14°
Engine lubrication	Force feed lubrication
Oil capacity in oil sump (litres)	min. max.
shallow	26 l 30 l
deep (pan at front)	24 l 30 l
deep (enlarged)	30 l 70 l
Oil change quantity (with filter)	
shallow	33 l
deep (pan at front)	33 l
deep (enlarged)	73 l
Lubrication oil pressure during operation (depends on engine speed, oil temperature and engine load)	must be monitored by oil pressure monitors/ gauges
Oil filter	Full-flow filter with paper filter elements
Engine cooling system	Liquid cooling
Coolant temperature	
D 2840 LE 201 / 211	80-90°C, 95°C permissible temporarily
D 2840 LE 203 / 213	90-100°C, 105°C permissible temporarily
Electrical equipment	
Starter	24 V; 6.5 KW
Alternator	28 V; 35 or 55 A

11.3.2 D2842 LE201/203/211/213

Engine model	D 2842 LE 201 / 203 / 211 / 213	
Design	V 90°	
Operating Principle	4-cycle diesel engine with turbocharging and charge air cooling	
Combustion system	Direct injection	
Charging	Turbocharger with charge air cooling	
Number of cylinders	12	
Bore	128 mm	
Stroke	142 mm	
Displacement	21,930 cm ³	
Compression ratio	15.5 : 1	
Rating	See engine model plate	
Firing order	1-12-5-8-3-10-6-7-2-11-4-9	
Valve clearance (cold engine)		
Intake	0.50 mm	
Exhaust	0.60 mm	
Valve timing		
Intake opens	24° before TDC	
Intake closes	36° after TDC	
Exhaust opens	63° before TDC	
Exhaust closes	27° after TDC	
Fuel system		
Injection pump	In-line injection pump with saddle mount	
Governor	Electronic rpm governor (GAC)	
Injection nozzles	6-hole nozzles	
Opening pressure of nozzles		
Nozzle holder, new:	295 + 8 bar	
Nozzle holder, worn:	280 + 8 bar	
Start of delivery ± 1° KW before TDC (constant rotational speed = no injection timing device)		
D 2842 LE 201	BE optimised	NO _x optimised
1500 rpm , continuous	15°	7°
1800 rpm, continuous	17°	12°
D 2842 LE 203		
1500 rpm , continuous	15°	10°
1800 rpm, continuous	17°	15°

D 2842 LE 211	
1500 rpm , continuous	15°
1800 rpm, continuous	16°
D 2842 LE 213	
1500 rpm , continuous	12°
1800 rpm, continuous	16°
Engine lubrication	Force feed lubrication
Oil capacity in oil sump (litres)	min. max.
half deep	22 l 30 l
depth	24 l 32 l
deep (land assembly)	40 l 90 l
deep (on-board assembly)	60 l 70 l
Oil change quantity (with filter)	
half deep	33 l
depth	35 l
deep (land assembly)	93 l
deep (on-board assembly)	73 l
Lubrication oil pressure during operation (depends on engine speed, oil temperature and engine load)	must be monitored by oil pressure monitors/ gauges
Oil filter	Full-flow filter with paper filter elements
Engine cooling system	Liquid cooling
Coolant temperature	
D 2842 LE 201 / 211	80-90°C, 95°C permissible temporarily
D 2842 LE 203 / 213	90-100°C, 105°C permissible temporarily
Electrical equipment	
Starter	24 V; 6.5 KW
Alternator	28 V; 35 A, 55 A or 80 A

Attachment to the EG-Declaration of Installation

Number Appendix I	Description	Applicable	Satisfied	Remarks
1.	Fundamental health and safety requirements			
1.1.2.	Basis for the integration of safety	☒	☒	
1.1.3.	Materials and Products	☒	☒	
1.1.4.	Lighting	☒	☒	
1.1.5.	Construction of the machine with regard to handling	☒	☒	
1.1.6.	Ergonomics	☒	☒	
1.1.7.	Operating positions	☐	☐	
1.1.8.	Seats	☐	☐	
1.2.	Controls and command devices	☒	☒	
1.2.1.	Safety and reliability of controls	☐	☐	
1.2.2.	Operating elements	☐	☐	
1.2.3.	Setting into operation	☐	☐	
1.2.4.	Shutdown	☐	☐	
1.2.4.1.	Normal shutdown	☐	☐	
1.2.4.2.	Operationally-conditioned shutdown	☐	☐	
1.2.4.3.	Shutdown in Emergency	☐	☐	
1.2.4.4.	Totality of machines	☐	☐	except
1.2.5.	Selection of the control and operating modes	☐	☐	except
1.2.6.	Failure of power supply	☐	☐	
1.3.	Protective measures against mechanical dangers	☐	☐	
1.3.1.	Risk of toppling	☒	☒	
1.3.2.	Risk of fracture during operation	☒	☒	
1.3.3.	Risks due to falling or impacted objects	☒	☒	
1.3.4.	Risks due to surfaces, edges and corners	☒	☒	
1.3.5.	Risks due to the combination of a number of machines	☐	☐	
1.3.6.	Risks due to changes in the conditions of use	☒	☒	
1.3.7.	Risks due to moving parts	☒	☒	
1.3.8.	Selection of the protective devices against risks due to moving parts	☒	☒	
1.3.8.1.	Moving parts of the power transfer system	☐	☐	
1.3.8.2.	Moving parts, which are involved in the work process	☐	☐	
1.3.9.	Risk of uncontrolled movement	☒	☒	
1.4.	Requirements for protective devices	☒	☒	
1.4.1.	General requirements	☐	☐	
1.4.2.	Special requirements for separative protective devices	☐	☐	
1.4.2.1.	Fixed separative protective devices	☐	☐	
1.4.2.2.	Moving separative protective devices with locking	☐	☐	
1.4.2.3.	Access-restricting adjustable protective devices	☐	☐	
1.4.2.4.	Requirements for non-separative protective devices	☐	☐	
1.5.	Risks due to other dangers	☐	☐	
	Electrical power supply	☐	☐	

Declaration of incorporation

Number Appendix I	Description	Applicable	Satisfied	Remarks
1.5.2.	Static electricity	☐	☐	
1.5.3.	Non-electrical power supply	☐	☐	
1.5.4.	Assembly faults	☐	☐	
1.5.5.	Extreme temperatures	☒	☒	
1.5.6.	Fire	☒	☒	
1.5.7.	Explosion	☒	☒	
1.5.8.	Noise	☒	☒	
1.5.9.	Vibration	☒	☒	
1.5.10.	Radiation	☐	☐	
1.5.11.	External radiation	☐	☐	
1.5.12.	Laser radiation	☐	☐	
1.5.13.	Emission of dangerous materials and substances	☒	☒	
1.5.14.	Risk, of becoming locked in a machine	☐	☐	
1.5.15.	Risks of tripping, slipping and falling	☒	☒	
1.5.16.	Lightning strike	☐	☐	
1.6.	Repair	☒	☒	
1.6.1.	Maintenance of the machine	☐	☐	
1.6.2.	Access to the operating stands and to the access points for maintenance	☐	☐	
1.6.3.	Separation of the energy sources	☐	☐	
1.6.4.	Intervention by operating personnel	☐	☐	
1.6.5.	Cleaning internal machine parts	☐	☐	
1.7.	Information	☒	☒	
1.7.1.	Information and warning notes on the machine	☐	☐	
1.7.1.1.	Information and information devices	☐	☐	
1.7.1.2.	Warning devices	☐	☐	
1.7.2.	Warnings concerning residual risks	☐	☐	
1.7.3.	Identification of the machines	☐	☐	
1.7.4.	Operating instruction	☐	☐	
1.7.4.1.	General principles for the composition of the operating instructions	☐	☐	
1.7.4.2.	Content of the operating instructions	☐	☐	
1.7.4.3.	Sales publications	☐	☐	