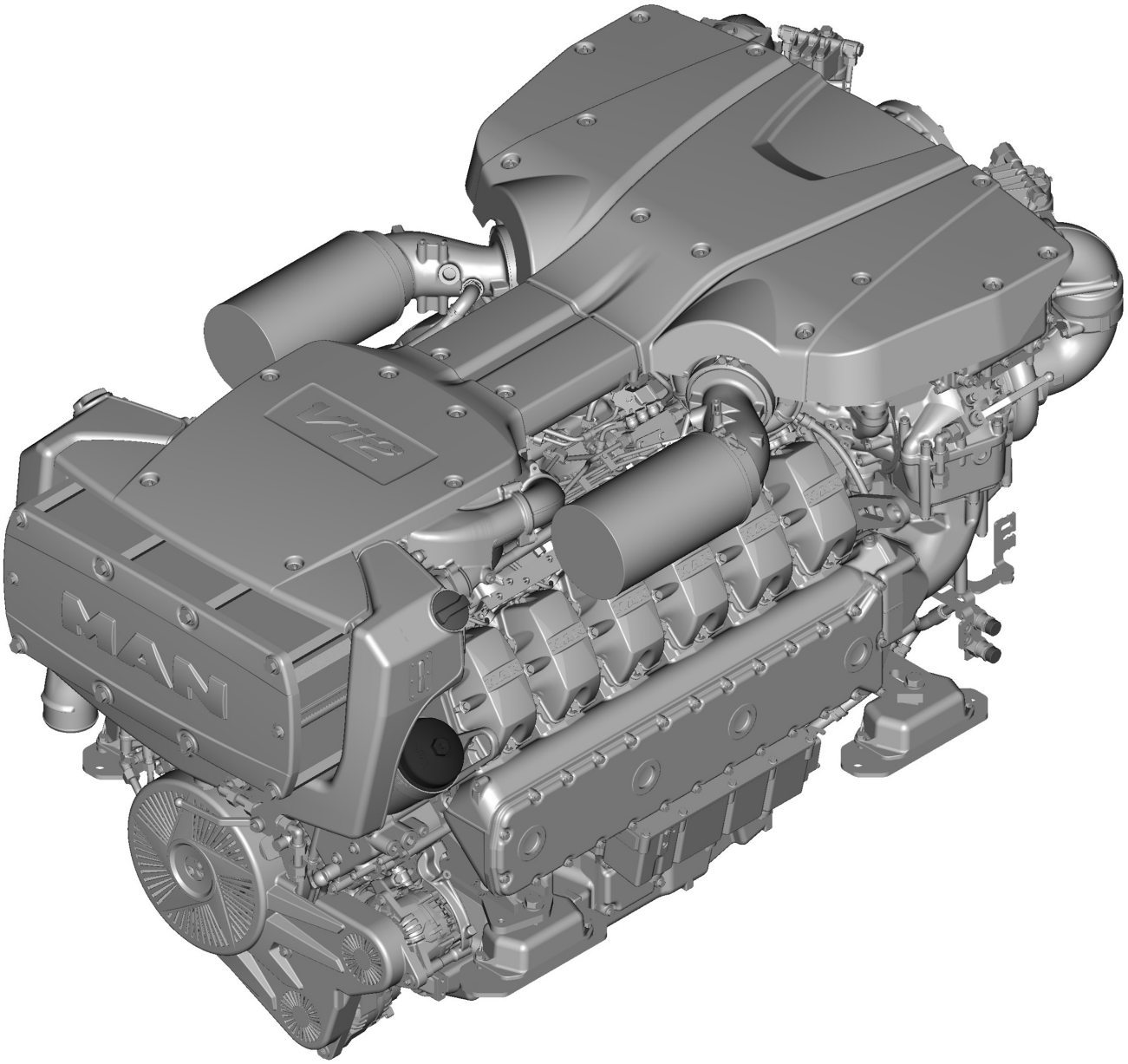


Operating Instruction

MAN Marine Diesel Engines V8/V12

Light Duty - unclassified

MAN Engines
A Division of MAN Truck & Bus

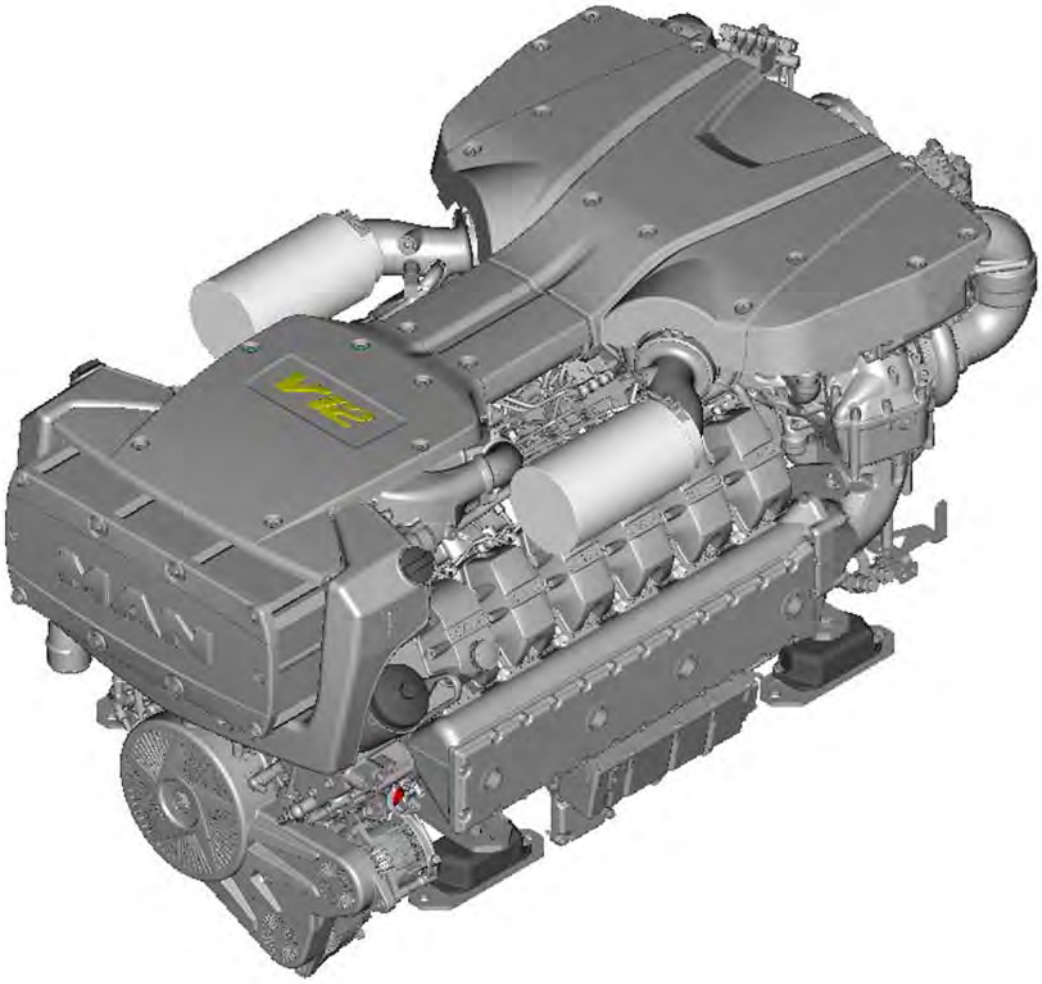
Installation and Operating Instructions

MAN Marine Diesel Engines

for light duty, not classified

V8-1000, V8-1200
V12-1400, V12-1550, V12-1650, V12-1800, V12-1900

Emission Status EPA-Tier 3



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Version 03

“Translation of the original instructions“

Printer's imprint

Subject to technical alterations in the interests of further development.

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Carefully read through the Operating Instructions Manual before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

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Carefully read through the Operating Instructions before starting any work!
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Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

1 Foreword

1.1 Information about these instructions

User tip

This provisional version of the instructions reflects the engine's current state of development.
This instructions therefore contain graphic representations of the MAN marine engine on which these instructions are based.

These instructions contain information on the installation, operation and maintenance of the engine.

All safety instructions and other instructions must be followed in order to ensure safe working practices.

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.

Only use genuine MAN spare parts and accessories or spare parts and accessories that have been approved by MAN. Only the genuine spare parts approved by us are tested by us and thus meet the relevant requirements for use of the engine.

The improvement of the protection of the environment is of special concern to MAN.
This starts with the development and construction of our engines. So we take great care to ensure that no environmentally damaging materials are used in this process and also, for example, that emission values satisfy the most stringent requirements.

Economical operation helps to conserve our resources and our environment.

1.1.1 Supplementary documents to these instructions

Supplementary documents to these instructions include:
- Service products for MAN diesel engines
- Maintenance record

All publications are a component of the product and must be kept in a location in the immediate vicinity of the engine and accessible by personnel at all times.

Carefully read through the Operating Instructions before starting any work! This particularly applies to the General Safety Instructions section and the safety instructions in the various chapters.

Failure to adhere to these instructions and all accompanying supplier operating instructions will lead to the loss of claims under the warranty.

1.1.2 Other relevant publications

The following publications also supplement these instructions:

- Spare Parts Catalogue (included)

1.2 Explanation of symbols

Warnings

Warnings in these instructions are indicated by symbols. The instructions are preceded by signal words that indicate the extent of the danger.

Always follow the instructions and proceed cautiously to prevent accidents, injury and damage.

DANGER

Describes an immediately dangerous situation that can lead to serious injury or death if it is not avoided.

WARNING

Describes a potentially dangerous situation that can lead to serious injury or death if it is not avoided.

CAUTION

Describes a potentially dangerous situation that can lead to minor or moderate injury if it is not avoided.

NOTE

Describes a potentially dangerous situation that can lead to damage if it is not avoided.

Tips and Recommendations

User tip

Tips and recommendations as well as information for efficient and trouble-free operation.

ENVIRONMENTAL NOTE

Tips for dealing with the topic of environmental protection.

General instructions

- This symbol indicates a first-level list.
- This symbol indicates a second-level list.

1. This symbol indicates an action/series of actions.

1 This symbol indicates a graphic item in the text.

Diese Anleitung vor Beginn aller Arbeiten sorgfältig durchlesen!
Dies gilt insbesondere für das Kapitel Allgemeine Sicherheitshinweise
und die jeweiligen Sicherheitshinweise in den Kapiteln.

1.3 Limitation of liability

All information and statements in these instructions have been compiled with due consideration of the applicable standards and regulations, the state of the art and also our many years of experience and our knowledge.

MAN accepts no liability for damage caused by:

- Failure to follow these instructions
- Non-intended use
- Employment of non-trained personnel
- Unauthorised conversions/alterations
- Technical changes
- Use of non-approved spare parts and fuels, lubricants and coolants

The actual scope of supply may differ from the explanations and representations described here in the case of special versions, if additional order options are selected or due to the latest technical modifications.

The obligations agreed in the supply contract, MAN's general terms and conditions and the legal regulations in force at the time the contract is signed all apply.

1.4 Notes on EPA Regulations

NOTE

Violation of federal law 40CFR 1068.105(b)

Therefore:

- Failing to follow these instructions when installing a certified engine in a vessel violates federal law 40CFR 1068.105(b) and is subject to fines or other penalities as described in the Clean Air Act.

1.5 Copyright

The installation and operating instructions are to be treated as confidential. They are intended solely for personnel who handle the engine.
Forwarding of the instructions to third parties is not permitted without the written approval of MAN.

User tip

The contents, texts, drawings, graphics and other representations are protected by copyright and subject to industrial property rights.
Improper use is a punishable offence.

1.6 Other applicable documentation

Supplied components (e.g. injection system) are installed in the engine. The suppliers concerned have performed risk assessments on these bought components.
The component suppliers have declared the design's compliance with the applicable European and national regulations.

1.7 Spare parts

Only use genuine MAN spare parts and accessories or spare parts and accessories that have been approved by MAN. Only the genuine spare parts approved by us are tested by us and thus meet the relevant requirements for use of the engine.

Spare parts and accessories must be either genuine MAN parts or parts approved expressly by MAN. The reliability, safety and suitability of these parts have been determined specifically for engines. Despite constant market observation, we cannot judge the aspects of other products, nor can we accept responsibility for them.

WARNING

Risk of injury due to use of incorrect spare parts
Incorrect or defective spare parts can lead to damage, malfunction or total failure and impair safety.

Therefore:
- Only use genuine MAN spare parts

User tip

Please always quote the engine model, engine number and order number when corresponding with MAN, see page 27.

Order spare parts through authorised outlets or directly from MAN.
For address, see page 2.

1.8 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

1.9 Warranty conditions

The obligations agreed in the supply contract, MAN's general terms and conditions and the legal regulations in force at the time the contract is signed all apply.

Failure to adhere to these instructions and all accompanying supplier operating instructions will lead to the loss of claims under the warranty.

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

Even after the expiry of the warranty period, we recommend the continued use of original parts, in order to ensure the continuing performance of the engine.

1.10 Customer service

MAN customer service/product support is available for technical information.

User tip

Please always quote the engine model, engine number and order number when corresponding with MAN, see page 27.

Contact details are available by phone, fax, email or on the internet. For address, see page 2.

Foreword

Diese Anleitung vor Beginn aller Arbeiten sorgfältig durchlesen!
Dies gilt insbesondere für das Kapitel Allgemeine Sicherheitshinweise
und die jeweiligen Sicherheitshinweise in den Kapiteln.

2 General Safety Instructions

This section provides information about residual risks and dangers when using the engine as intended. Generally applicable and valid safety instructions that help ensure optimum protection for personnel as well as safe and trouble-free operation of the engine are included.

Specific safety instructions that apply to specific actions or situations are included afterwards before the action concerned or in the described section.

Grave danger can result if the specific and safety instructions in these operating instructions are not followed.

2.1 Intended use

The engine is designed and built exclusively to power marine vessels.
Any use other than this is deemed non-intended use.
MAN accepts no liability for damage resulting from non-intended use. In this case, the risk is borne entirely 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 changes to the engine absolve MAN of any liability for resulting damage or injury.
Likewise, tampering or changing the injection and control system can impact the engine's performance and emissions.
Compliance with the statutory environmental protection requirements is therefore no longer assured.

DANGER

Danger due to non-intended use
Any use other than the intended use and/or any other use of the engine can lead to dangerous situations and invalidate the operating permit.

Therefore:
- Only use the engine for its intended use.
- Use the engine outside of hazardous areas where there is a risk of explosion.
- Only use the engine with a fitted overspeed protection device or system.

User tip

Observe the following information when operating the engine:
- The safety instructions in these operating instructions and in the instructions provided by suppliers.
- The "Technical data" section in these instructions and in the instructions provided by suppliers.
- Country-specific regulations.

2.2 Content of the installation and operating instructions

Every person charged with working on or with the engine must have read and understood these instructions before commencing work on the engine. This also applies if the person concerned has already worked on this type of engine or a similar engine or has already received training from MAN.

Familiarity with these instructions is therefore essential.

2.3 Changes and alterations to the engine

To avoid danger and ensure optimum performance, the engine is not allowed to be modified, converted or fitted with add-ons unless expressly approved by MAN.

If any changes are made without the written approval of MAN, MAN shall not be liable for any warranty or warranty claims arising from damage and defects attributable to the unauthorised modification. Furthermore, MAN shall not be liable for any damage resulting from the unapproved modification.

2.4 Operator's responsibility

The engine operator must comply with the statutory requirements regarding work safety.

As well as following the work safety instructions in these instructions, compliance with the safety, accident prevention and environmental protection regulations applicable to the engine's field of application must be assured.

In particular:
- The operator must be familiar with the applicable industrial safety regulations and additionally determine risks that arise due to the specific working conditions at the engine installation location in a risk assessment. The operator must implement this in the form of operating instructions for operation of the engine.
- During the entire time the engine is in use, the operator must check to ensure that the operating instructions they have produced comply with the latest standards and requirements and, if necessary, amend these operating instructions.
- The operator must clearly assign and define responsibilities for installation, operation, maintenance and cleaning.
- The operator must ensure that all employees who handle the engine have read and understood the operating instructions.
  In addition to this, the operator must ensure that the personnel receive regular training and information about the risks.
- The operator must provide personnel with the required protective equipment.
- These instructions must be kept near the engine and be accessible to the personnel handling the engine at all times.

The operator is responsible for ensuring that the engine is always technically faultless and operationally reliable.

The following therefore applies:
- Perform maintenance work as described in these instructions and the maintenance instructions in its entirety and at the specified intervals or have it performed by a MAN Service workshop/authorised MAN agent.
- The operator must have the safety equipment checked regularly to ensure that it is operational and complete.
- Follow the operating instructions without fail!

2.5 Personnel requirements

2.5.1 Qualifications

⚠ WARNING

Risk of injury due to lack of qualifications
Incorrect actions can lead to serious injury or damage.

Therefore:
- Always have specific work performed by the appointed personnel as per the relevant sections in these instructions.

The following qualifications for various areas of activity are described in the instructions:

- **Instructed person**
  has received instruction regarding the tasks assigned to them and possible risks in the event of incorrect actions.
- **Trained personnel**
  are able to perform the assigned tasks correctly based on their technical training and experience and their awareness of the relevant requirements.
- **Qualified electrician**
  is able to perform work on electrical systems and detect and prevent possible risks based on their technical training, knowledge and experiences as well as their awareness of the relevant standards and requirements.
  The qualified electrician is trained for the specific application site at which they are active and is aware of the relevant standards and requirements.

Only persons who can be expected to perform their work reliably can be employed as personnel. Persons who's reactions may be impaired, e.g. due to drugs, alcohol or medication, are not allowed to be employed as personnel.

- Observe the age and occupation-specific requirements at the application site.

2.5.2 Unauthorised persons

⚠ WARNING

Danger for unauthorised persons
Unauthorised persons who do not meet the requirements described here are not aware of the risks in the working area.

Therefore:
- Keep unauthorised persons away from the working area.
- In case of doubt, approach a person and get them to leave the working area.
- Stop work if there are unauthorised persons in the working area.

2.5.3 Instruction

Personnel must receive regular instruction. Any instruction given must be documented to ensure better traceability.

2.6 Personal protective equipment

Personal protective equipment must be worn during work to minimise health risks.

- Always wear the personal protective equipment required for the particular work whilst performing this work.
- Observe the signs regarding personal protective equipment in the working area.

Protective workwear

means tight-fitting work clothes with low tear strength, tight sleeves and no protruding parts. Its primary purpose is to protect against injury, climate effects and dirt.

Do not wear rings, chains or other jewellery whilst working.

Hard hat

to protect against falling or flying parts.

Safety shoes

to protect against heavy falling parts and slipping on slippery surfaces.

Safety gloves

to protect the hands against friction, abrasion, stabbing or deep cuts as well as against contact with hot or corrosive parts or fluids.

Wear during specific work

Special protective equipment is required when performing specific work. Such work is mentioned specifically in the individual sections of this manual.

Safety goggles

to protect the eyes against flying parts or sprayed liquids.

Ear protectors

to protect against hearing damage caused by noise.

2.7 Specific dangers

Determined residual risks are described in the following section.

- Follow the safety instructions included here and the warning instructions in the other sections of these operating instructions to reduce health risks and avoid dangerous situations .

Electrical Current

DANGER

Danger to life due to electrical voltage
Touching live parts poses a danger to life.
Damage to the insulation or individual components is life-endangering.

Therefore:
- If the insulation is damaged, shut off the voltage supply immediately and arrange for repairs to be made.
- Work on the electrical system must be performed by qualified electricians only.
- Deenergise the electrical system and check that there is no voltage before commencing any work on it.
- Shut off the voltage supply and prevent it from being switched back on again before commencing maintenance, cleaning or repair work.
- Do not bypass or disable fuses. When changing fuses, make sure the correct amperage is used.
- Keep moisture away from live parts as it can cause short circuits.

Moving parts

WARNING

Risk of injury due to moving parts
Rotating and/or linear moving parts can cause injuries.

Therefore:
- Do not reach into moving parts or handle moving parts during operation.
- Do not open the covers during operation.
- Only perform checking and maintenance work when the engine is at a standstill.
- Observe the run-on time: before opening any covers ensure that no parts are still moving.
- Wear close-fitting clothing in the hazard area.

Flying parts in the event of sudden engine damage

WARNING

Risk of injury due to running engines
In the event of engine damage parts may fly around the engine room with high energy, injuring persons in the immediate vicinity.

Therefore:
- Do not remain in the engine room when the engine is running.

General Safety Instructions

Exhaust gases

WARNING

Health risk due to leaking exhaust system
Exhaust gases pose a health risk.

Therefore:
- Immediately stop and repair machines with leaking exhaust systems.
- Ensure sufficient ventilation.

Highly flammable substances - diesel fuel, oils and greases

WARNING

Risk of injury due to highly flammable substances
Highly flammable substances, fluids or gases catch fire.

Therefore:
- Smoking, naked flames and sources of ignition are strictly prohibited in the danger zone and close proximity.
- Fire extinguishers must be provided.
- Report any suspicious substances, fluids or gases to the person in charge immediately.
- Repair leaks.
- Stop work immediately in the event of a fire. Leave the danger zone and do not return until it is safe to do so.

Coolants - water-antifreeze, corrosion inhibitor

WARNING

Risk of injury due to hazardous coolants
Coolant contains hazardous substances.

Therefore:
- Observe the manufacturers' safety data sheets.
- Always wear protective workwear, chemical-resistant protective gloves and safety goggles when handling coolants.
- Avoid spillage and fog formation.

Hot fuels, lubricants and coolants

WARNING

Risk of burns due to hot fuels, lubricants and coolants
Fuels, lubricants and coolants get hot during operation and cause burns if touched.

Therefore:
- Before handling fuels, lubricants and coolants, check that they are not hot and, if necessary, let them cool down first.

Hot Surfaces

⚠ CAUTION

Risk of burns due to hot surfaces
Contact with hot parts causes burns.

Therefore:
- Always wear protective workwear and protective gloves when working near hot parts.
- Ensure that all parts have cooled down to ambient temperature before commencing any work.

Noise

⚠ WARNING

Hearing damage due to noise
The noise level in the working area can cause serious hearing damage.

Therefore:
- Always wear ear protectors whilst working.
- Only remain in the danger zone for as long as necessary.

Sharp Edges and Corners

⚠ CAUTION

Risk of injury on edges and corners
Sharp edges and corners can cause skin grazes and cuts.

Therefore:
- Always proceed with caution when working hear sharp edges and corners.
- Wear protective gloves if in doubt.

Dirt and discarded objects

⚠ CAUTION

Risk of tripping due to dirt and discarded objects
Dirt and discarded objects are slipping and tripping hazards and can cause serious injuries.

Therefore:
- Keep the working area clean at all times.
- Remove objects that are no longer needed.
- Mark areas where there is a risk of tripping with yellow and black tape.

Work on the common-rail system

⚠ WARNING

Risk of injury due to discharging fluids
Fluids discharged under high pressure (1800 bar) can cause serious injuries.

Therefore:
- Always have work on the common-rail system performed by trained, qualified personnel.
- Switch off the engine and wait for depressurisation before commencing work on the common-rail system.

⚠ WARNING

Danger to life due to defective lines
Jet of fluid discharged under high pressure.

Therefore:
- Never touch the jet of fluid.
- Press the emergency off button immediately.
- If necessary, implement further measures to reduce the pressure and stop the jet of fluid.
- Collect and dispose of discharged fluids in the correct manner.
- Replace the defective parts.

⚠ WARNING

Danger to life due to strong magnetic fields

Therefore:
- People with pacemakers are not allowed to be near the engine.
- People with metal implants are not allowed to be near the engine.
- Keep ferro-magnetic materials and electromagnets away from the magnetic source (minimum distance 3 m).
- Set aside metallic objects (jewellery, watches, writing implements etc.) before commencing maintenance work.
- Do not allow any electronic devices near the magnetic source.
- Do not allow any storage media, credit cards etc. near the magnetic source.

2.8 Safetyequipment

The operator must have the following safety equipment in place:

Install emergency off device and include in the plant's safety system before operating the engine.

Connect the emergency off device so as to prevent dangerous situations for people and property if the energy supply is interrupted or if the energy supply is activated after an interruption.
The emergency off device must be freely accessible at all times.

⚠ WARNING

Danger to life due to non-functioning safety equipment

Therefore:
- Check whether all safety equipment is functioning properly and installed correctly before commencing work.
- Check whether all safety equipment is functioning properly and installed correctly before starting the engine.

2.9 Protective equipment

The operator must retrofit the following protective equipment:

The V-belt cover included in the scope of supply is not protective equipment. Suitable protective equipment must be put in place before commissioning/operation of the engine.

⚠ WARNING

Danger to life due to insufficient protective equipment
The V-belt cover included in the scope of supply is not protective equipment.

Therefore:
- Put suitable protective equipment in place before commissioning/operation of the engine.

2.10 Procedure in the event of danger or accidents

Preventive measures

- Always be prepared for accidents or fire!
- Keep first-aid equipment (first-aid kit, blankets etc.) and fire extinguishers close to hand.
- Regularly check first-aid equipment and fire extinguishers for completeness and proper functioning.
- Ensure people are familiar with accident-reporting, first-aid and rescue equipment.
- Provide regular safety instruction.
- Keep access routes for rescue vehicles clear.

In the event of an accident: do the right thing

- Stay calm.
- Stop the engine immediately using the emergency off button.
- Perform first-aid.
- Alert the rescue services and/or fire brigade.
- Assist with getting people out of the danger zone if possible.
- Make sure the access routes for rescue vehicles are clear.
- Inform the person in charge.

⚠ CAUTION

Accident despite all precautionary measures
If an accident occurs despite all the precautionary measures taken, e.g. due to one of the following reasons.

Therefore, seek immediate medical assistance in the event of:
- Contact with corrosive acid.
- Fuel penetration into the skin.
- Scalding by hot oil or coolant.
- Antifreeze spraying into the eyes etc.

2.11 Signs and notices

The following symbols should be attached in the immediate danger zone.

⚠ WARNING

Risk of injury due to illegible symbols
Signs, notices and symbols get dirty over time or become illegible in some other way.

Therefore:
- Make sure that all safety, warning and operating signs and notices are always easily legible.
- Clean or replace illegible safety, warning and operating signs and notices.

Access forbidden

Areas that display this warning must notbe entered.

Electrical voltage

Only qualified electricians are allowed to work in areas that display this sign.

Unauthorised persons are not allowed to enter areas that display this sign.

Hot Surfaces

Hot surfaces, such as hot engines and hot fluids, are not always obvious. Do not touch them without wearing protective gloves.

Danger to life due to suspended loads
Loads can swing out and fall during lifting, which can cause serious injury or even death.

Risk of injury
Risk of injury if the instructions are not followed.

2.12 Weight data

Ensure, that when handling the engine and the engine parts listed in the table, suitable lifting equipment is used.

Description	Weight (kg)
Crankcase	500
Crankshaft	135
Flywheel	38
Intercooler	54
Engine slides	189
Oil pan	35
Expansion tank	45
Exhaust manifold parts set	26
Gearbox	561
Flywheel housing	30
Expansion tank	45
Resilient coupling with flange bearing	117
Terminal box	36
Oil filter, switchable	88

2.13 Environmental protection

ENVIRONMENTAL NOTE

Risk of environmental pollution due to incorrect handling of fuels, lubricants and coolants
This can severely damage the environment.

Therefore:
- Follow the safety instructions.
- Take suitable measures immediately if environmentally hazardous substances are inadvertently released into the environment.
- If necessary, inform the responsible municipal authorities about the problem.

The following environmentally hazardous substances are used:

Lubricants

Lubricants and oils contain toxic and environmentally hazardous substances. They must not be released into the environment and must be disposed of by a specialist disposal company.

Diesel Fuel

Diesel fuel contains toxic and environmentally hazardous substances. It must not be released into the environment and must be disposed of by a specialist disposal company.

Coolant

Coolants can contain toxic and environmentally hazardous substances. They must not be released into the environment and must be disposed of by a specialist disposal company.

General Safety Instructions

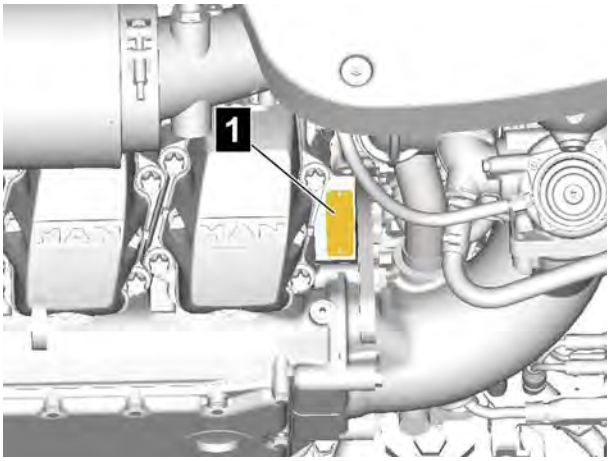
Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

3 Engine model plate

Always quote the engine model, engine number and plant number/order number in all correspondence and enquiries.

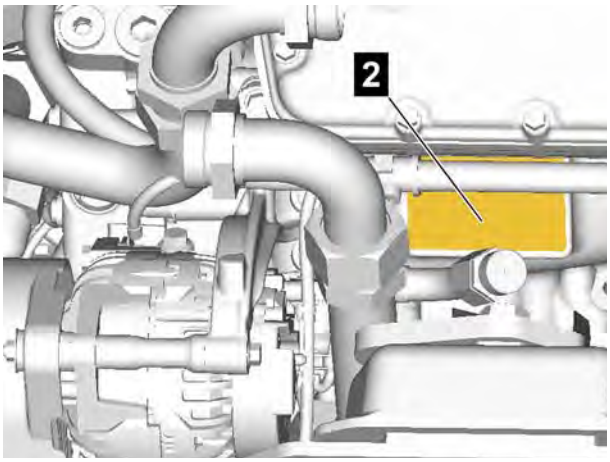
You should therefore check the relevant data on the engine model plates and enter it below before first commissioning of the engine.

The engine model plates 1 and 2 are attached on the crankcase.



Engine model 3

.....

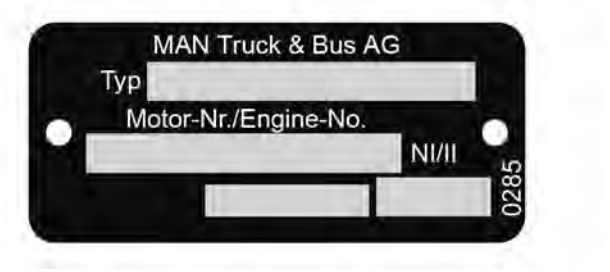


Engine number 4

.....

Plant number/order number 5

.....



Engine Model Plate

3.1 Explanation of Motor-Nr./Engine-No. (Engine identification number)

Class identifier (assignment)	1	2	3	4
Motor-Nr./Engine-No.	XXX	XXXX	XXX	XXXX
1 Model number according to model code				
2 Date of assembly (internal works reference)				
3 Assembly sequence (cumulative number on assembly date)				
4 Production and equipment-specific data				

3.2 Explanation of model designation

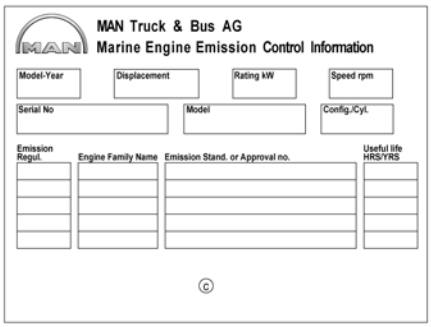
Model designation	Explanation	Example
D	Fuel type	Diesel
28	Figure + 100	128 mm bore
6	Stroke figure (rounded)	157 mm stroke
8 or 2	Number of cylinders	8 or 12 cylinders
L	Turbocharging	with turbocharger and intercooler
E	Engine installation	Marine engine
4..	Model designation identification	Development number

3.3 Data on the engine model plate

Please always quote the engine model, engine number and order number when corresponding with MAN. You should therefore check the relevant data on the engine model plates and enter it on page 27 before commissioning of the engine.

3.4 Emission control information label

If you install the engine in a way that makes the engine's emission control information label hard to read during normal engine maintenance, you must place a dublicate label on the vessel, as described in 40 CFR 1068.105.



4 Design and function

4.1 Engine application fields

The D2868 LE4.. (V8) and D2862 LE4.. (V12) marine engines are suitable for powering marine vessels for light-duty applications.
Correlation of the engine types to the approved modes of operation, see "Technical Data" on page 106.

Typical applications

Light Duty: Pleasure crafts, escort and patrol boats, ambulance boats

4.2 Engine construction and engine equipment

The D2868 LE4.. engines are 8-cylinder 4-stroke, the D2862 LE4.. engines are 12-cylinder 4-stroke diesel engines with turbocharging and intercooling.

Split crankcase, wet cylinder liners made of highly wear-resistant special centrifugal casting, steel pistons with cooling duct for piston cooling. Single cylinder heads with shrink-fitted valve seats and pressed-in valve guides. 4 valves per cylinder. Valve timing by means of central camshaft, roller tappets, tappet push rods and rocker arms (OHV).

Injection system

High-pressure common-rail injection system in conjunction with EDC7 (Electronic Diesel Control).

Fuel system

Low-pressure system consisting of fuel lines, the hand pump and the fuel filters.
High-pressure system consisting of the volume-controlled high-pressure pumps, flange-mounted fuel pumps and the rails with rail pressure sensor and pressure limiting valve.

Engine Lubrication

Force-feed lubrication for all bearing points. 2 rotor-type oil pumps driven by the crankshaft.
2 oil modules consisting of oil cooler, oil separator and oil pressure control valve.
Oil injection nozzles for piston cooling.

Cooling System

The engine is liquid-cooled. The cooling system is configured as an overpressure system. The cooling circuit is a thermostat-controlled forced-circulation system.
The maintenance-free coolant pump is mounted on the front end of the engine and is driven by a gear set. Elastomer elements absorb the transmission of the crankshaft's torsional vibrations.
The heat exchanger and intercooler are cooled with seawater.

Intake and Exhaust System

The intake air flows to the exhaust turbochargers via the air filters. The then precompressed charge air is recooled when it flows through the intercooler before being supplied to the engine.
The exhaust manifolds are cooled by the engine coolant. The gear-driven sea water pump is mounted on the flywheel housing.

Design and Function

Flywheel housing and flywheel

The flywheel housing is provided with a connection in accordance with SAE1.
Various flywheel versions can be supplied, depending on the type of application, e.g. for flange-mounting of a gearbox or for mounting of a flexible jointed shaft coupling.

Starter

The electric starter is double-pole insulated. The starter can be mounted either on the left or the right of the engine.

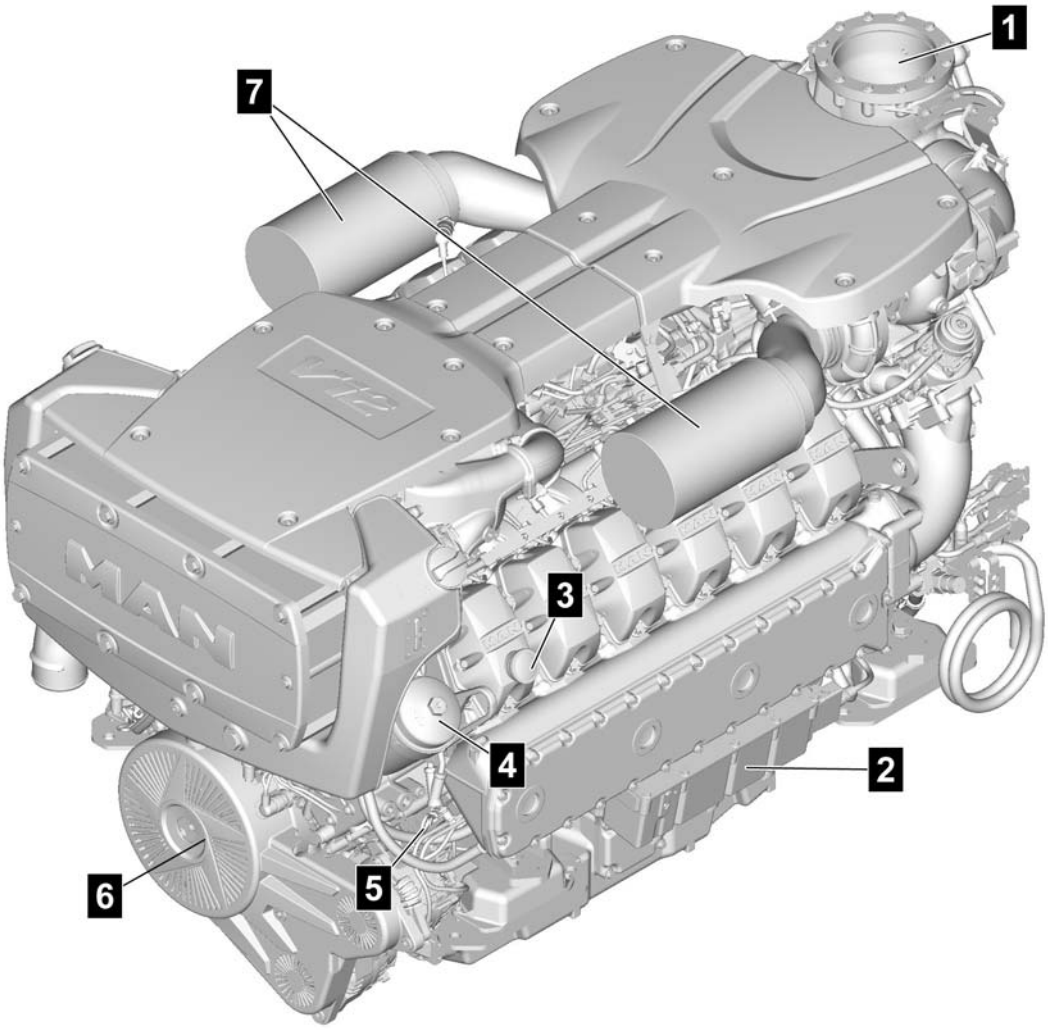
Alternator

Double-pole insulated alternators (1 x 120 A or 2 x 120 A) can be supplied.

Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

4.3 Engine views

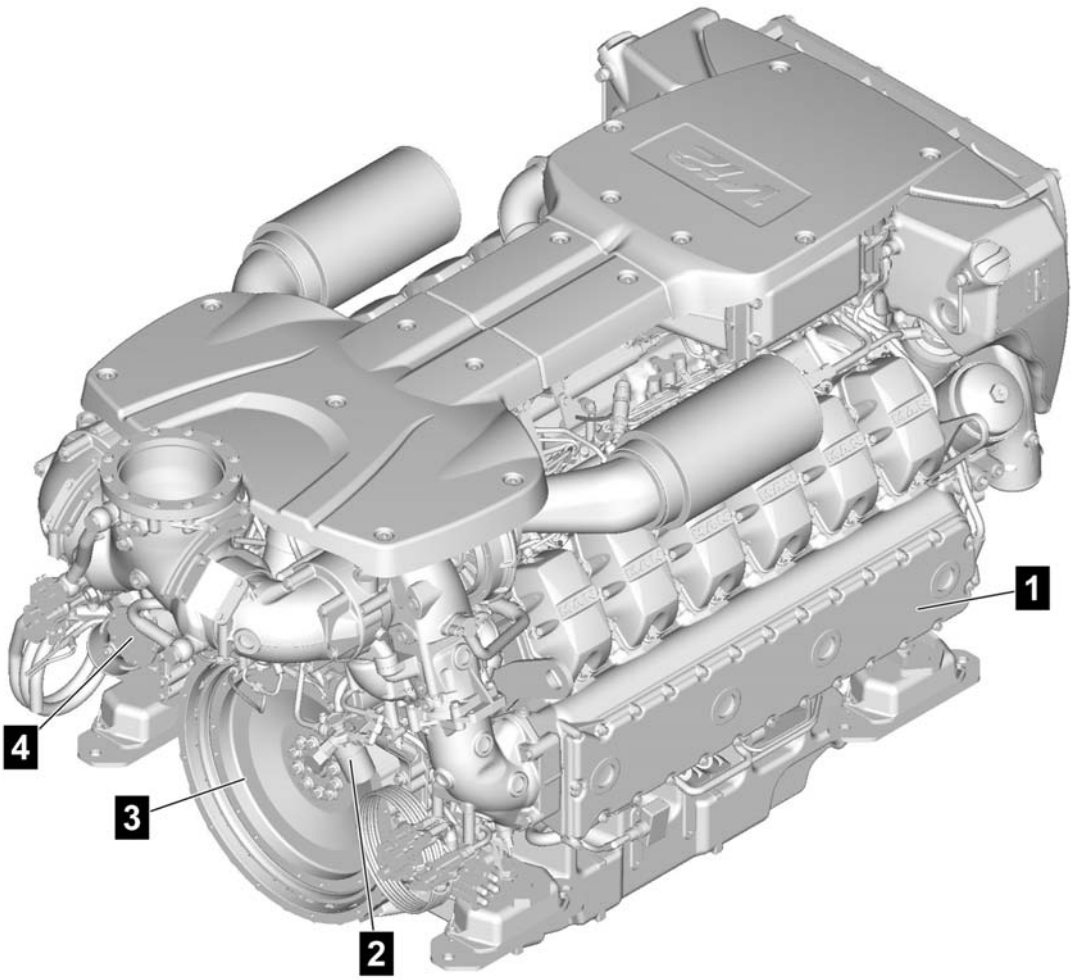
4.3.1 Front left view



The picture shows an D2862 LE4.. engine with 1-stage turbocharching (example).

1 Exhaust manifold
2 EDC-Box
3 Oil filler neck
4 Oil filter
5 Oil dip stick
6 V-belt guard
7 Air cleaners

4.3.2 Rear right view



The picture shows an D2862 LE4.. engine with 1-stage turbocharching (example).

1 Exhaust pipe, liquid cooled
2 Fuel pre-filter with hand priming pump
3 Flywheel
4 Sea water pump

5 Transport, packaging and storage

Always read the installation instructions when installing and commissioning a new or overhauled engine.

User tip

Installation and commissioning is performed solely by the employees of the plant manufacturer or persons authorised by the manufacturer.

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 workwear
- Hard hat
- Safety shoes
- Safety gloves

5.2 Safety instructions

Heavy Suspended Loads

WARNING

Danger to life due to suspended loads
Loads can swing out and fall during lifting.

Therefore:

- Do not stand under or remain in the swinging 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.
- Before leaving the work area, lower load to ground.

Transport, Packaging and Storage

Off-Centre Point of Gravity

WARNING

Danger to life due to incorrect handling of package
Package swings out, tilts and/or falls.

Therefore:
- Use the crane hook lugs solely for transporting the engine without mounted components (without alternator).
- 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.
- Handle packages carefully and note the symbols and instructions on the packaging.
- Use lifting gear. Angle of incline is not permitted.

Swinging loads

WARNING

Risk of injury due to swinging packages
Package can cause injury and damage

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

Unauthorised Transport

NOTE

Risk of damage due to untrained personnel

Therefore:
- Always have the packages unloaded by trained personnel.
- No unauthorised transporting or mounting/removal of transport aids permitted.
- No unauthorised removal of packaging permitted.

Improper Transport

NOTE

Property damage due to incorrect transportation
In the event of improper transport, packages can fall or tip over, leading to serious damage.

Therefore:
- 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.

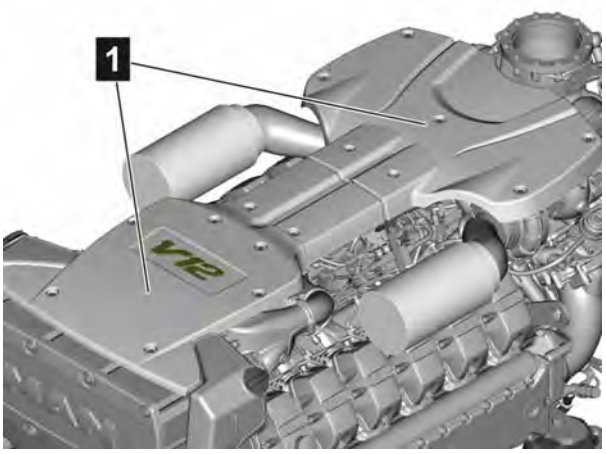
If external signs of transport damage are apparent:

- 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.

User tip

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

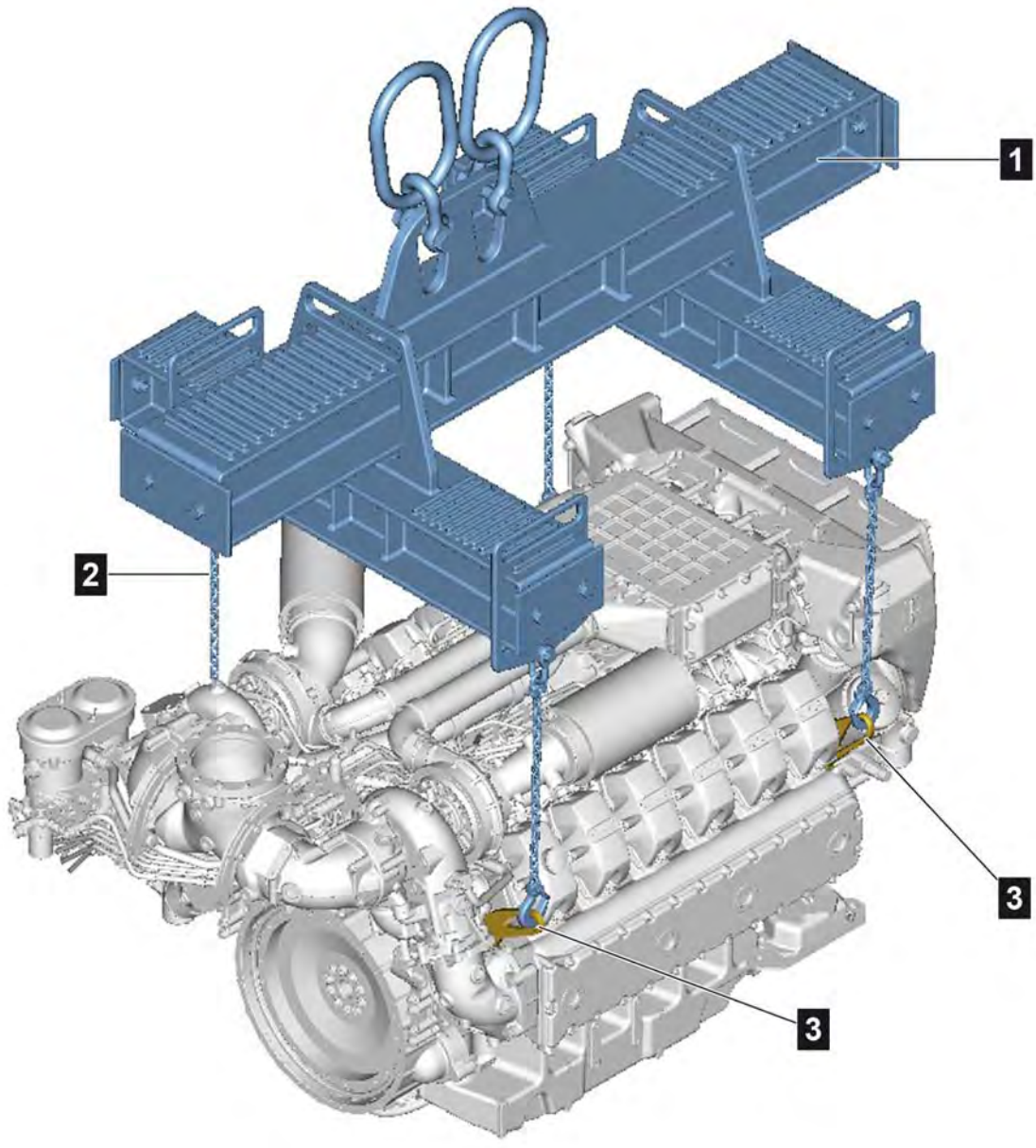
During work on the engine, the engine must 1 not be accessed!



5.4 Transport

5.4.1 Engine without gearbox

Lifting Points



For lifting the engine, 4 crane hook lugs 3 are mounted on the engine.
Use sufficiently dimensioned crane lifting gear 1 to lift the engine!
Cables, ropes and chains 2 must exert vertical tension (tolerance 5°) on the crane hooks!

DANGER

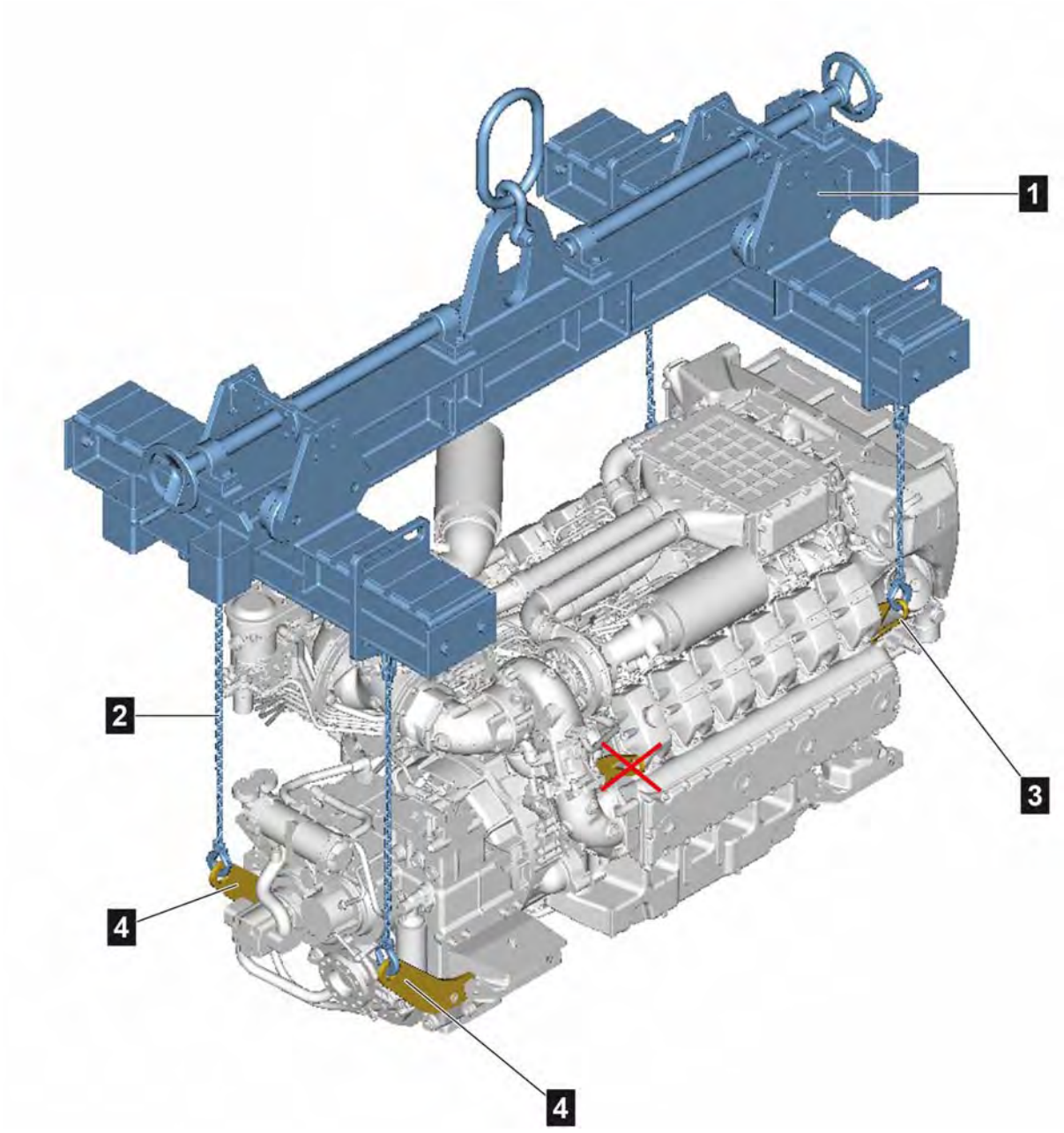
Falling loads (weighing up to 2500 kg!) can lead to serious accidents!

Therefore:

- Use crane lifting gear to lift the engine!
  The crane lifting gear, cables, ropes and chains must be in perfect condition.

5.4.2 Engine with gearbox

Lifting Points



For lifting the engine with gearbox, there are 2 crane hook lugs mounted on the gearbox 4 and 2 crane hook lugs mounted on the engine 3.
Use sufficiently dimensioned crane lifting gear 1 to lift the engine!
Cables, ropes and chains 2 must exert vertical tension (tolerance 5°) on the crane hooks!

⚠ DANGER

Falling loads (weighing up to 3500 kg!) can lead to serious accidents!

Therefore:

- Use crane lifting gear to lift the engine!
  The crane lifting gear, cables, ropes and chains must be in perfect condition.

Transport, Packaging and Storage

WARNING

Danger to life due to incorrect handling of package
Package swings out, tilts and/or falls.

Therefore:
- Use the crane hooks solely for transporting the engine with gearbox.
- 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.
- Handle packages carefully and note the symbols and instructions on the packaging.
- Use lifting gear. Angle of incline is not permitted.

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.
- Cables, ropes and chains must not exert diagonal tension on the crane hooks.
- 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, observe offset centre of gravity if applicable.
3. Start transport.

Transport with forklift

The engine can be transported with 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 of off-centre.
4. Lift the pallet with package and start transport.

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.

ENVIRONMENTAL NOTE

Risk to the environment due to incorrect disposal of packaging materials

- Dispose of packaging materials in an environmentally responsible manner.
- Observe the locally applicable disposal regulations. Enlist the help of a specialist company to deal with disposal if necessary.

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 sunlight.
- 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, reapply or replace the preservative.

User tip

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

Transport, Packaging and Storage

6 Installation and commissioning

6.1 Instructions for installation and commissioning

6.1.1 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 workwear
- Safety shoes
- Safety gloves

6.1.2 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.

Therefore:
- Installation and commissioning must only be carried out by specialist personnel trained by MAN.

Ground Rules

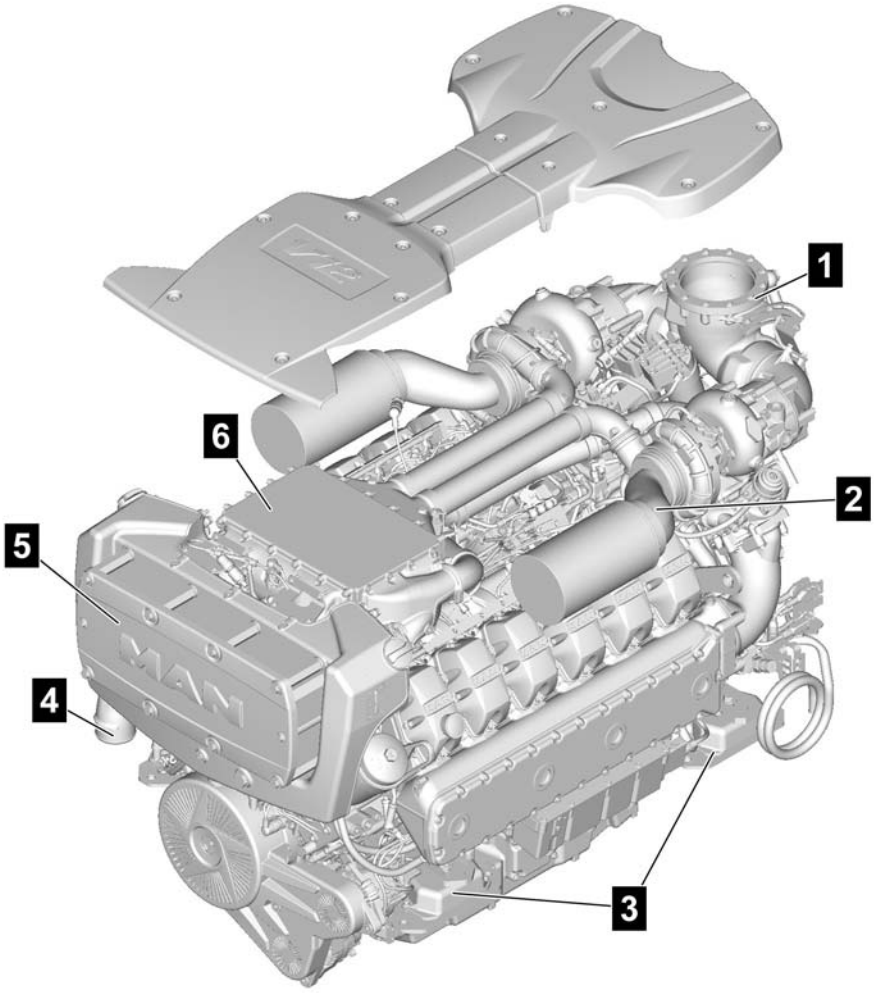
⚠ WARNING

Risk of injury due to incorrect installation and commissioning
Improper installation and commissioning can cause serious personal injury or considerable property damage.

Therefore:
- 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 cannot fall or tip over.

6.2 Engine installation

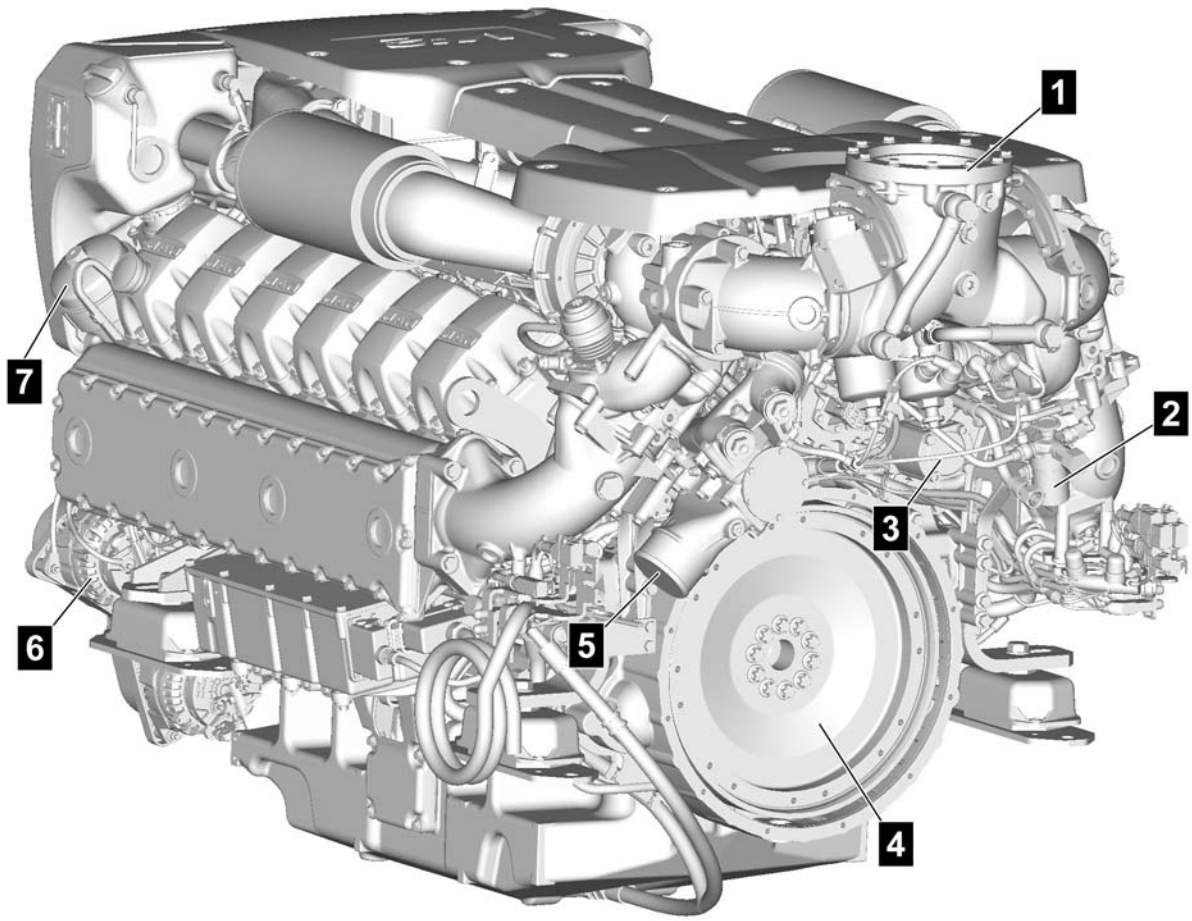
6.2.1 Interfaces between engine and plant



1 Exhaust system
2 Intake system
3 Engine mounts
4 Sea water outlet
5 Engine cooling system
6 Intercooling system

The following assembly work must be performed at the interfaces between engine and plant when installing the engine:

1 Mount exhaust system, see page 52
3 Assemble the resilient engine mounts, see page 48
4 Connect sea water circuit, see page 49



1 Exhaust system
2 Fuel system
3 Auxiliary power take-off
4 Flywheel
5 Sea water inlet
6 Electrical system
7 Lube oil system

The following assembly work must be performed at the interfaces between engine and plant when installing the engine:

1 Mount exhaust system, see page 52
2 Connect fuel system, see page 50
4 Mount clutch/gearbox, see page 46
5 Connect sea water circuit, see page 49

6.2.2 Installation Instructions

Only general instructions on the installation of the engine can be given in this chapter.
More precise information is provided in Installation instruction for MAN Ship's Diesel Engines for commercial vessels. This instruction can be obtained from MAN. for the contact address, see page 2.

6.2.3 Installation drawing

The installation drawing provides information on the type of connections and the connection dimensions.
In addition, depending on the scope of delivery, circuit diagrams, arrangement drawings for resilient engine mounts, etc., may also be required, which can be obtained from MAN. See page 2 for the contact address.

NOTE

Engine installation is based on the installation instructions and the installation drawing.

Therefore:

- Please observe these sources of information for all of the following installation/assembly work.

6.2.4 Threaded connections

Always use a torque wrench to tighten the threaded connections.
The tightening torques of all of the standard threaded connections can be found listed on page 56.

NOTE

Danger of damage to property due to incorrectly tightened screwed connections.
Components may be damaged.

Therefore:

- Use impact wrench when pre-tightening with a max. 50% of the stated final tightening torque.
- The final tightening stage may only be performed using a torque wrench.

6.3 Completion of the engine and assembly of the equipment set

When installing the engine, ensure that there is enough space available for the regular maintenance work specified in the maintenance schedule.

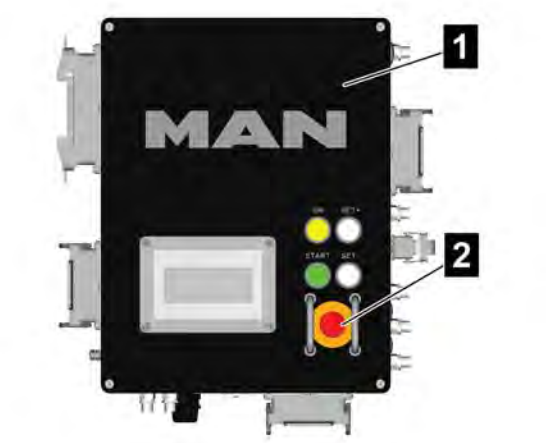
6.3.1 E-box (terminal box) accessibility

DANGER

Danger to life due to incorrectly installed safety equipment
Safety equipment is not accessible.

Therefore:
- In an emergency, it must be possible to stop the engine quickly and reliably in the engine room.
- Die rote Notstopptaste am Klemmenkasten muss schnell und sicher erreichbar sein.
- Keep safety equipment clear.

The E-box 1 must be mounted in the engine room so that it is easily accessible. There is an emergency stop button on the E-box 2.

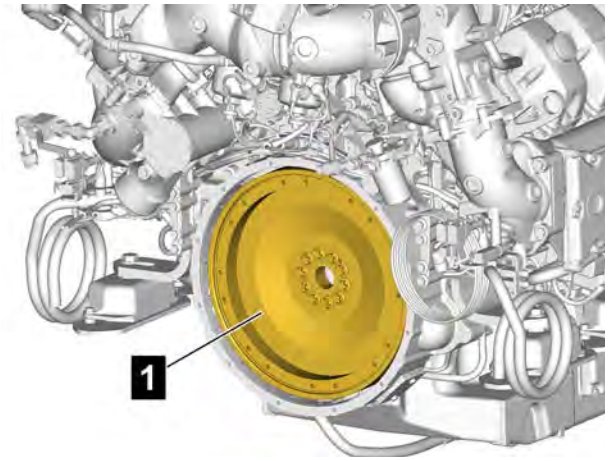


6.3.2 Mounting a gearbox on the flywheel housing

Flywheel

The connection dimensions for the flywheel 1 are indicated on the installation drawing.

- Remove oil, grease and preservative from the flywheel.

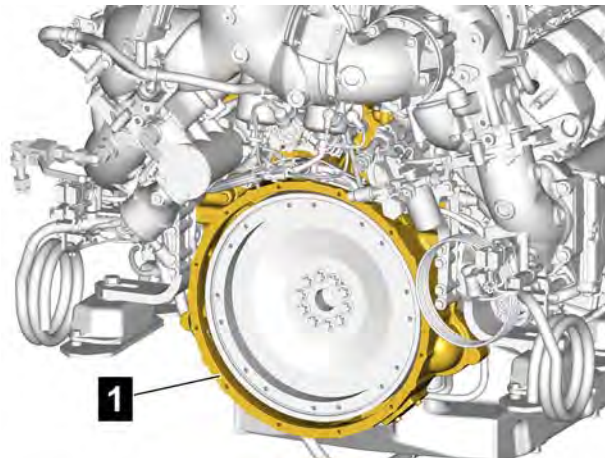


Flywheel housing

User tip

For bolt tightening torques, see page 56.

Details of the dimensions for the flywheel housing 1 and the type of threaded connections for mounting the gearbox are included on the installation drawing.



Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

6.3.3 Checking the crankshaft axial clearance

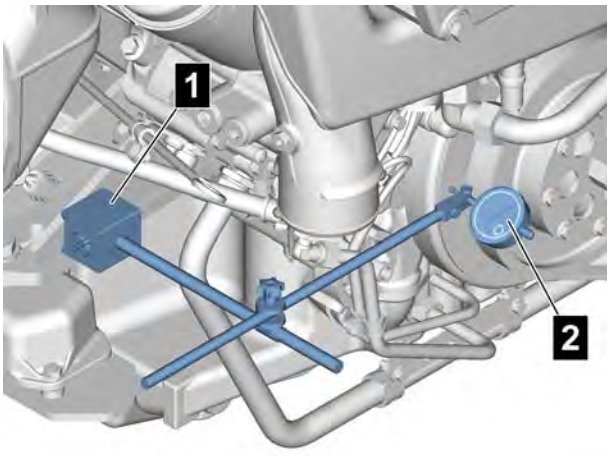
NOTE

The designed crankshaft axial clearance of the engines must not in any event be reduced by the installation of couplings or other components.

Therefore:

- It is essential to determine the crankshaft axial clearance using a dial gauge held on a magnetic stand **before** and **after** flange-mounting add-on parts.

- Remove the V-belt guard
- Position the dial gauge holder 1 with dial gauge 2 on the engine mounting so that the dial gauge tracer pin is resting on the vibration damper with a preload
- Press crankshaft all the way in the axial direction to the flywheel housing
- Zero the dial gauge
- Pull crankshaft all the way in the axial direction from the flywheel housing
- Check the dial gauge indicator



If the results of the two measurements to not match or if the crankshaft springs back after being moved, check the mounting.

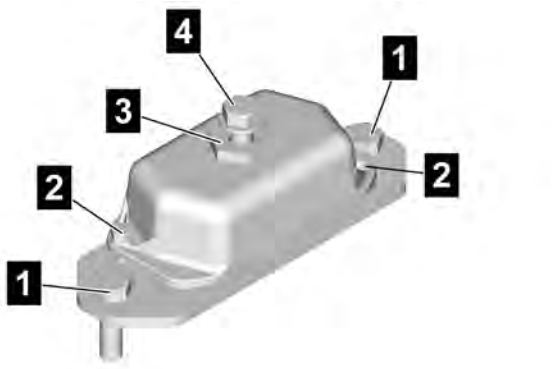
Engines	Crankshaft axial clearance
D2868 LE4.. D2862 LE4..	0.20-0.40 mm

6.4 Installation of the propulsion system in the ship

6.4.1 Installing the resilient engine and gearbox mounts

Identification of the mounts

The resilient mounts can be supplied by MAN.
For the dimensions of the bearings and hole pattern, see the arrangement drawings. These can be obtained from MAN; see page 2 for the contact address.



1 Mounting bolts M 20, strength class 8.8
2 Transport protection bolts
3 Height adjustment
4 Mounting bolt for engine mounting M 20

- Put the propulsion system on the engine foundation with resilient mounts. Ensure that the mounts are arranged correctly (shore hardness).
- Bolt the engine mountings and the gearbox mountings to the resilient mounts.

Assignment of the resilient mounts to the engine and gearbox			
Engine model	Gearbox arrangement	MAN part number	Shore hardness
V8	Flange-mounted gearbox	51.96210-7052	60
V8	Free-standing gearbox	51.96210-7052	60
V12	Flange-mounted gearbox	51.96210-7051	65
V12	Free-standing gearbox	51.96210-7051	65

The maximum adjustment height for all mounts is 10 mm. This adjustment height cannot be exceeded. Larger height differences must be balanced using shims.
The lower the adjustment height can be adjusted, the more reserve there is for subsequent readjustments.
Align the propulsion system before commissioning, see installation instructions.

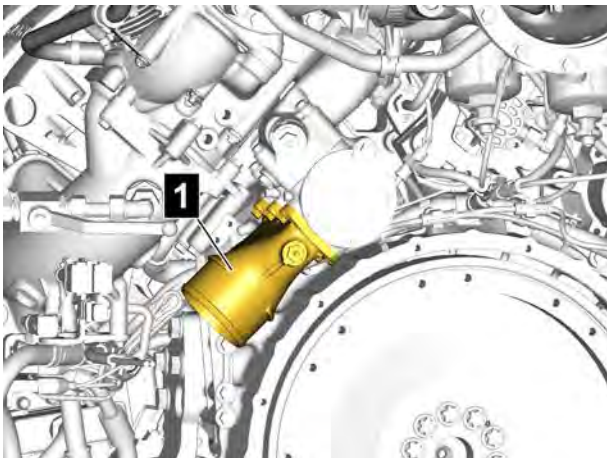
Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

6.5 Connecting the cooling system

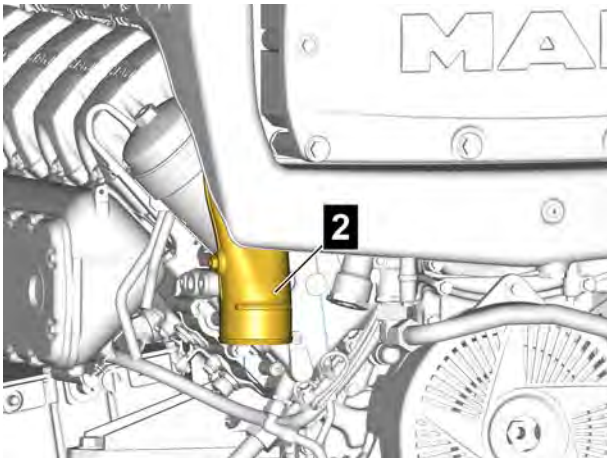
6.5.1 Connecting the sea water lines for engine cooling

The installation drawing specifies the implementation of the coolant connections.

- Connect 1 coolant inlet



- Connect 2 coolant outlet

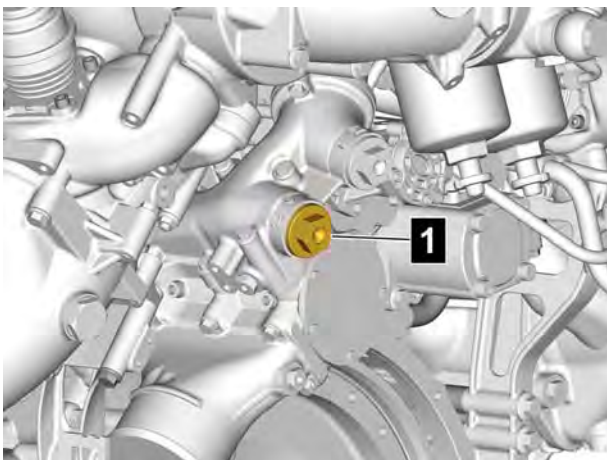


6.5.2 Gearbox oil cooler

The coolant is supplied to the gearbox oil cooler via the connection 1 on the sea water pump.

The coolant feed to the gearbox oil cooler is marked "out".
The connection for the coolant return from the gearbox cooler is to be installed by the shipyard on the ship-side piping.
There are 2 possibilities for this:

- •. Inclusion in the sea water outlet downstream of the engine
- Inclusion in the exhaust system's sea water injection

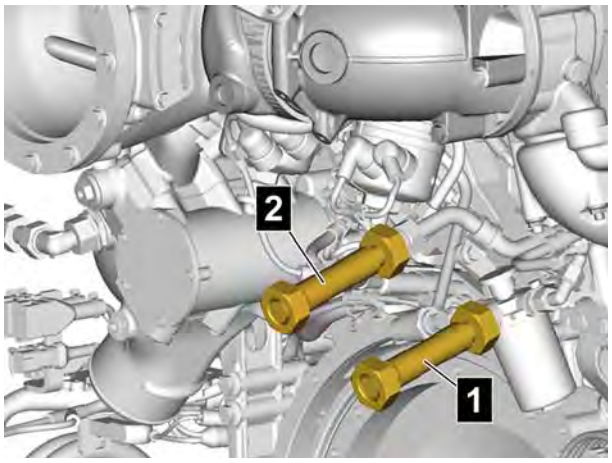


6.6 Connecting the fuel lines

6.6.1 Connecting the fuel lines

- Connect the fuel feed 1
- Connect the fuel return 2

For hose connections, see installation drawing on page 113.



6.6.2 Securing the fuel pre-filter

NOTE

Risk of damage due to dirt particles
Risk of component damage due to dirt in the fuel system

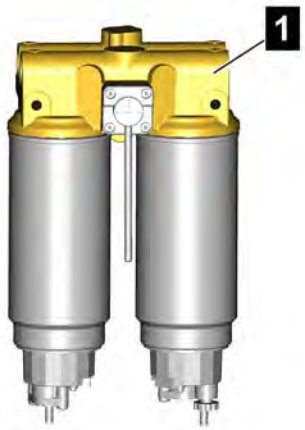
Therefore:
- Ensure complete cleanliness when working on the fuel system.

Securing the fuel pre-filter

The fuel pre-filter with water separator 1 must not be mounted directly on the engine as the engine vibrations impair water separation.

There must be sufficient space available for catching the separated water and for changing the filter cartridges (H approx. 200 mm).
The changeover lever must be easily accessible and freely movable.

Mounting bolts: M10 hexagon bolts or M10 socket head bolts, each with DIN 125-10.5 washers.

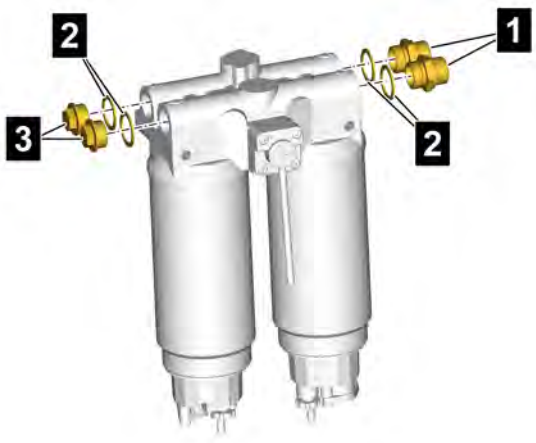


Connecting the fuel pre-filter

To connect the fuel hoses of the tank - fuel pre-filter and the fuel pre-filter - engine, screw fittings are delivered with the equipment; these can be combined depending on the installation situation.

The fuel inlet is marked "IN" on the fuel pre-filter.

The fuel outlet can be either on the same side as the fuel inlet or on the opposite side. The free outlet opening must be fitted with a screw plug in each case.



1 Screw plug M30x1.5
2 Sealing ring
3 Screw-in fitting M30x1.5 / M30x2

6.7 Exhaust system

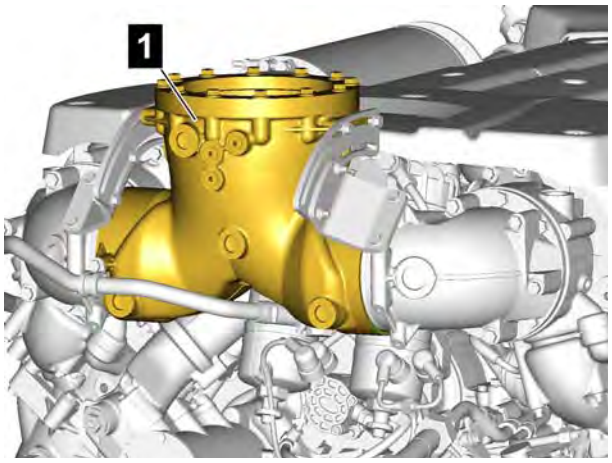
6.7.1 Exhaust gas outlet on the engine

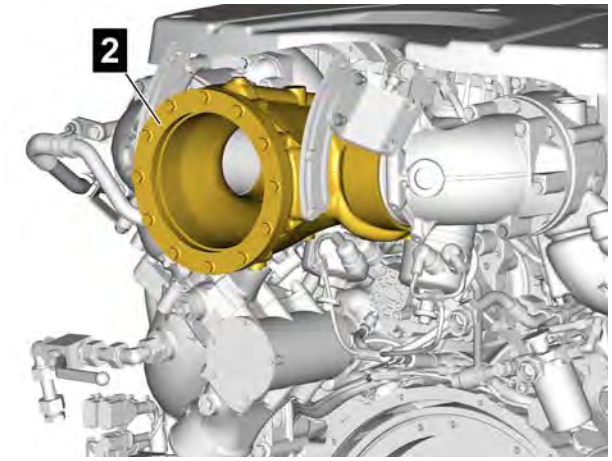
Both cylinder banks are combined in a central exhaust outlet.

The exhaust manifold for the exhaust outlet can be swivelled upwards 1 or rearwards 2 by 90°.

The dimensions of the flange for connecting the ship's exhaust system can be found on the installation drawing, see page 113.

A pipe elbow with subsequently falling exhaust line ("gooseneck") in the piping prevents water from getting into the engine when reversing or in the event of swell.





NOTE

Irreparable engine damage due to water being sucked in

Therefore:

- Under no circumstances allow water to pass into the engine.

Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

6.7.2 Connection between the exhaust system and the engine

Elastic connecting elements have to be installed between the engine and the exhaust system, which permit engine motion to take place due to the elastic engine mounting and decouple the engine vibration from the exhaust system.
Example: compensator 1

NOTE

Component damage due to the effect of forces on the turbocharger.

Therefore:

- Exhaust pipes are to be fixed and supported, such that no forces have an effect on the turbocharger.

6.7.3 Starter motor

NOTE

Component damage due to corrosion

Therefore:

- The negative cable of the starter battery is to be connected to starter terminal 31.
- Connect the engine and all pipe connections from and to the engine with the ship's potential by means of "grounding cable".

In the case of dual engine plants, each engine requires independent wiring, i.e. the engines' circuits must not be linked with each other.

Batteries

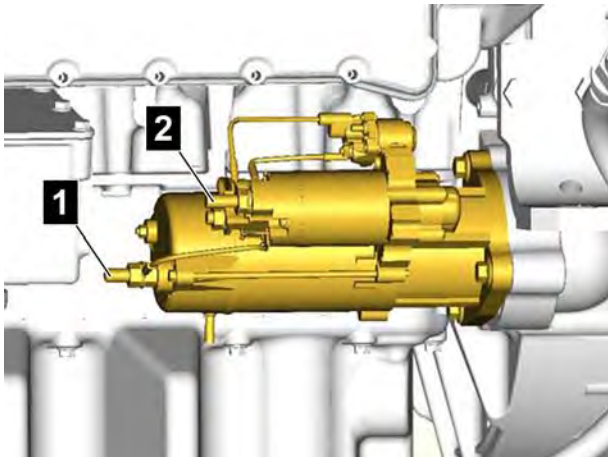
Separate batteries are to be provided for the starters for **each** engine. The on-board 24V direct current consumer items are to be supplied from their own individual batteries.

Starter

All MAN marine engine starters are of double-pole design. The positive cable of the starter battery must therefore be fed back to starter terminal 30 2, the negative cable of the starter battery to starter terminal 31 1 .

The starter can be mounted either on the left or the right of the engine.

The negative cable must never be connected to the ship's potential, the hull or other components.



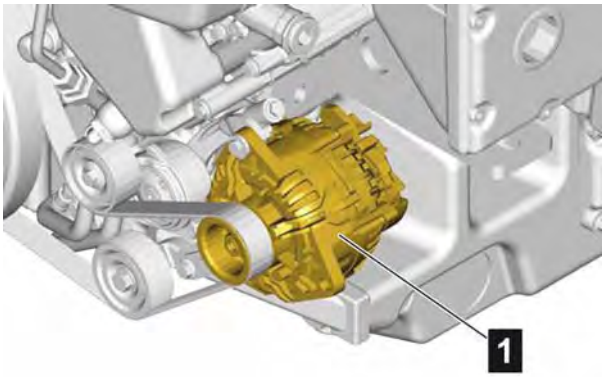
6.7.4 Alternators

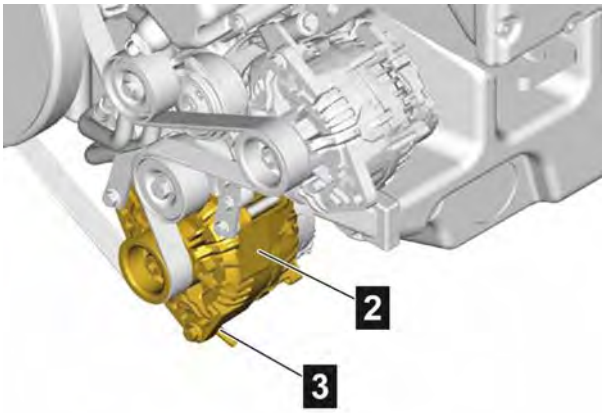
For charging the starter batteries, each engine has an alternator 1 available.
The alternator has been completely wired at the factory.
This alternator may not be used to charge other batteries used to power other consumers.

If batteries for supplying other consumers are to be charged independently of this, a second alternator 2 (optional) can be mounted.

The two alternators are not double-pole insulated. In order to ensure isolated (potential-free) wiring, the entire mounting of the alternators on the engine is isolated. The housing for the alternators is therefore connected to the negative terminal of the relevant battery 3.

Engine models	V8 / V 12
Alternator type	Bosch
Rated voltage	24 V
Rated current	120 A



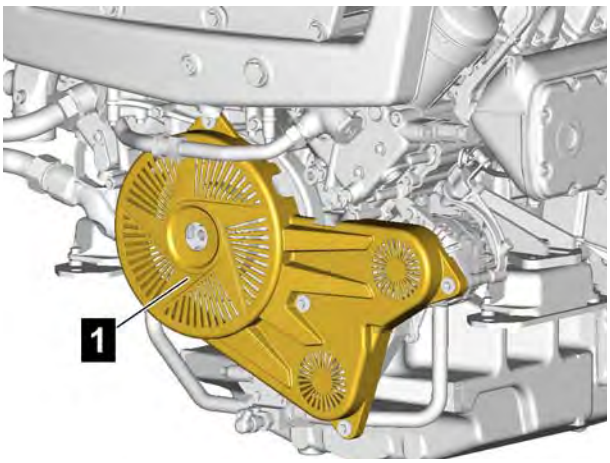


⚠ WARNING

Danger to life due to insufficient protective equipment
The V-belt guard included in the scope of supply is not protective equipment.

Therefore:
- Put suitable protective equipment in place before commissioning of the engine.

- Supplied V-belt guard 1.
- Put in place suitable protective equipment.



6.8 Tightening torques for threaded connections to Works Standard M 3059

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

Thread size x pitch	Strength classifications / tightening torque in Nm		
	at **8.8 / 8**	at **10.9 / 10**	at **12.9 / 12**
M4	2,5	4,0	4,5
M5	5,0	7,5	9,0
M6	9,0	13,0	15,0
M7	14,0	20,0	25,0
M8	22,0	30,0	35,0
M8x1	23,0	35,0	40,0
M10	45,0	65,0	75,0
M10x1.25	45,0	65,0	75,0
M10x1	50,0	70,0	85,0
M12	75,0	105,0	125,0
M12x1.5	75,0	110,0	130,0
M12x1.25	80,0	115,0	135,0
M14	115,0	170,0	200,0
M14x1.5	125,0	185,0	215,0
M16	180,0	260,0	310,0
M16x1.5	190,0	280,0	330,0
M18	260,0	370,0	430,0
M18x2	270,0	290,0	450,0
M18x1.5	290,0	410,0	480,0
M20	360,0	520,0	600,0
M20x2	380,0	540,0	630,0
M20x1.5	400,0	570,0	670,0
M22	490,0	700,0	820,0
M22x2	510,0	730,0	860,0
M22x1.5	540,0	770,0	900,0
M24	620,0	890,0	1040,0
M24x2	680,0	960,0	1130,0
M24x1.5	740,0	1030,0	1220,0

6.9 First commissioning

Correct commissioning in the first instance is of key importance for the operational safety and reliability of the engines. If commissioning is performed incorrectly, engine damage will be the inevitable consequence.

The procedure comprises several steps:

- Thorough installation check
- Filling of the engine with engine oil, marking the oil dipstick
- Filling of the engine with coolant, bleeding of the cooling system
- Starting the engine
- Performing a test drive, including measuring and recording important data

Performing initial commissioning requires specific know-how on the part of the personnel as well as specific equipment.

First commissioning may therefore only be performed by persons or workshops authorised and certified by MAN Nuremberg (Marine Engines department).

NOTE

Incorrectly performed first commissioning results in operating faults which lead to the engine becoming a total write-off.

Therefore:

- Commissioning is to be performed solely by personnel authorised by MAN Nuremberg (Marine Engines department).

WARNING

Danger to life due to non-functioning safety equipment

Therefore:

- Check whether all safety equipment is functioning properly and installed correctly before commencing work.
- Check whether all safety equipment is functioning properly and installed correctly before starting the engine.

Installation and commissioning

7 Control and operation

7.1 Prerequisite

Wear personal protective equipment.

The following protective equipment must be worn:

- Protective workwear
- 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 due to incorrect operation
Incorrect operation can lead to serious injury and/or damage.

Therefore:
- Perform all operating steps as indicated in these instructions.
- Before commencing work, ensure that all covers and protective equipment are operational and installed correctly.
- Never shut off any safety equipment while in operation.
- Make sure the working area is kept clean and orderly!

7.3 Preparation for operation

By means of simple, but regular inspection of the engine in the course of the daily routine, impending engine damage and engine failure can be avoided. For these inspections neither tools or test equipment are required. It is sufficient to carry out simple visual and functional controls before the daily start up of the engine and after long periods of standstill. This only requires a few minutes per inspection.

With experience and special knowledge in the handling of diesel engines, minor faults can be detected at an early stage and major engine damage prevented.

User tip

The causes of engine damage are often small faults, which can lead to a chain reaction and result in severe engine damage and even eventually result in the total failure of the engine.

Therefore:
- Carry out regular simple visual and functional inspections.
- Eliminate minor faults immediately!

The basic prerequisite for fault-free operation is the provision of equipment which has been approved by MAN.

Before operation, check fuel supply, level of coolant and oil.
If necessary, top up diesel fuel, coolant and oil.

NOTE

MAN accepts no liability for material defects caused by the use of non-approved fuels, lubricants and coolants.
No liability for material defects can be accepted if non-approved fuels, lubricants and coolants are used.

Therefore:
- Only use approved fuels, lubricants and coolants (see publication entitled "Fuels, lubricants and fluids for MAN industrial and marine diesel engines").

7.3.1 Checking and topping up the fuel level

DANGER

Fire risk due to diesel fuel
Diesel fuel is highly inflammable.

Therefore:
- Do not smoke in the danger zone when refuelling.
  Naked flames and sources of ignition are strictly prohibited.
- Only refuel when the engine is stopped.
- Ensure cleanliness.
- Take care not to spill diesel fuel.

1. Check the fuel level and, if necessary, top up as specified by the system manufacturer.
2. Open the shut-off valves in the fuel feed.

ENVIRONMENTAL NOTE

Do not let fuel spill while filling. Do not let fuel leak out onto the ground or into bodies of water.

7.3.2 Checking and topping up the coolant

DANGER

Risk of scalding!
The coolant is hot.

Therefore:
- Only check the coolant level with the engine **cooled down**.

NOTE

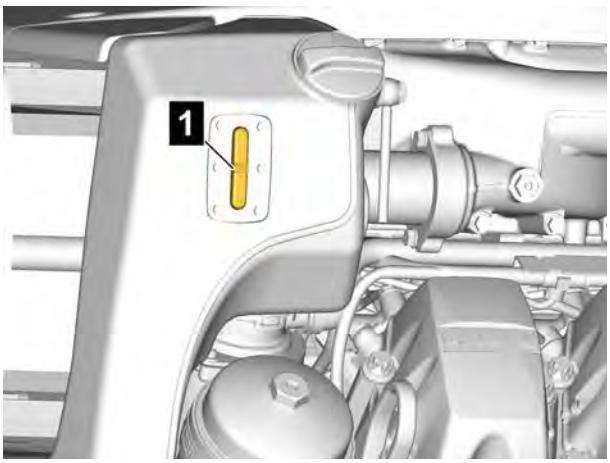
Engine damage due to lack of antifreeze and corrosion inhibitor
An incorrect mixture of antifreeze and corrosion inhibitor leads to failure of the cooling system.

Therefore:
- Prepare coolant as specified in the publication entitled "Fuels, lubricants and coolants for MAN industrial and marine diesel engines".

Checking the coolant level

Only check the coolant level with the engine cooled down.

- The coolant level in the sight glass 1 on the expansion tank must be between "MIN" and "MAX".

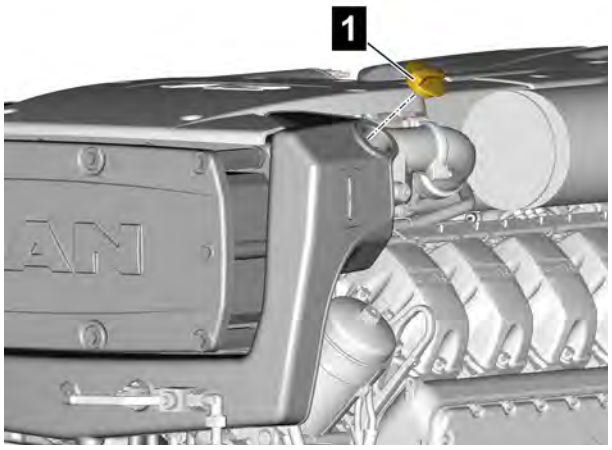


Operation

Topping up the coolant

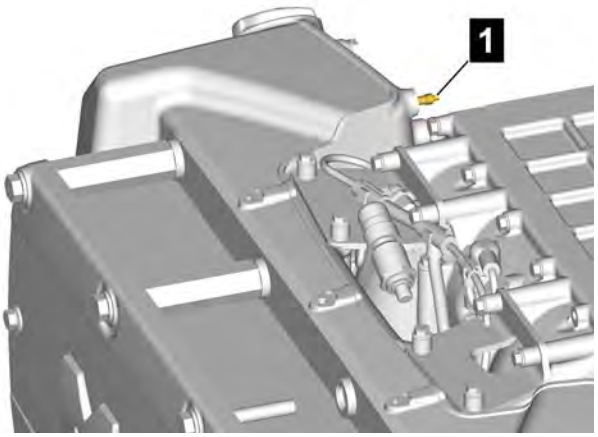
Only top up the coolant with the engine cooled down.

- If, under exceptional circumstances, the **coolant level has** to be checked with the engine at operating temperature, carefully turn the cap 1 to the first detent position - drain pressure - then open it carefully.
- When topping up do not add cold coolant to an engine that is still hot after operation.
- Ensure that the correct "water - antifreeze" mixing ratio is restored.
- The engine cooling system must be filled with a mixture of potable mains water and antifreeze based on ethylene glycol/corrosion inhibitor.
- Screw the cap 1 as far as the stop but do not tighten it.



Overtightened caps can not be opened again.

If the cooling system is opened when the engine is at operating temperature, there will be pressure loss in the cooling system.
On continuing engine operation, this may lead to the engine monitoring system MMDS triggering the “Pressure in expansion tank" alarm. The consequence of this alarm is a reduction in engine power.
After opening the cap, the warm engine can only be operated again without an alarm if there is an initial pressure of 0.7 bar in the cooling system.
To achieve this, a pressure valve 1 is mounted on the expansion tank, allowing a commercially available air pump to be connected. This must be used to increase the system pressure to 0.7 bar.



7.3.3 Checking the engine oil level

NOTE

Ensure that the engine's entire oil supply has collected in the oil pan

Therefore:

- Carry out an engine oil level check with the engine horizontal and approx. 5 minutes after the engine has been switched off.

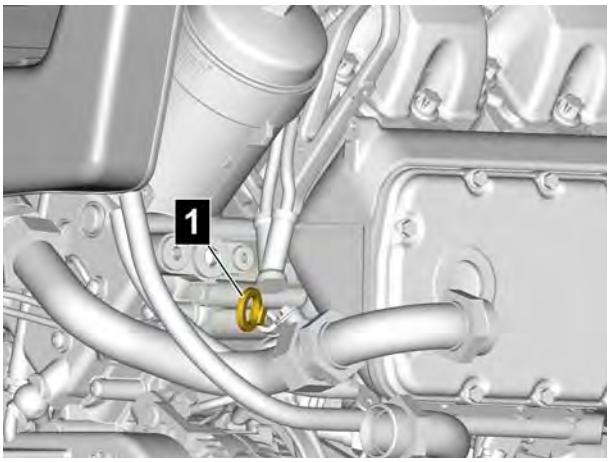
Stop the engine.

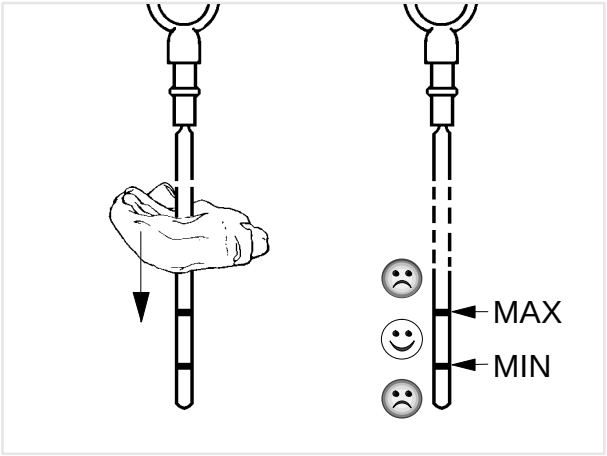
Check the oil level after around 5 minutes:

- Pull out the oil dipstick 1 .
- Oil dipstick 1 with a clean, lint-free cloth.
- Oil dipstick 1 as far as the stop.
- Pull out the oil dipstick 1 again.

The oil level should lie between the two marks on the dipstick and must never be below the lower mark.

- Top up the oil if necessary.
  Do not overfill.





7.3.4 Topping up the engine oil

NOTE

Risk of damage due to incorrect oil quantity
Engine damage

Therefore:
- Never add more than the specified oil quantity.
- Ensure that the oil level is correct.
- Observe the Min./Max. mark on the oil dipstick.

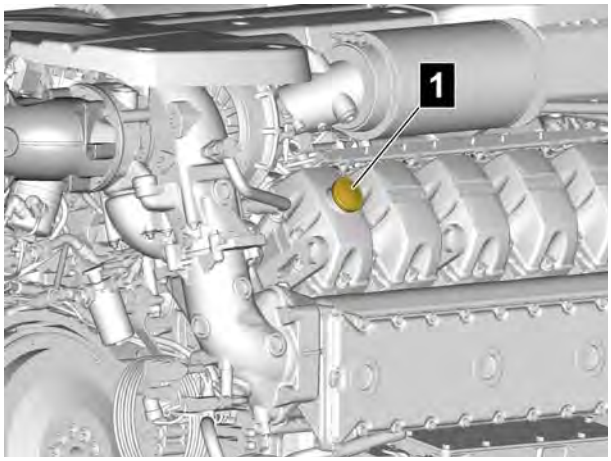
ENVIRONMENTAL NOTE

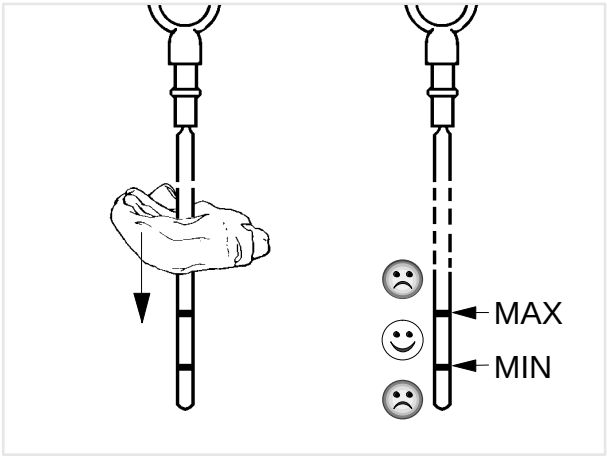
Do not let engine oil spill while filling. Do not let engine oil leak out onto the ground or into bodies of water.

- Unscrew the cap 1 .
- Pour in fresh engine oil at the oil filler neck 1 .

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

- Screw on cap 1 back on.
- Check the engine oil level.





Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

7.3.5 Check water separator of fuel filters

In order to protect the engine from dirt and water in the fuel, a fuel prefilter with water separator is installed in the fuel line from the tank to the engine.

NOTE

Dirt and water in the fuel cause:

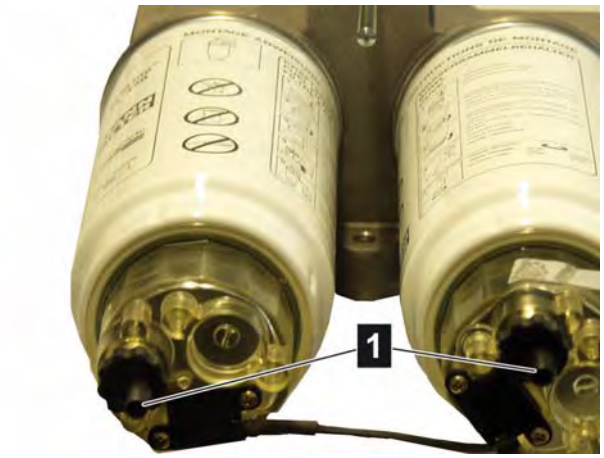
- Incorrect combustion
- Injection system damage
- Piston damage
- Irreparable engine damage

Therefore:

- Carry out maintenance on the fuel pre-filter regularly, according to the amount of water used and in accordance with the manufacturer's instructions.

Drain the water from the fuel pre-filter water separator

- Drain plugs 1 .
- Let the accumulated water drain into a suitable container.
- Close the drain plugs 1 .

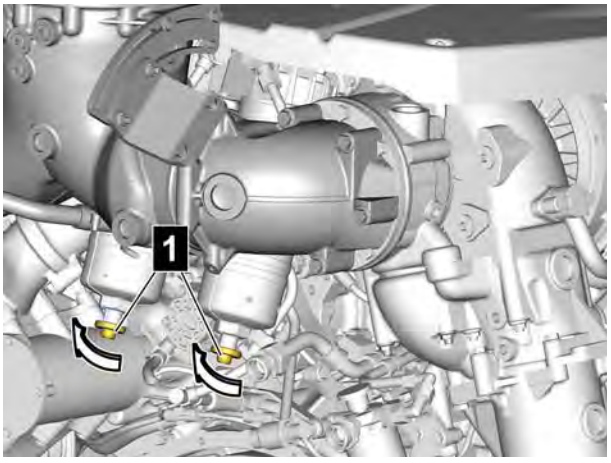


Drain the water from the fuel filter water separator

- Nach Bedarf, spätestens bei jedem Motoröl-wechsel, Ablassschrauben 1 .
- Let the accumulated water drain into a suitable container.

Tightening torque . . . . . 3-4 Nm

- Close the drain plugs 1 .



7.3.6 Daily inspection before starting the engine

Daily visual and functional inspections should be carried out:

- Oil leakage
- Coolant leakage
- Condition of V-belts
- Loose and defective parts; loose threaded connections

With the engine running:

- Unusual noise
- Generation of smoke

7.4 Starting and stopping the engine

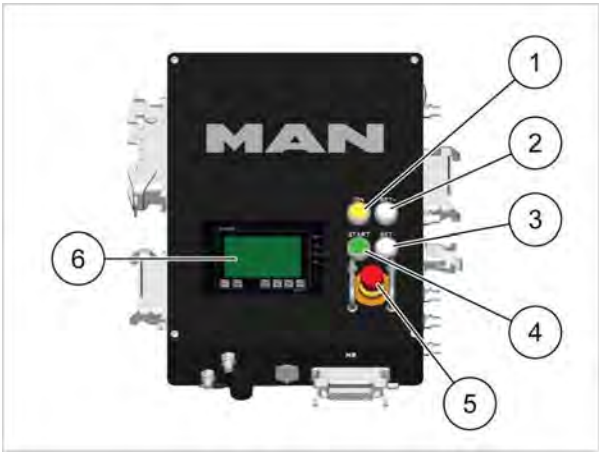
The engine can be started and stopped by one of the following:

1. An ignition lock
2. A button (without ignition lock)

Starting the engine

The engine can be started and stopped in the engine room. The ignition must be activated from the control stand beforehand.

(1) Button for switching the ignition on and off
(2) Button for increasing the engine speed
(3) Button for reducing the engine speed
(4) Button for starting the engine
(5) Emergency stop button
(6) Observation window
(indication of EDC faults, SFFR faults and MMDS alarms)



NOTE

Only press the emergency stop button in an emergency
When the engine is stopped using the emergency stop function, there is an entry in the fault memory of the MAN Monitoring and Diagnostic System (MMDS).

Therefore:
- Do not use the emergency stop function to stop the engine unless there is good reason to do so.
- Shutting off the voltage supply to the EDC engine management using the battery master switch when the ignition is switched on is not permissible.

Stopping the engine

Stopping with ignition lock

1. Move the ignition lock to position 0:
the engine stops
2. Wait a few seconds (after-run test)
2. Battery master switch to "off"

Stopping with button (ignition on/off)

1. Press the ignition button once:
the engine stops
2. Wait a few seconds (after-run test)
3. Battery master switch to "off"

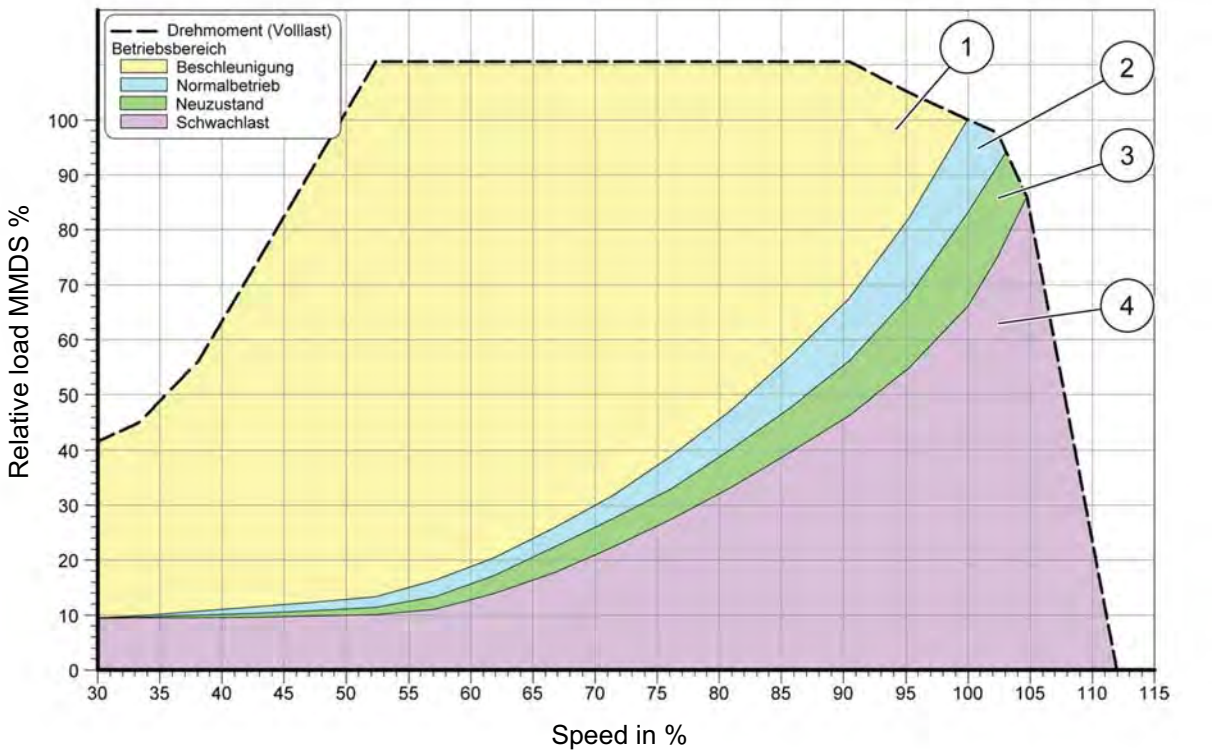
NOTE

Non-compliance with the stopping procedure leads to fault entries in the fault memory (EDC / SFFR / MMDS) and can lead to a reduction in the engine speed.

Therefore:
- Shutting off the voltage supply to the EDC engine management using the battery master switch when the ignition is switched on is not permissible.

7.5 Running the engine for ship operation

7.5.1 Operating ranges for marine engines



(1) Acceleration

- Brief operation for increasing the load by increasing the rpm
- Speed less than 100% of the rated speed
- If there is prolonged operation with overload, a warning is output via the MMDS
- Continuous operation is allowed for "heavy" operating mode
- Continuous operation is not allowed for medium and light operating modes

(2) Normal operation

- Continuous operation allowed, limit speed 100 to 102% of rated speed

(3) "As new" condition

- Operating range for new, fully laden ship
- Continuous operation allowed, limit speed 102 to 104% of rated speed

(4) Low load

- Operating range for relatively high rpm and low loads
- Continuous operation allowed but inefficient

7.5.2 Display systems and instruments

Colour display MMDS-CLC 6.5

MAN can supply the MMDS-CLC 6.5 colour display as an option.
This device registers the engine and gearbox sensor data.

Several graphic pages 1 depict the recorded measured values in the form of digital displays and circular gauges. For further graphic pages, see page 72.

If a value reaches a critical level, a warning message or an alarm is tripped and shown on the display, depending on importance 2. If the value exceeds certain plausible limits, a sensor fault is displayed. An integrated buzzer emits a warning sound each time a new alarm message is issued. This sound can be stopped at the push of a button.

Navigation through the various monitoring and alarm pages is possible using the buttons directly on the display 3. The language, desired system of units, date, time and display contrast can be set by means of screen menu.

Operation

Visualisation of engine data on colour display MMDS-CLC 6.5

Several graphic pages depict the recorded measured values in the form of digital displays and circular gauges. The numeric values on the digital instruments are coloured to indicate their alarm status.

Instrument page 1: rpm, fuel consumption, coolant temperature, engine oil pressure

Instrument page 2: rpm, throttle lever position, load, fuel pressures, charge-air temperature, charge-air pressure

Instrument page 3: rpm, operating hours, engine oil temperature, battery voltage, exhaust gas temperatures

Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

Instrument page 4: rpm, trip consumption, gear oil temperature, gear oil pressure, coolant pressure, coolant pressure in expansion tank

A separate alarm table lists all pending alarms with detailed information. For commissioning and service, there is a service page available on which the engine and gearbox data as well as all sensor alarm states can be viewed at a glance.
Alarm page: the last alarm that occurred is at the top, while non-acknowledged alarms have a flashing background.

7.5.3 Override system

Following an alarm that can lead to engine damage, the MAN Monitoring Diagnostic System reduces the engine speed and, therefore, the engine power.
The override system allows the original engine power to be restored.
In dangerous situations, it is thus possible to activate the full engine power and, therefore, ensure the ship's safety.

NOTE

Risk of engine damage caused by ignoring alarms

Therefore:
- The override system is only allowed to be used in emergencies. Remedy the cause of an alarm.

MAN accepts no liability for engine damage caused by the use of the override system.

Activation of the override system

The override system is activated by pressing button 1 .

The LED in the button comes on when the override system is activated.

8 Maintenance and care

8.1 Requirements

Personal Protective Equipment

The following protective equipment must be worn:

- Protective workwear
- Safety shoes
- Safety gloves

8.2 Safety instructions

Personnel

The engine maintenance work described in the manual must be performed by trained, qualified personnel.

Ground rules

WARNING

Risk of injury due to incorrectly performed maintenance

For this reason:

- Shut down engine before performing maintenance.
- Ensure that the engine cannot be started by unauthorised persons.
- Perform all maintenance steps as indicated in these instructions.
- Ensure adequate work space before starting any work.
- Make sure the working area is kept clean and orderly!

NOTE

MAN accepts no liability for material defects caused by the use of non-approved fuels, lubricants and coolants.
No liability for material defects can be accepted if non-approved fuels, lubricants and coolants are used.

For this reason:

- Only use approved fuels, lubricants and coolants (see publication entitled "Fuels, Lubricants and Coolants for MAN Industrial and Marine Diesel Engines").

ENVIRONMENTAL NOTE

Coolant

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

Engine oil

- Oil must not be allowed to be dispersed in the ground!
  Carefully collect old oil and pass it on for waste oil recycling.
  When handling used engine oil observe the health protection precautions.

Filter inserts and filter cartridges

- Filter inserts and filter cartridges, such as oil and fuel filters, are regarded as hazardous waste and must be disposed of correctly. Observe the regulations of the responsible 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 instructions are available for the engines as a supplement to these installation and operating instructions.

They contain a maintenance schedule for all routine maintenance work. The maintenance work is described in this chapter.

8.4 Maintenance work

8.4.1 Engine oil change

WARNING

Risk of injury due to hot oil
Engine oil reaches high temperatures during operation and causes scalding if touched.

For this reason:
- Always wear protective gloves when holding oil drain plugs.

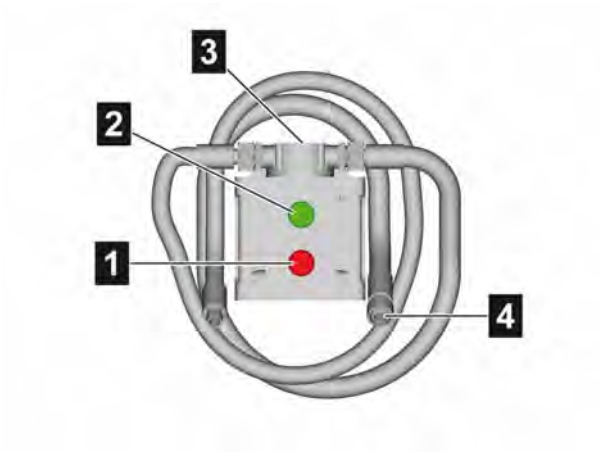
User tip

Use a container with a capacity of at least 100 litres when changing the oil.

Maintenance and Care

Draining the engine oil

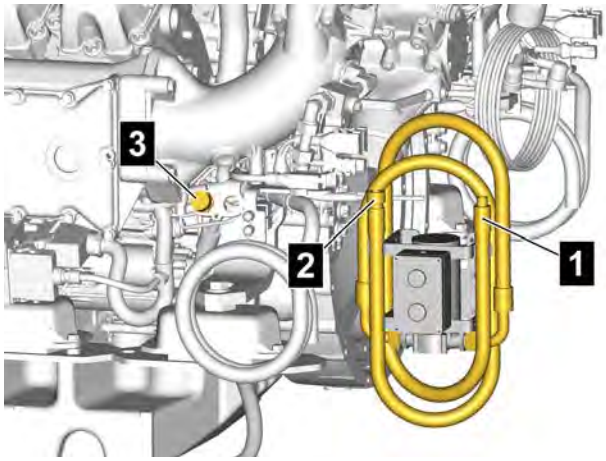
An electrically operated oil suction and filling pump (which can be supplied by MAN) is required for pumping the oil out of the oil pan.

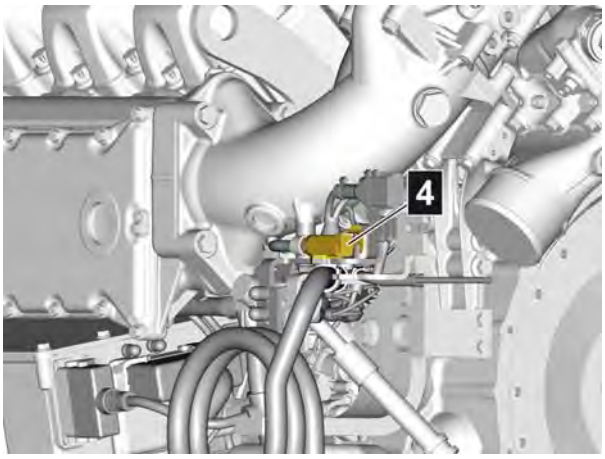


1 "Oil in" button
2 "Oil out" button
3 Flow direction marking
4 Hose coupling for connecting to engine

Supply voltage: 24 V

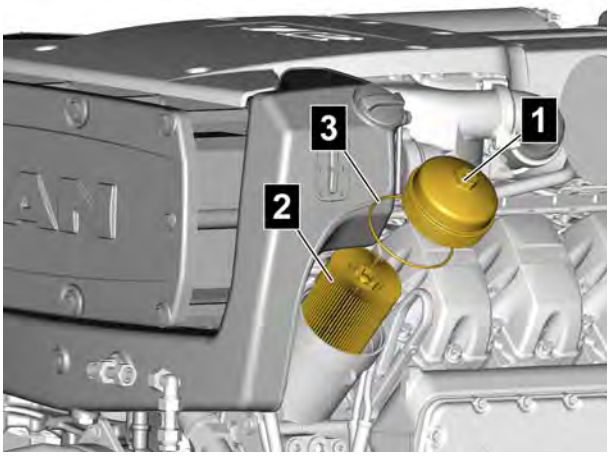
1. Unscrew the cap 3 .
2. Connect the suction line 2 of the oil drain pump to the oil drain hose 3 of the engine.
3. Connect the power supply of the electric oil suction and filling pump to the plug 4 .
4. When the engine is at operating temperature, press the oil drain pump's "OIL OUT" button and pump all of the used oil through the drain hose 1 into a container with sufficient capacity.





Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

Changing oil filter cartridges



- Unscrew oil filter cover 1 with O-ring 3 and oil filter insert 2 and then remove.
- Remove oil filter insert 2 and O-ring 3 from oil filter cover 1 .
- Clean oil filter cover 1 .
- Fit new O-ring 3 on oil filter cover 1 .
- Insert new oil filter insert 2 into oil filter cover 1 .
- Insert oil filter cover 1 into the oil module and then tighten.

Tightening torque . . . . . 40 Nm

The second filter insert is changed in the same way.

Oil grade

The engines are only allowed to be operated with high-performance diesel engine oil to Works Standard M3277.

NOTE

MAN accepts no liability for material defects caused by the use of non-approved fuels, lubricants and coolants.
No liability for material defects can be accepted if non-approved fuels, lubricants and coolants are used.

For this reason:

- Only use approved fuels, lubricants and coolants (see the publication entitled "Fuels, Lubricants and Coolants for MAN Industrial and Marine Diesel engines"). A current list of approved products can be found on the internet at: **www.asp.mantruckandbus.com**

Determining the engine oil fill quantity

NOTE

Risk of damage due to incorrect oil quantity
Engine damage

For this reason:

- Determine the fill quantity of the oil pan mounted on the engine. For oil pan oil fill quantity, see following table or label on a valve cover.

Oil quantities in the oil pan			
Engine model	MAN oil pan part number	Minimum Litres	Maximum Litres
D2868 LE4..	50.05801-0002	50	60
D2862 LE4..	50.05801-0003	70	90

Maintenance and Care

Filling engine oil

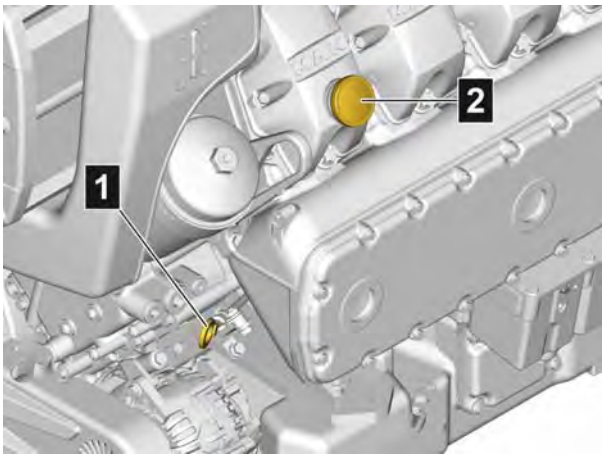
The engine oil pan can be filled via the filler neck on a valve cover and using the electric oil change pump.

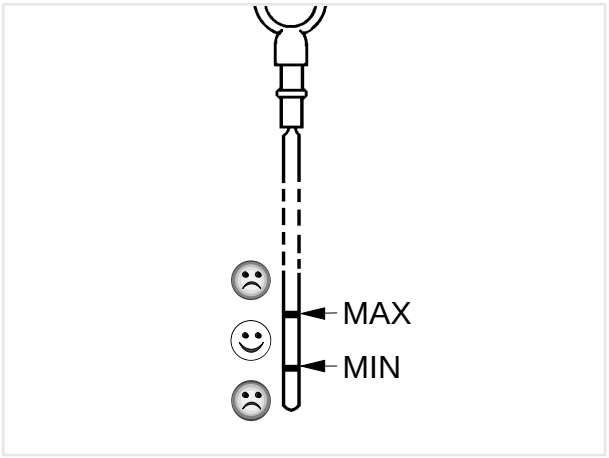
Fill the engine oil pan via the oil filler neck

Prepare the specified maximum fill quantity for the oil pan mounted on the engine in a canister.

1. Slowly pour in the entire oil quantity through the filler neck 2. Wait around 20 minutes for the (cold) engine oil to collect in the oil pan.
2. Pull out the oil dipstick 1 and check the oil level.

The oil level must be between the two notches on the dipstick.





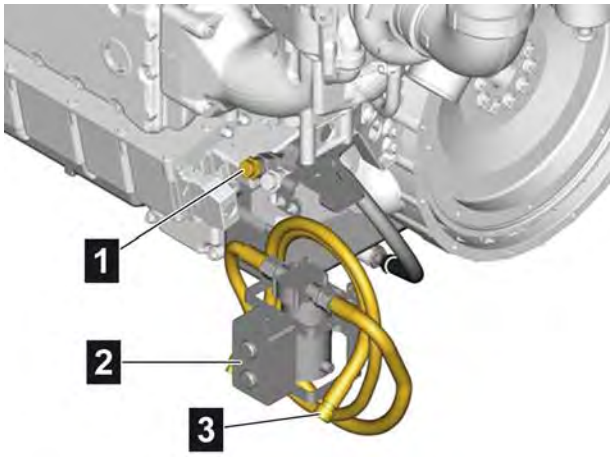
Fill engine oil using the electric oil change pump

An electric oil change pump 2 can be used to fill the engine oil pan, also see page 76.

Prepare the required engine oil fill quantity in a canister.

1. Unscrew the cap 1 .
2. Connect the hose coupling 3 to connection 1 .
3. Switch on the oil change pump 2 using the "OIL IN" button and fill the engine.
4. Pull out the oil dipstick and check the oil level.

The oil level must be between the two notches on the dipstick.



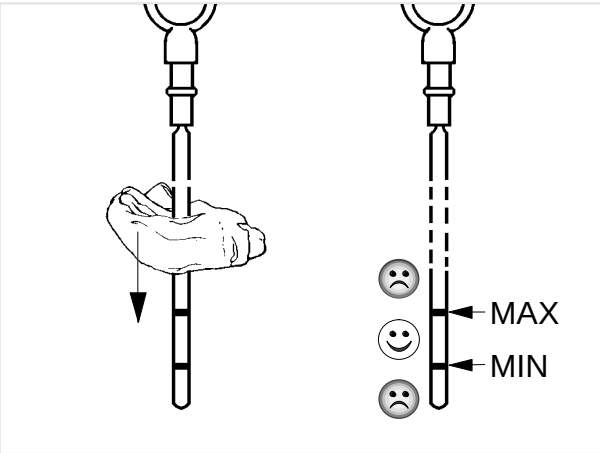
Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

Check the engine oil level

Perform oil level check.

1. Pull out the oil dipstick.
2. Wipe off the oil dipstick with a clean, lint-free cloth.
3. Re-insert the oil dipstick up to the stop.
4. Pull out the oil dipstick again and check the oil level.
5. Re-insert the oil dipstick up to the stop.

If the oil level in the oil pan is above the MAX mark, pump the surplus oil out of the oil pan.



Change transmission oil

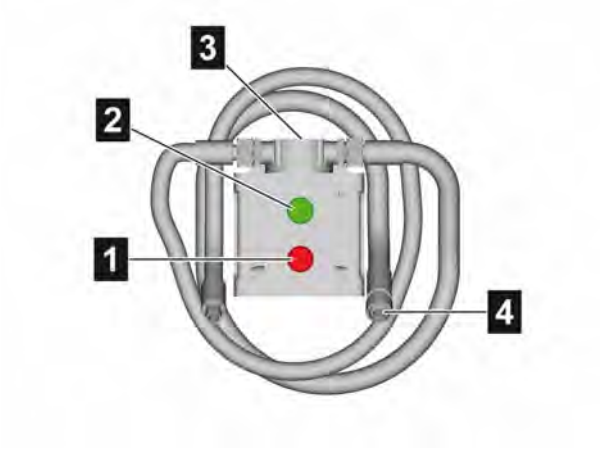
An electrically operated oil suction and filling pump, which can be supplied by MAN, is required for pumping the oil out of the oil pan.

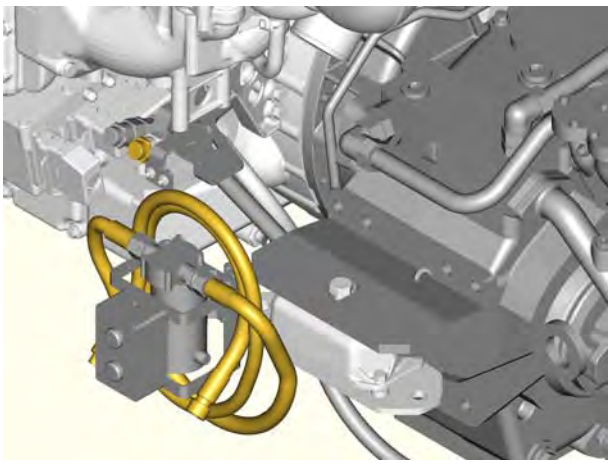
1 "Oil in" button
2 "Oil out" button
3 Flow direction marking
4 Hose coupling for connecting to engine

Supply voltage: 24 V

1. Unscrew the oil drain plug cap 3 .
2. Connect the suction line 2 of the oil drain pump to the oil drain hose 3 of the gearbox.
3. When the machine is at operating temperature, press the oil drain pump's "OIL OUT" button and pump all of the used oil through the drain hose 1 into a container with sufficient capacity.
4. Press the oil drain pump's "OIL IN" button and fill the gearbox with transmission oil using drain hose 3
5. Disconnect the suction line 2 of the oil drain pump from the oil drain hose 1 of the gearbox. Screw on the oil drain hose cap 1 .

For gearbox oil fill quantity, refer to gearbox manufacturer's documentation.





8.4.2 Maintaining the fuel filter

WARNING

Risk of injury due to highly flammable substances
Highly flammable substances, fluids or gases catch fire.

For this reason:
- Smoking, naked flames and sources of ignition are strictly forbidden in the danger zone and close proximity.
- Keep fire extinguishers at hand.
- Report any suspicious substances, fluids or gases to the person in charge immediately.
- Repair leaks.
- Stop work immediately in the event of a fire. Leave the danger zone and do not return until it is safe to do so.

NOTE

Risk of damage due to dirt particles
Risk of component damage due to dirt in the fuel system

For this reason:
- Ensure complete cleanliness when working on the fuel system.

ENVIRONMENTAL NOTE

The emerging fuel must not be allowed to pass into the ground or into sources of water.

Cleaning the fuel prefilter

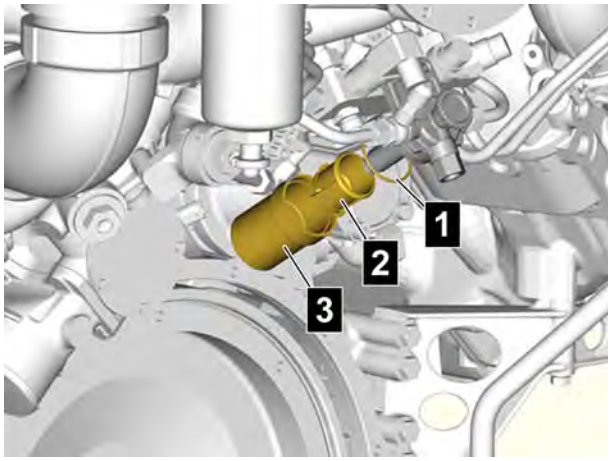
Make sure the engine is stopped before performing maintenance on the fuel prefilter

Close shut-off valves between engine and tank.

Dismantle the fuel prefilter:

1. Unscrew the filter housing 3
2. Remove the O-ring 1 from the filter housing 3
3. Wash out the filter housing 3 and strainer 2 in clean diesel fuel and blow out with compressed air
4. Screw the filter housing 3 with strainer 2 and new O-ring 1 onto the fuel prefilter housing

Tightening torque . . . . . 10 Nm



Fuel prefilter with water separator - changing fuel filter cartridge

1 Close shutoff valves between engine and tank.
2. Disconnect the electrical connection 3 .
3. Unscrew the filter cup 2 and fuel filter cartridge 1 .
4. Clean the filter cup 2 .
5. Coat new seals with fuel.
6. Screw on a new fuel filter cartridge 1 with a new seal until the seal makes contact.
7. Tighten the fuel filter cartridge 1 by hand by a 3/4 turn.
8. Tighten the filter cup 2 with new seal.

Tightening torque . . . . . 20 Nm

9. Connect the electrical connection 3 .
10. Bleed the fuel system, see page 85.

NOTE

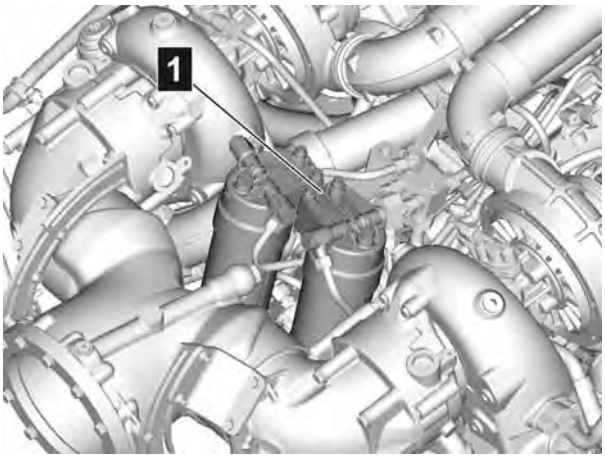
MAN accepts no liability for material defects caused by the use of non-approved spare parts.
MAN accepts no responsibility for damage caused by the installation of spare parts of non-MAN origin.

For this reason:
- Only use genuine MAN spare parts.

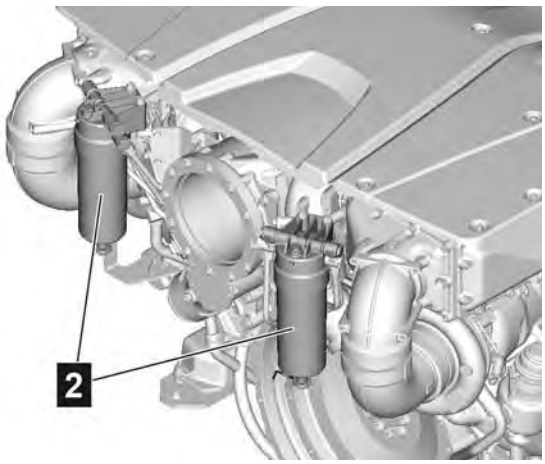
Maintenance and Care

Fuel filter on engine - changing the fuel filter cartridge

A two-stage fuel filter is fitted in the engines.



1 Arrangement of the two-stage fuel filter on engines with one-stage turbocharging.



2 Arrangement of the two-stage fuel filter on engines with two-stage turbocharging.

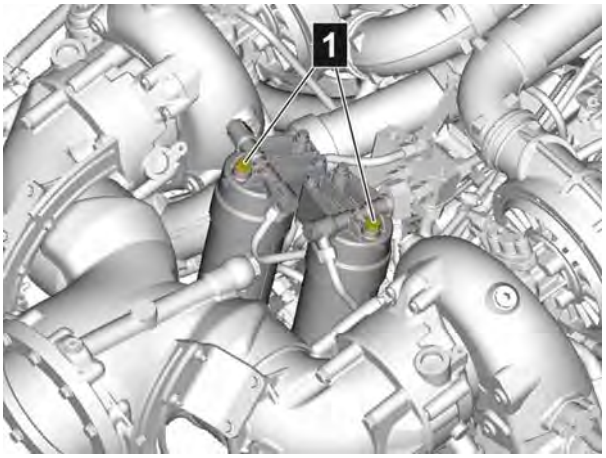
Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

Drain the fuel from the filter

ENVIRONMENTAL NOTE

Do not let fuel spill while draining. Do not let fuel leak out onto the ground or into bodies of water.
Use a container with a capacity of 3 litres to collect the fuel.

1. Open the bleed screws 1 .

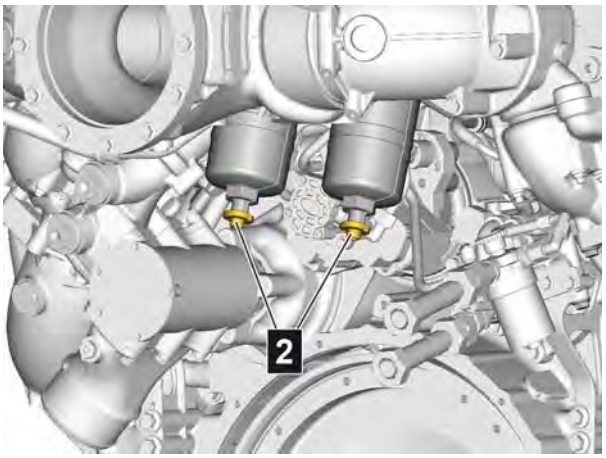


2. Unscrew the drain screws 2 and collect the emerging fuel in a container.
3. Close the drain screws 2 .

Tightening torque . . . . . 3-4 Nm

4. Close the bleed screws 1 .

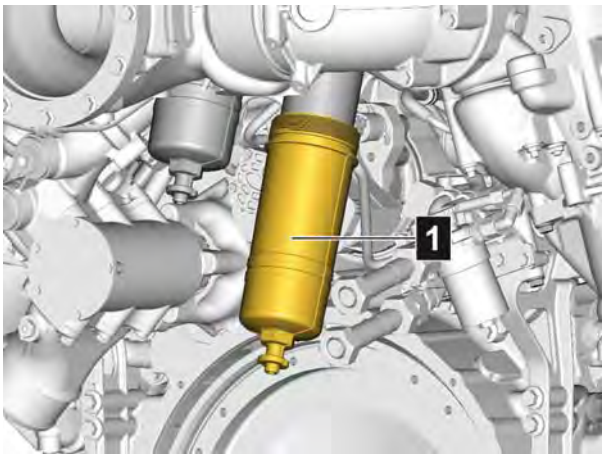
Tightening torque . . . . . 25-30 Nm



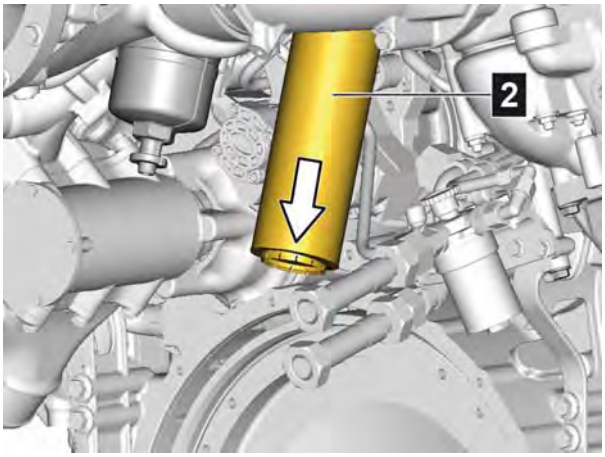
Maintenance and Care

Change the fuel filter cartridge

1. Undo and unscrew the filter cup 1 using an oil filter wrench.



2. Remove the fuel filter cartridge 2 from the housing.

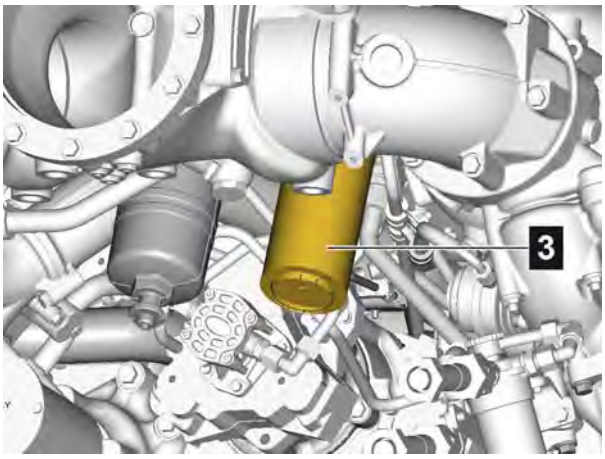


NOTE

MAN accepts no liability for material defects caused by the use of non-approved spare parts.
MAN accepts no responsibility for damage caused by the installation of spare parts of non-MAN origin.

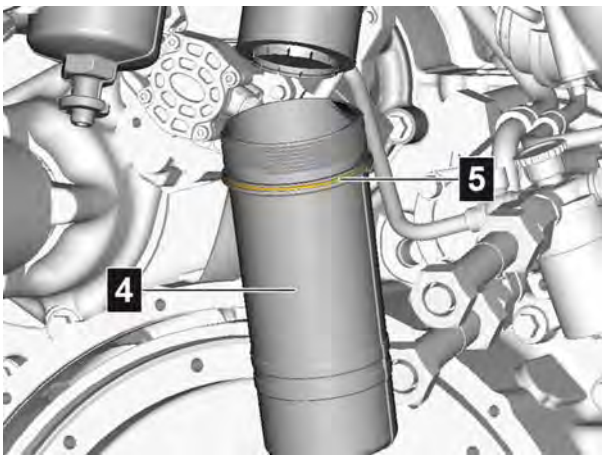
For this reason:
- Only use genuine MAN spare parts.

3. Insert a new fuel filter cartridge 3 into the housing.



4. Clean the filter cup 4 then fit a new O-ring 5 and screw into the housing.

Tightening torque . . . . . 25-30 Nm



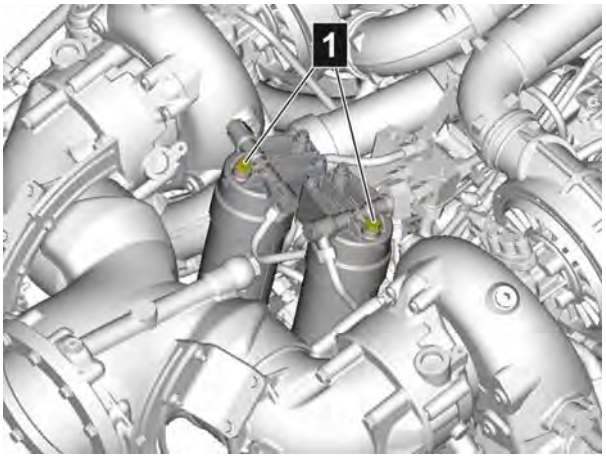
Change the two-stage fuel filter's second fuel filter cartridge.

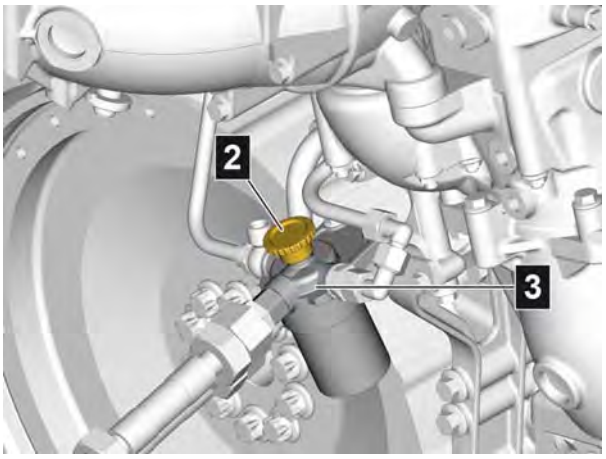
8.4.3 Bleeding the fuel system

1. Undo the bleed screws 1 .
2. Loosen the plunger 2 of the hand pump 3 .
3. Actuate the plunger 2 of the hand pump until fuel emerges at bleed screws 1 without bubbles.
4. Tighten the bleed screws 1 .

Tightening torque . . . . . 25-30 Nm

5. Screw the hand pump plunger back in and tighten it.
6. Check the fuel system for leaks.





8.4.4 Changing the coolant

WARNING

Risk of injury due to hot fluid
Coolant reaches high temperatures during operation and causes scalding if touched.

For this reason:
- Always wear protective gloves when holding the coolant drain plug.

User tip

Use a container with a capacity of at least 100 litres when changing the coolant.

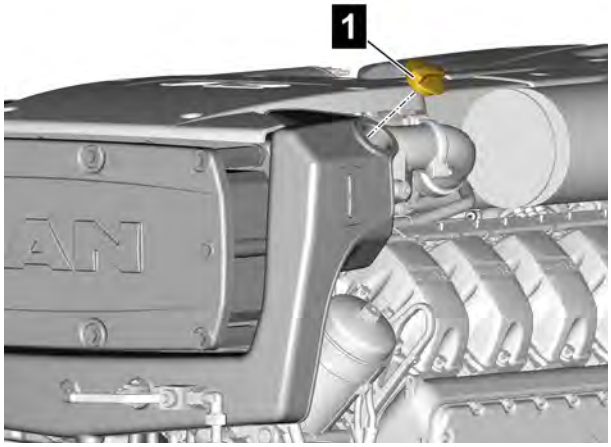
ENVIRONMENTAL NOTE

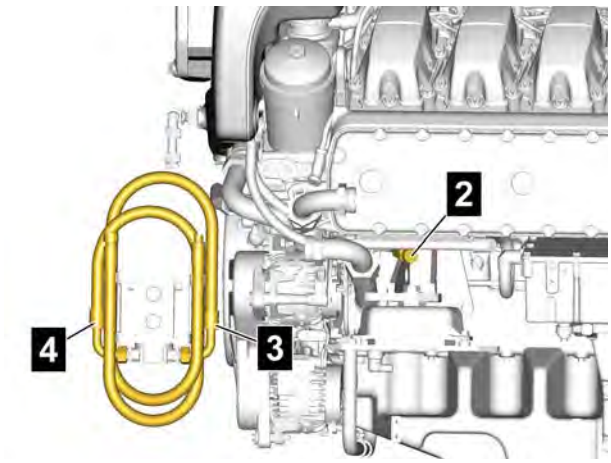
Dispose of refrigerant and refrigerant oil correctly.

Draining the cooling system

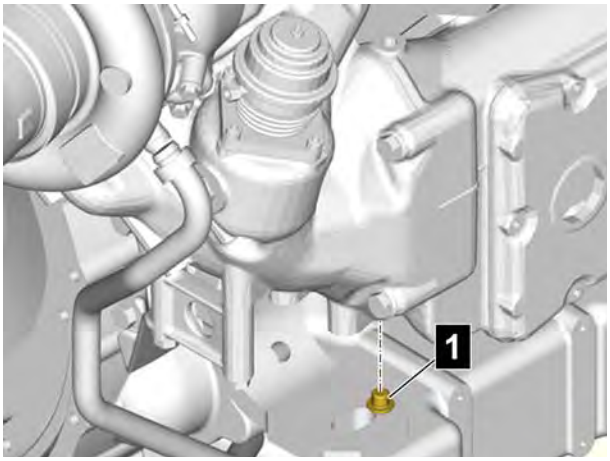
Only drain the cooling system when the ***engine*** has cooled down as follows:

- Open the cover 1 of the filler neck onthe expansion tank.
- Unscrew the protective cap from the drain/filler valve 2 .
- Connect the hose 3 of the pump at the drain/ filler valve 2.
- Hang the hose 4 of the pump into a collecting container
- Switch on the pump and pump out the coolant .
- Switch off the pump.
- Disconnect the hose 3 of the pump from the drain/filler valve 2 .
- Screw the protective cap onto the drain/filler valve 2 .





- Unscrew the screw plug 1 on the exhaust manifold on the left engine side and drain the coolant.
- Screw the screw plug 1 back in and tighten it.
- Filling/bleeding the cooling system.



Filling/bleeding the cooling system

WARNING

Risk of damage due to excessive temperature difference
Engine damage when topping up with cold coolant if the engine is at operating temperature.

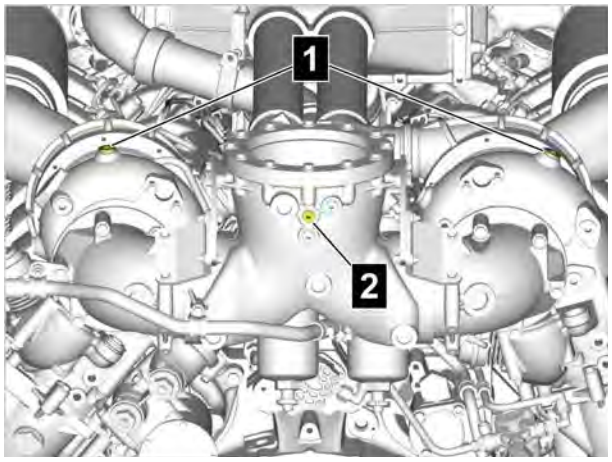
For this reason:
- Do not add cold coolant.
- Let the engine cool down.

NOTE

Engine damage due to lack of antifreeze and corrosion inhibitor
An incorrect mixture of antifreeze and corrosion inhibitor leads to failure of the cooling system.

Therefore:
- Prepare coolant as specified in the publication entitled "Fuels, lubricants and coolants for MAN industrial and marine diesel engines".

During filling, bleed the cooling system through the bleed screws 1 at the liquid-cooled exhaust turbochargers and at the exhaust manifold 2 .



Engine installed inclined towards flywheel side

The bleed screws 1 and 2 are below the coolant level in the expansion tank 4.

1. Undo the bleed screws 1 and 2 .
2. Slowly add coolant at the filler neck of the expansion tank 3 until coolant emerges from the bleed screws without bubbles.
3. Screw in the bleed screws 1 and 2 one after the other, then screw in the cap 3 as far as the stop but do not tighten it.

Overtightened caps can not be opened again!

4. Leave the engine running at a speed of 1200 rpm for around 15 minutes.
5. Shut down the engine.

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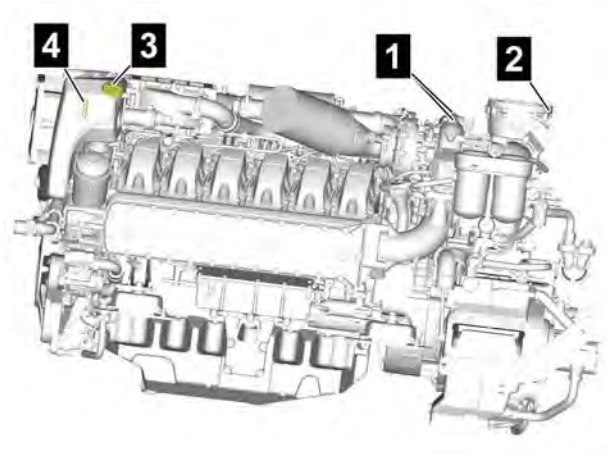


Continue with item 13, see page 96.

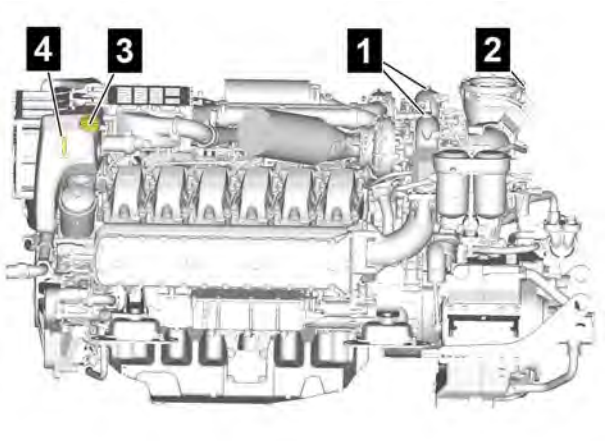
Engine installed horizontally

The bleed screws 1 and 2 are above the coolant level in the expansion tank 4.

In this case, complete filling and bleeding of the cooling system is only possible if the cooling system is filled via the drain/filler valve 5 on the side of the crankcase.

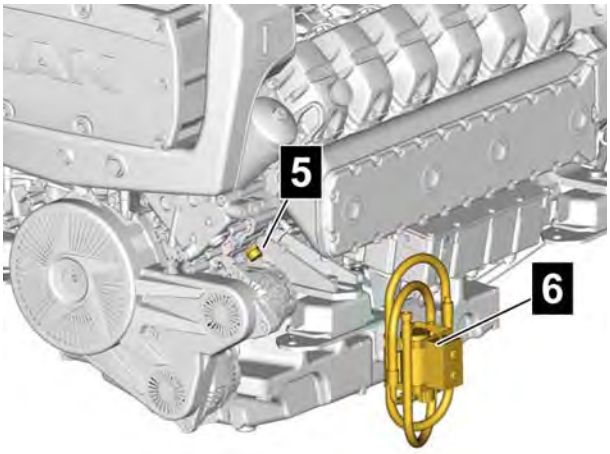
This is performed using a pump 6:

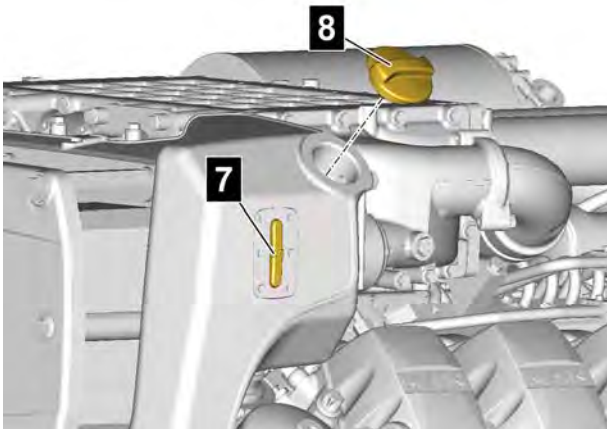
1. Undo the bleed screws 1 and 2 .
2. Open the cover on the filler neck 3 .
3. Connect the filler hose of the pump 6 at the drain/filler valve 5 .
4. Switch on the pump and fill the cooling system until coolant emerges at the filler neck 3. Switch off the pump.
5. Screw in the cap 3 as far as the stop but do not tighten it.



Overtightened caps can not be opened again.

6. Switch on the pump again until coolant emerges at the bleed screw 1 without bubbles.
7. Switch off the pump and tighten the bleed screws 1 .
8. Switch on the pump again until coolant emerges at the bleed screw 2 without bubbles.
9. Switch off the pump and tighten the bleed screws 2 .
10. Unscrew the pump filler hose, screw the cap onto the drain/filler valve 5 and tighten it.
11. Leave the engine running at a speed of 1200 rpm for around 15 minutes.
12. Stop the engine.
13. The coolant level on the sight glass 7 of the expansion tank must be in the middle of the sight glass.
14. Before the next startup (with the engine cold), check the coolant level and top up as necessary. To top up, carefully undo the cap 8 partly in order to release the pressure, then carefully open it and top up the coolant.





The turbochargers must not be vented while the cooling system is being topped up.

Keep repeating this procedure until it is not possible to top up the coolant any more.

Checking the coolant level

WARNING

Risk of injury due to hot fluid
Coolant reaches high temperatures during operation and causes scalding if touched.

For this reason:
- Only open the cooling system when the engine is at operating temperature in exceptional circumstances.
- Carefully undo the cap with safety valve.
- Release the pressure.
- Carefully open the cap.

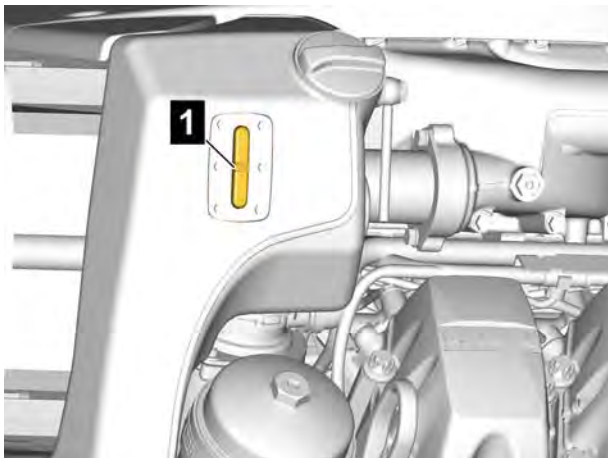
User tip

Do not open the cooling system when the engine is at operating temperature. Pressure will be lost in the cooling system.
If the cooling system is opened when the engine is at operating temperature, this can cause a "Pressure in expansion tank" alarm and reduced engine power when the engine is then operated.
The coolant pressure in the expansion tank only builds up again after the engine has cooled down. Only top up the coolant when the engine is cold.

User tip

In case of overfilling, an excessive amount of filled coolant is discharged via the drain hoses during operation.

- Before the next startup (with the engine cold), check the coolant level. The coolant level on the sight glass 1 of the expansion tank must be at the height of the "COLD LEVEL" mark or higher.
- Top up the coolant if the coolant level is below "min".

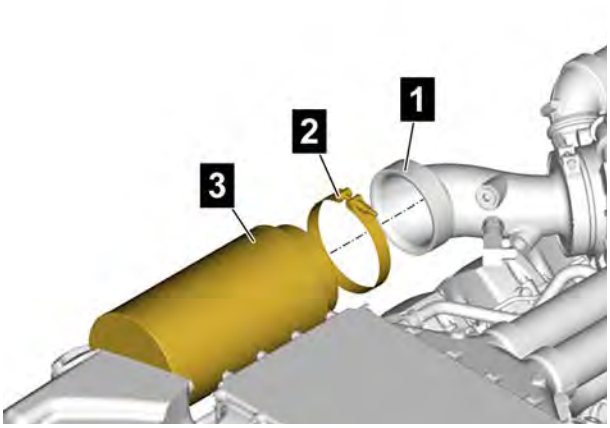


8.4.5 Changing the air filter

Removing the air filter

- Undo the hose clamp 2 .
- Remove the air filter 1 from the intake neck 3 .

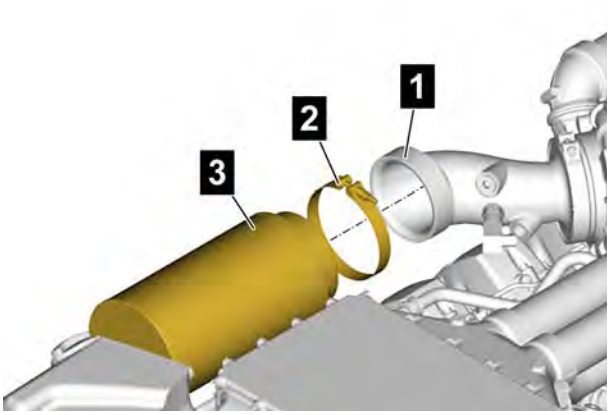
The second air filter is removed in the same way.



Mounting the air filter

- Push the new air filter 1 onto the intake neck 3
- Position the hose clamp 2 and tighten it.

Tightening torque . . . . . 7 Nm



8.4.6 Poly-V-belt

WARNING

Risk of crushing due to moving parts
Rotating and/or linear moving parts can cause injuries.

For this reason:
- Make sure the engine is stopped before checking and replacing poly-V-belts/V-belts.

8.4.7 Checking condition

- Check the poly-V-belts for cracks, fouling by oil, overheating and wear.
- Replace damaged poly-V-belts.

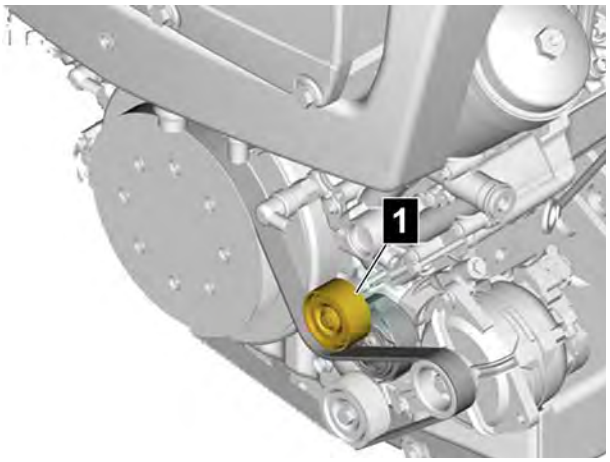
8.4.8 Changing poly-V-belts

CAUTION

Risk of injury due to spring tension
Springing back of the poly-V-belt tensioner

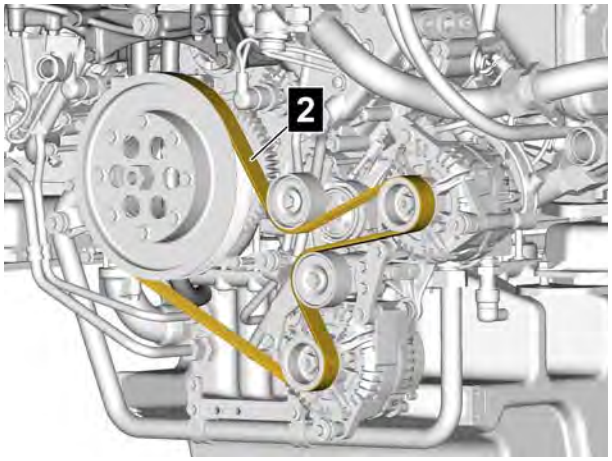
For this reason:
- Brace the poly-V-belt tensioner to prevent it from springing back unintentionally.

- Turn the poly-V-belt tensioner tensioning pulley 1 clockwise as far as the stop and hold it there.
- Remove the poly-V-belt 2 .
- Slacken the poly-V-belt tensioner tensioning pulley 1 carefully.



- Turn the poly-V-belt tensioner tensioning pulley 1 clockwise as far as the stop and hold it there.
- Fit a new poly-V-belt 2 .
- Slacken the poly-V-belt tensioner tensioning pulley 1 carefully.

Only use genuine MAN spare parts.



8.4.9 Alternator

The alternator is maintenance-free.

Observe the following requirements to prevent alternator damage:

- Do not switch off the battery master switch.
- Do not disconnect the battery whilst the engine is running.

8.4.10 Visual inspections on the engine, external cleaning

Engine damage is frequently caused by occurrences, which at first seem to be unimportant or insignificant. Therefore simple visual inspection can be used to detect impending faults at an early stage.
Cleanliness is a prerequisite for faultless operation.

Visually inspect hose connections

Check the coolant hoses for:

- Leakage of coolant or sea water.
- Firm seating of the hose clamps.
- Soiling and oil contamination.
- Ageing (porosity and brittleness) of the hose material.

Check for oil leaks

Visual inspection of the complete engine, in particular of the turbocharger in respect of:

- Oil discharge at the compressor and exhaust duct.
- Damage and leaks at the oil pressure and oil return lines.

Maintenance and Care

9 Faults

The D2868 LE.. / D2862 LE4.. engines are equipped with the MAN Monitoring and Diagnostics System MMDS.

All key engine parameters are continuously monitored by sensors. These data are registered by the MAN Monitoring and Diagnostics System MMDS and compared with stored desired values.

In the event of a fault, the registered engine parameters are outside of the permissible tolerance limits and the system trips an alarm.

The MAN Monitoring and Diagnostics System can reduce the power output of the monitored engine to prevent follow-on damage.

The MAN Monitoring and Diagnostics System can stop the monitored engine autonomously if machine operation is endangered by a technical defect.

To ensure vessel safety in dangerous situations, the override system provides an option for preventing the engine from being stopped or the power from being reduced and for re-activating the full engine power.

The alarms registered by the MMDS are indicated visually and audibly:

- On the MMDS CLC 6.5 colour display on the control stand
- On the engine display of the E-Box in the engine room

NOTE

Risk of engine damage
Alarms are indicators of technical faults that can lead to consequential damage

For this reason:
- Have the cause of a fault remedied immediately by ***MAN Service for marine engines***.

Current directory of service centres on the internet at:
http://www.asp.mantruckandbus.com

MMDS CLC 6.5 colour display on the control stand

If a value reaches a critical level, a warning message or an alarm is tripped and shown on the display, depending on importance. If the value exceeds certain plausible limits, a sensor fault is displayed. An integrated buzzer emits a warning sound each time a new alarm message is issued. This sound can be stopped at the push of a button.

A separate alarm table lists all pending alarms with detailed information. Examples of alarms are shown on the illustration opposite.
The system makes a distinction between:

- Alarm, e.g. EDC combined fault, red, 3100 SPN
- Warning, e.g. SFFR combined fault, orange, 4022 SPN
- Sensor fault, e.g. gearbox oil pressure, yellow

The "SPN numbers", see "Value" column in table opposite, are used by MAN Service to identify the fault.

Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section and the safety instructions in the various chapters.

Display in cover of E-box in engine room

The display 2 in the cover of the E-box 1 is used for visual indication of engine alarms.
Navigation through the various monitoring and alarm pages is possible using the buttons directly on the display.
The language, desired system of units, date, time and display contrast can be set by means of screen menu. In the event of an alarm, the built-in buzzer is activated.

10 Decommissioning and recommissioning

10.1 Prerequisite

Personal Protective Equipment

The following protective equipment must be worn:

- Protective workwear
- Safety shoes
- Safety gloves

10.2 Safety instructions

Personnel

The decommissioning and recommissioning of an engine must only be carried out by trained specialist personnel.

Ground Rules

WARNING

Risk of injury and damage due to untrained personnel

Therefore:

- Ensure that the engine cannot be started be unauthorised persons.
- Perform all work steps as indicated in these instructions.
- Ensure adequate work space before starting any work.
- Make sure the working area is kept clean and orderly.

10.3 Temporary decommissioning of the engine

Frequently, the use of ships is on a seasonal basis.

During a prolonged period of downtime, the engine is exposed to the corrosive influence of the environment. In particular the humidity of the ambient air and also the formation of condensate below the dew point, lead to corrosion damage on cylinder liners, piston rings and valves.

NOTE

Corrosion damage to cylinder liners, piston rings and valves after prolonged period of engine downtime
The ingress of foreign substances can necessitate the complete dismantling of the engine.

Therefore:
- Observe measures for corrosion protection.

10.3.1 Decommissioning of the engine for up to 3 months

Simple precautions taken before the temporary decommissioning of the engine provide effective corrosion protection:

- Thoroughly clean the external surfaces of the engine using compressed air. Thoroughly dry the surfaces.
- Fill the fuel tank with diesel fuel.
- Ensure the correct concentration of antifreeze in the coolant and the specified mixing ratio, see publication entitled "Fuels, lubricants and coolants for MAN industrial and marine diesel engines".
- Close all engine openings (for intake air and exhaust gas), so that no exchange of air can take place inside the engine.
- Drain the water from the sea water pump.

10.3.2 Decommissioning of the engine for between 3 and 6 months

If the engine is to be decommissioned for longer than 3 months, in addition to the precautions named in 10.3.1, conservation of the engine is also necessary.

10.3.2.1 Preservation of the fuel system

The fuel system and the engine combustion chambers are preserved by operating with corrosion-inhibiting fuel. Corrosion-inhibiting fuel is a mixture of conventional diesel fuel and
2% (by volume) Autol Desolite K corrosion inhibitor.

The fuel system must be preserved as follows:

- Prepare corrosion-inhibiting fuel in a container.
- Connect the engine fuel system to this container.
- Operate the warmed-up engine with corrosion-inhibiting fuel for 3 minutes at rated speed.
- Operate the engine for 2 minutes at idle.
- Stop the engine.
- Close off the openings for suction air and exhaust gas and seal them air tight, with the engine still warm.

NOTE

Damage to property due to incorrect preservation
When the engine is cranked with the starter, the engine may not start so as to allow the combustion chambers, cylinder liners and valves to be preserved.

Therefore:
- Opening for intake air closed and airtight.

During the preservation of the injection system, injections are made according to the start characteristic map.

Therefore:
- Supply power to the control unit.

10.3.2.2 Preservation of the intake and exhaust system

- Spray corrosion protection oil (MAN-Part No. 09.11002-0025) into the air intake pipe and exhaust pipe.
- Close off the openings for suction air and exhaust gas and seal them air tight, with the engine still warm.

10.4 Recommissioning of shutdown engines

A routine and careful restart of new or already run engines has a major effect on their operating safety and residual life. The basic aim should be to preserve the engines directly after decommissioning. In this context the specifications in accordance with the MAN Works Standard M3069 should be followed.

User tip

Ex Works the engines are preserved in accordance with Works Standard M3069.
The Works Standard is available from the customer service department at the Nuremberg plant.

If the engine was not preserved before shutdown there is a danger of corrosion to cylinder liners, piston rings and valves, in particular if the suction and exhaust openings have not been sealed and storage has been outside. Foreign substances that have ingressed, including rainwater and the like necessitate, among other actions, a complete dismantling of the engine.

A distinction must therefore be made between the commissioning procedures of preserved and non-preserved engines:

10.4.1 Commissioning of preserved engines compliant to MAN Works Standard M 3069

1. Remove external preservation. Never use a high pressure cleaner for this.
2. Remove caps from intake and exhaust openings.
3. Check the cooling system, add antifreeze according to the list of fuels, lubricants and coolants (see publication entitled "Fuels, lubricants and coolants..."), check concentration and correct as necessary.
4. Check engine oil level and add fresh approved engine oil if necessary.
5. Add fuel, bleed the system.
   Check for correct functioning of the monitoring and emergency stop device.
6. Check condition and proper installation of elastic fasteners, such as V-belts, coolant hoses and charge-air hoses. Retighten if necessary.
7. Crank the engine with the starter without filling until the oil pressure rises, in so doing actuate the starter for a maximum of 5 seconds.
8. Enable filling and start engine.
9. Check engine for possible leaks, check for abnormal noises, observe oil pressure and temperatures. Gradually increase the engine load.
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

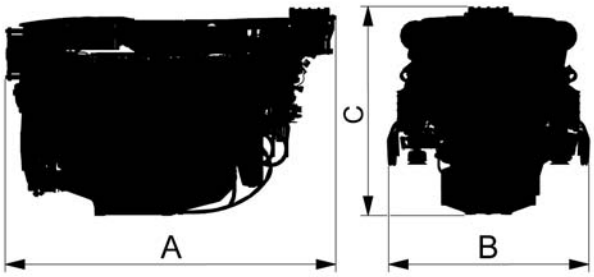
In addition to the work sequences for a preserved engine, the commissioning of non-preserved engines requires the following additional work relating to possible deterioration in storage.

1. Endoscope the combustion chambers, remove and install injectors to do this.
   Check valves for free movement, check valve clearance and adjust as necessary.
   Replace defective/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 filters and exhaust turbochargers for dirt, onset of corrosion, clean or repair as necessary.
5. Clean the fuel system, drain any old fuel. Check, clean and, if necessary, replace filters.

Decommissioning and recommissioning

11 Technical data

11.1 Weights and measures



Engines with 1-stage turbocharching

Specification	V8-1000 (D2868 LE426)	V12-1550 (D2862 LE426) V12-1400 (D2862 LE446)	Unit
Weight (dry)	1780	2270	kg
A	1736	2124	mm
B	1153	1153	mm
C	1236	1290	mm

Engines with 2-stage turbocharching

Angabe	V8-1200 (D2868 LE436)	V12-1800 (D2862 LE436)	V12-1900 (D2862 LE476)	V12-1650 (D2862 LE456)	Unit
Weight (dry)	1875	2365	2365	2365	kg
A	1745	2140	2140	2255	mm
B	1153	1153	1153	1150	mm
C	1222	1275	1275	1350	mm

11.2 Requirements of assembly location, space requirements

Observe the information in the installation instructions.

11.3 Engine data of engines for light duty

11.3.1 V8-1000 (D2868 LE426)

Engine model	**V8-1000 (D2868 LE426)**
Design	V 90°
Operating principle	4-stroke diesel
Combustion system	Direct injection
Supercharging	1-stage exhaust turbocharging with intercooling and charge-air control (Waste Gate)
Number of cylinders	8
Bore	128 mm
Stroke	157 mm
Swept volume	16 160 cc
Compression ratio	17 : 1
Operating mode	Up to 1000 operating hours per year at a maximum of 20 % of time at full load and an average load of 50 %
Rating D2868 LE426	 735 kW / 1000 hp at 2300 rpm
Max. torque D2868 LE426	 3340 Nm at 1300 - 2100 rpm
Ignition sequence DIN 73021	1-5-7-2-6-3-4-8, cylinder arrangement, see page 111
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.80 mm
Fuel system	
High-pressure pump	Bosch CP 3.4
Injection system	Common rail
Governor	Electronic Diesel Control (EDC) - Type EDC 7 C32
Injectors	8-hole nozzles
Engine lubrication	Forced lubrication
Oil change quantity (with filter)	62 litres
Oil filter	2 oil modules, each with 2 oil coolers and one oil separator
Engine cooling system	Liquid cooling
Coolant capacity	85 litres
Coolant temperature	80-90 °C, short term 95 °C permissible
Electrical equipment	
Starter	24 V; 7.0 KW
Alternator	28 V; 1x 120A or 2x 120A

Diese Anleitung vor Beginn aller Arbeiten sorgfältig durchlesen!
Dies gilt insbesondere für das Kapitel Allgemeine Sicherheitshinweise
und die jeweiligen Sicherheitshinweise in den Kapiteln.

11.3.2 V8-1200 (D2868 LE436)

Engine model	**V8-1200 (D2868 LE436)**
Design	V 90°
Operating principle	4-stroke diesel
Combustion system	Direct injection
Supercharging	2-stage exhaust turbocharging with intercooling and charge-air control (Waste Gate)
Number of cylinders	8
Bore	128 mm
Stroke	157 mm
Swept volume	16 160 cc
Compression ratio	17 : 1
Operating mode	Up to 1000 operating hours per year at a maximum of 20 % of time at full load and an average load of 50 %
Rating D2868 LE436	 882 kW / 1200 hp at 2300 rpm
Max. torque D2868 LE436	 4010 Nm at 1200 - 2100 rpm
Ignition sequence DIN 73021	1-5-7-2-6-3-4-8, cylinder arrangement, see page 111
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.80 mm
Fuel system	
High-pressure pump	Bosch CP 3.4
Injection system	Common rail
Governor	Electronic Diesel Control (EDC) - Type EDC 7 C32
Injectors	8-hole nozzles
Engine lubrication	Forced lubrication
Oil change quantity (with filter)	62 l
Oil filter	2 oil modules, each with 2 oil coolers and one oil separator
Engine cooling system	Liquid cooling
Coolant capacity	85 litres
Coolant temperature	80-90 °C, short term 95 °C permissible
Electrical equipment	
Starter	24 V; 7.0 KW
Alternator	28 V; 1x 120A or 2x 120A

11.3.3 V12-1550 (D2862 LE426), V12-1400 (D2862 LE446)

Engine model	**V12-1550 (D2862 LE426), V12-1400 (D2862 LE446)**
Design	V 90°
Operating principle	4-stroke diesel
Combustion system	Direct injection
Supercharging	1-stage exhaust turbocharging with intercooling and charge-air control (Waste Gate)
Number of cylinders	12
Bore	128 mm
Stroke	157 mm
Swept volume	24 243 cc
Compression ratio	17 : 1
Operating mode	Up to 1000 operating hours per year at a maximum of 20 % of time at full load and an average load of 50 %
Rating D2862 LE426 D2862 LE446	 1140 kW / 1550 hp at 2300 rpm 1029 kW / 1400 hp at 2300 rpm
Max. torque D2862 LE426 D2862 LE446	 5180 Nm at 1200 - 2100 rpm 4680 Nm at 1200 - 2100 rpm
Firing order	1-12-2-11-3-10-6-7-5-8-4-9, cylinder arrangement, see page 111
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.80 mm
Fuel system	
High-pressure pump	Bosch CP 3.4
Injection system	Common rail
Governor	Electronic Diesel Control (EDC) - Type EDC 7 C32
Injectors	8-hole nozzles
Engine lubrication	Forced lubrication
Oil change quantity (with filter)	92 litres
Oil filter	2 oil modules, each with 2 oil coolers and one oil separator
Engine cooling system	Liquid cooling
Coolant capacity	113 litres
Coolant temperature	80-90 °C, short term 95 °C permissible
Electrical equipment	
Starter	24 V; 7.0 KW
Alternator	28 V; 1x 120A or 2x 120A

Diese Anleitung vor Beginn aller Arbeiten sorgfältig durchlesen!
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und die jeweiligen Sicherheitshinweise in den Kapiteln.

11.3.4 V12-1800 (D2862 LE436), V12-1650 (D2862 LE456)

Engine model	**V12-1800 (D2862 LE436), V12-1650 (D2862 LE456)**
Design	V 90°
Operating principle	4-stroke diesel
Combustion system	Direct injection
Supercharging	2-stage exhaust turbocharging with intercooling and charge-air control (Waste Gate)
Number of cylinders	12
Bore	128 mm
Stroke	157 mm
Swept volume	24 243 cc
Compression ratio	17 : 1
Operating mode	Up to 1000 operating hours per year at a maximum of 20 % of time at full load and an average load of 50 %
Rating D2862 LE436 D2862 LE456	 1324 kW / 1800 hp at 2300 rpm 1213 kW / 1650 hp at 2300 rpm
Max. torque D2862 LE436 D2862 LE456	 6010 Nm at 1200 - 2100 rpm 5510 Nm at 1200 - 2100 rpm
Firing order	1-12-2-11-3-10-6-7-5-8-4-9, cylinder arrangement, see page 111
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.80 mm
Fuel system	
High-pressure pump	Bosch CP 3.4
Injection system	Common rail
Governor	Electronic Diesel Control (EDC) - Type EDC 7 C32
Injectors	8-hole nozzles
Engine lubrication	Forced lubrication
Oil change quantity (with filter)	92 l
Oil filter	2 oil modules, each with 2 oil coolers and one oil separator
Engine cooling system	Liquid cooling
Coolant capacity	113 litres
Coolant temperature	80-90 °C, short term 95 °C permissible
Electrical equipment	
Starter	24 V; 7.0 KW
Alternator	28 V; 1x 120A or 2x 120A

11.3.5 V12-1900 (D2862 LE476)

Engine model	**V12-1900 (D2862 LE476)**
Design	V 90°
Operating principle	4-stroke diesel
Combustion system	Direct injection
Supercharging	2-stage exhaust turbocharging with intercooling and charge-air control (Waste Gate)
Number of cylinders	12
Bore	128 mm
Stroke	157 mm
Swept volume	24 243 cc
Compression ratio	17 : 1
Operating mode	Up to 500 operating hours per year at a maximum of 5 % of time at full load
Rating D2862 LE476	 1397 kW / 1900 hp at 2300 rpm
Max. torque D2862 LE476	 6220 Nm at 1200 - 2100 rpm
Firing order	1-12-2-11-3-10-6-7-5-8-4-9, cylinder arrangement, see page 111
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.80 mm
Fuel system	
High-pressure pump	Bosch CP 3.4
Injection system	Common rail
Governor	Electronic Diesel Control (EDC) - Type EDC 7 C32
Injectors	8-hole nozzles
Engine lubrication	Forced lubrication
Oil change quantity (with filter)	92 l
Oil filter	2 oil modules, each with 2 oil coolers and one oil separator
Engine cooling system	Liquid cooling
Coolant capacity	113 litres
Coolant temperature	80-90 °C, short term 95 °C permissible
Electrical equipment	
Starter	24 V; 7.0 KW
Alternator	28 V; 1x 120A or 2x 120A

Diese Anleitung vor Beginn aller Arbeiten sorgfältig durchlesen!
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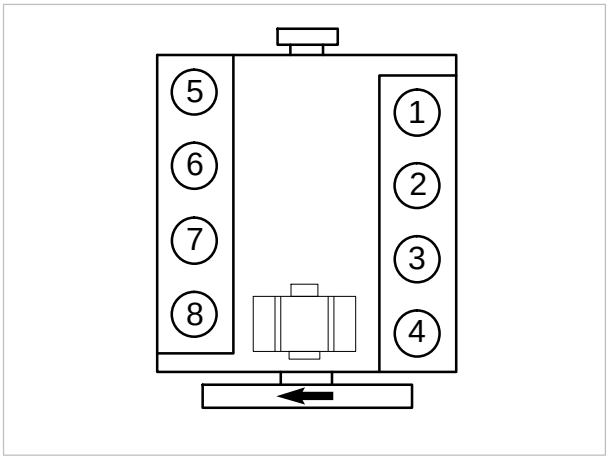
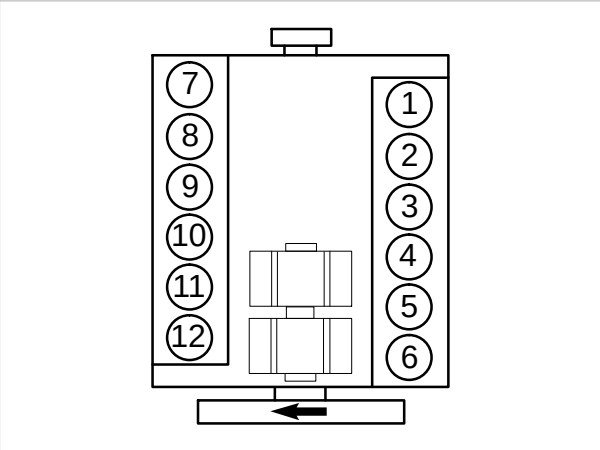
und die jeweiligen Sicherheitshinweise in den Kapiteln.

Cylinder arrangements

Cylinder arrangement V8



Cylinder arrangement V12



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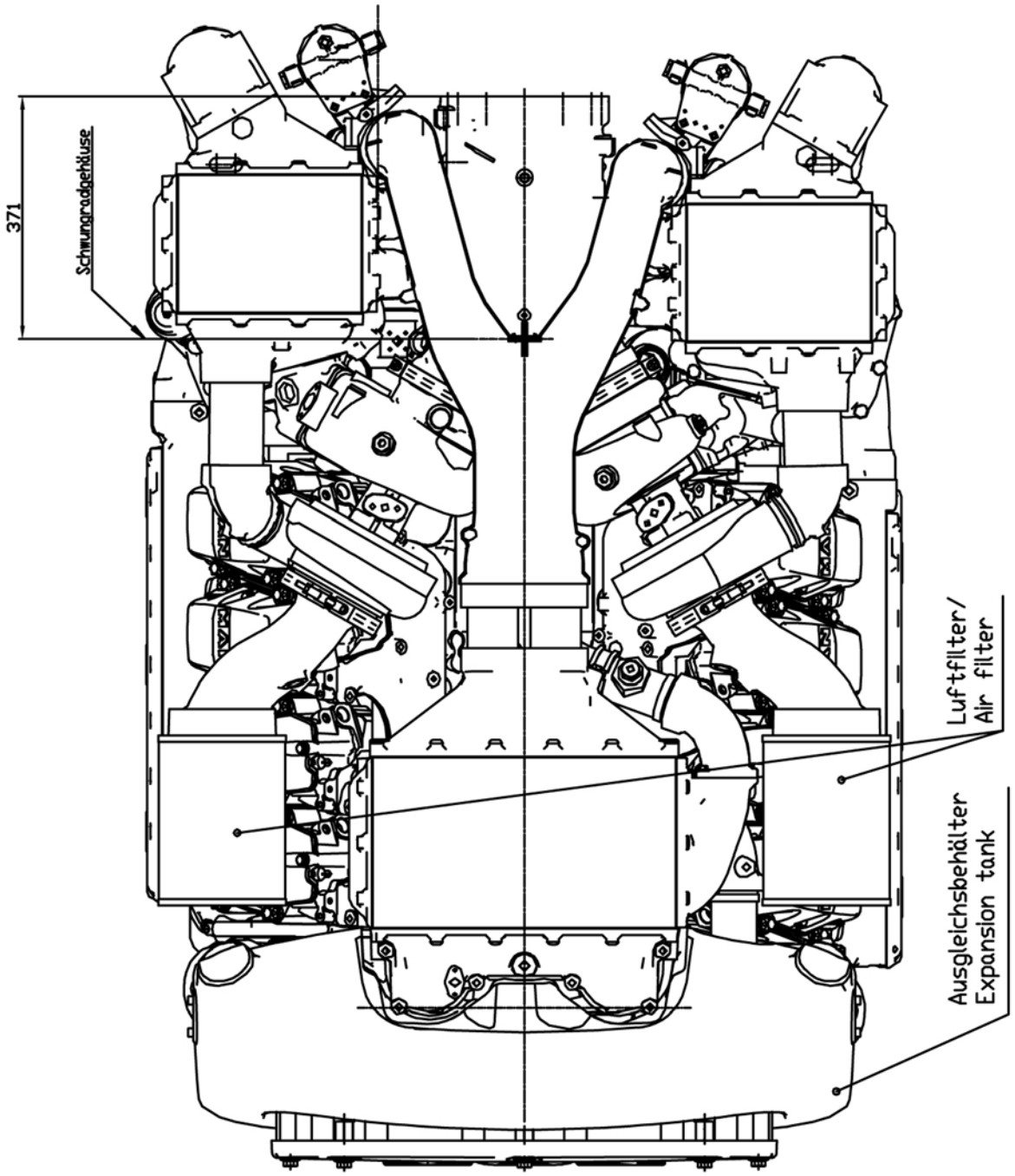
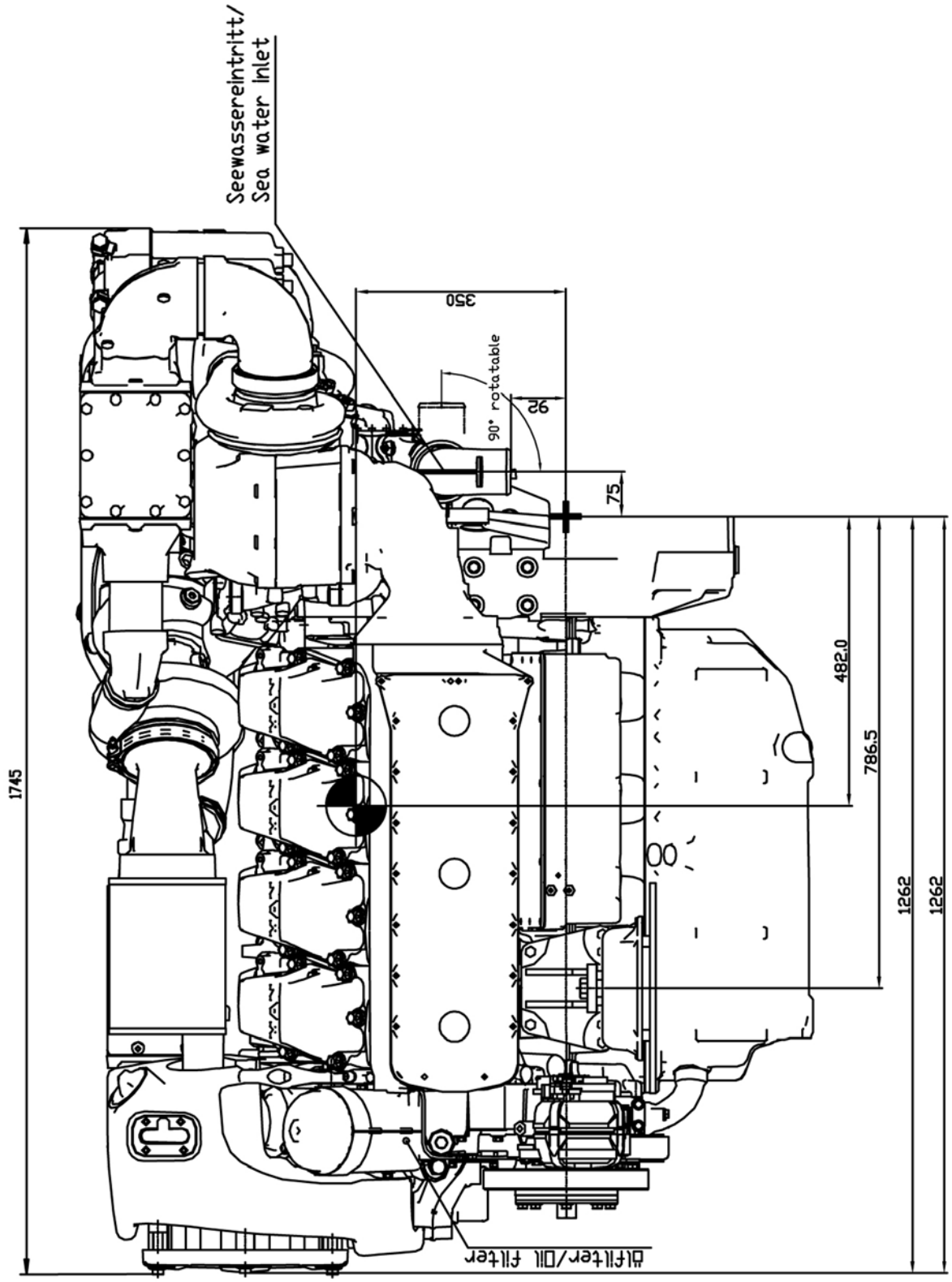
Dies gilt insbesondere für das Kapitel Allgemeine Sicherheitshinweise
und die jeweiligen Sicherheitshinweise in den Kapiteln.

12 Installation drawings V8-1200 (D2868 LE436)

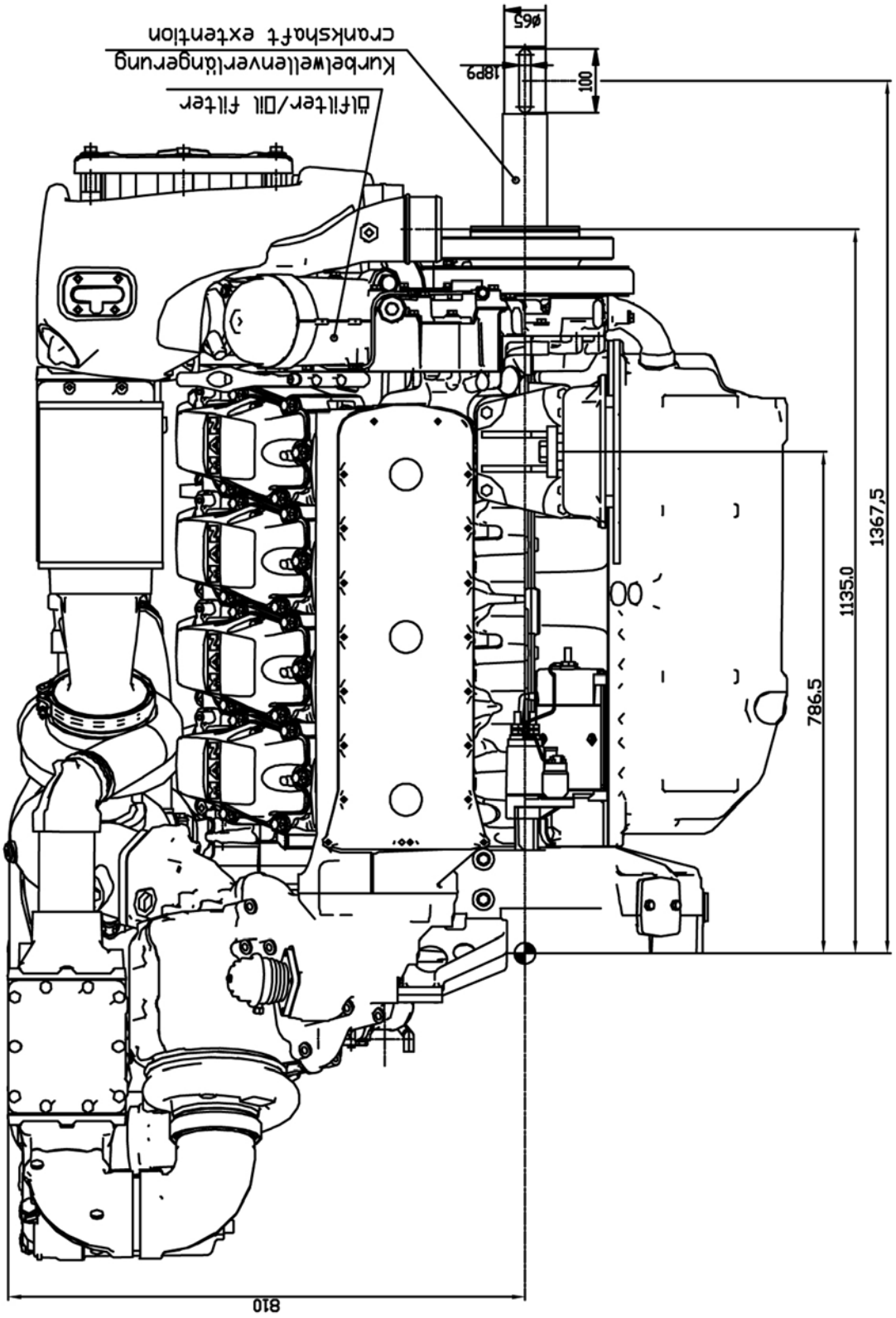


Identification number for installation drawing: 51.00508-7126,
drawn on 08.11.2011

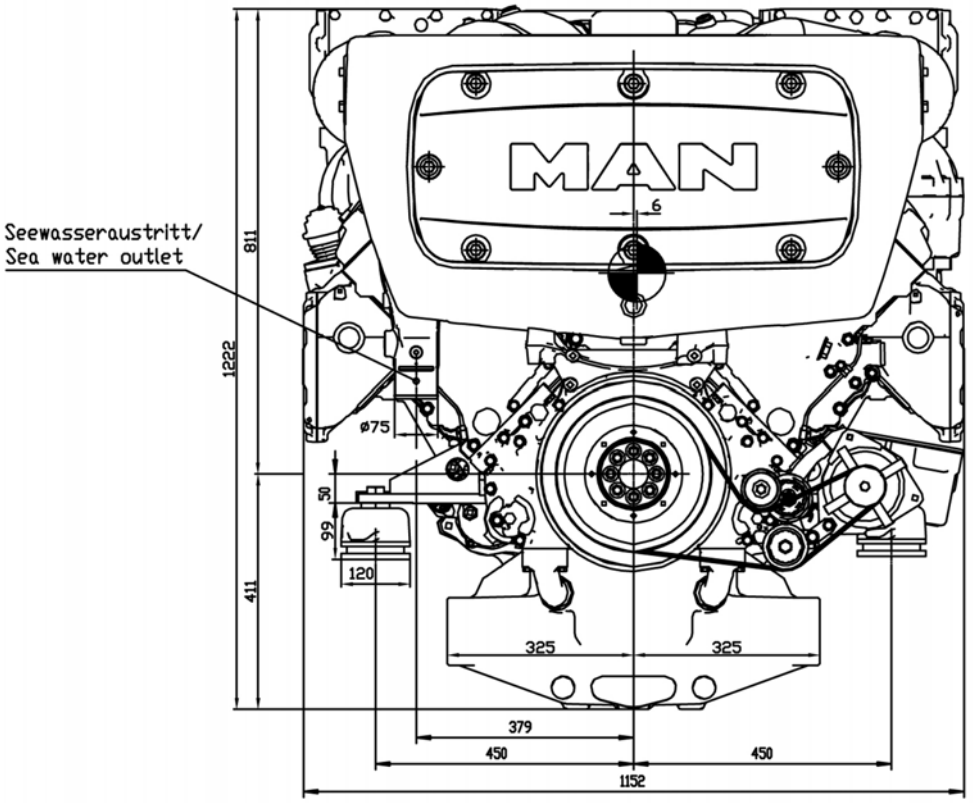
Installation drawings V8-1200

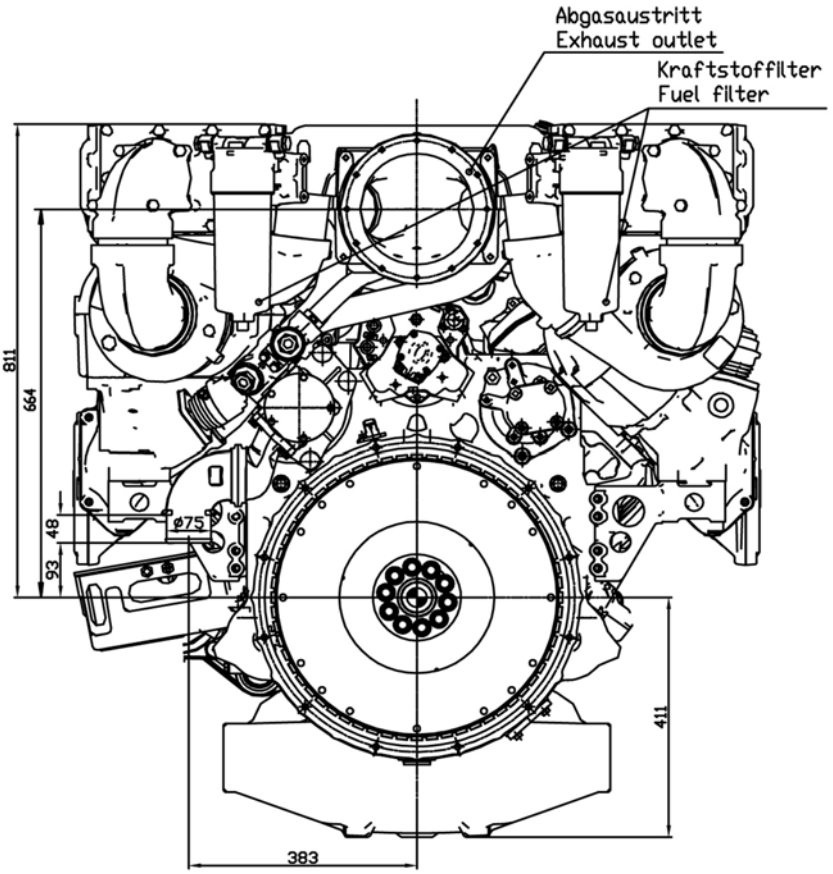


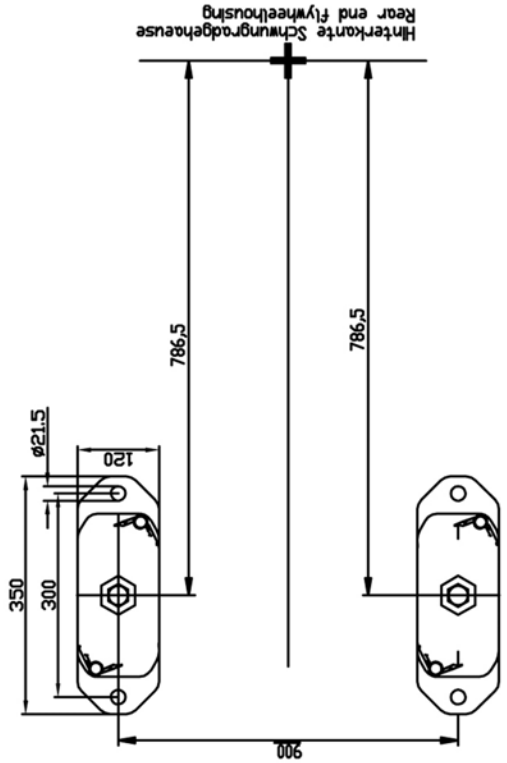
Identification number for installation drawing: 51.00508-7126,
drawn on 08.11.2012


Ø65
18P9
100
Kurbelwellenverlängerung
Crankshaft extention
Ölfilter/Oil filter
1367,5
1135.0
786.5
810

Installation drawings V8-1200

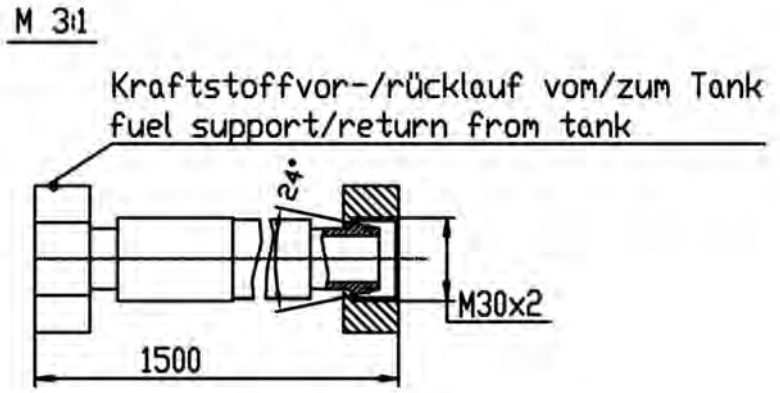


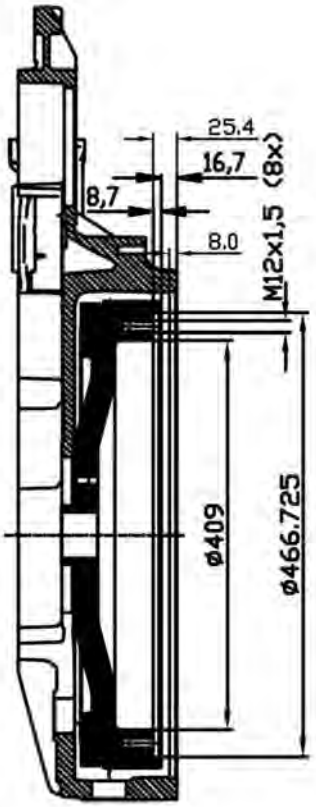




Anordnung Motorlagerung
Arrangement engine mountings

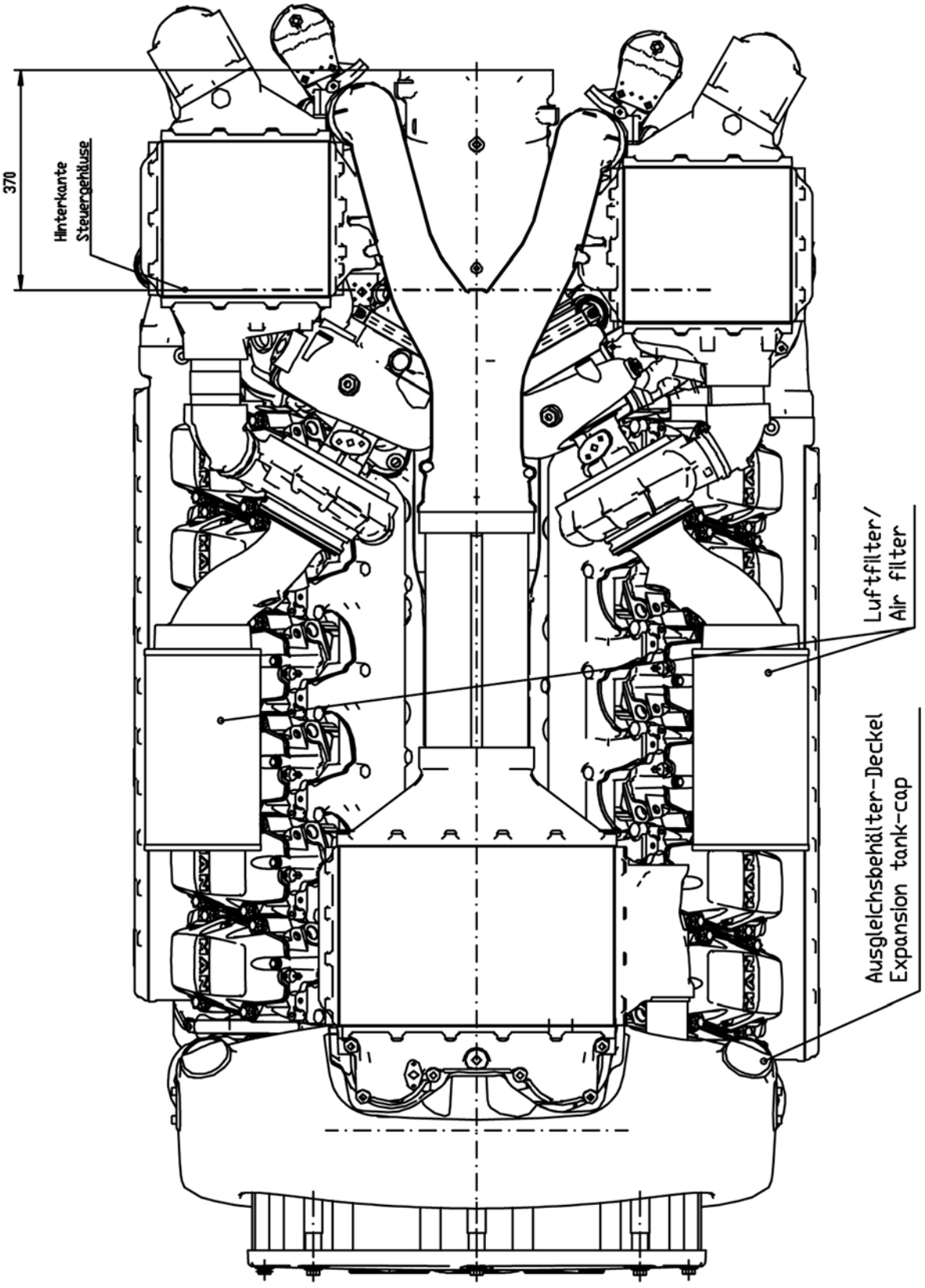
Installation drawings V8-1200





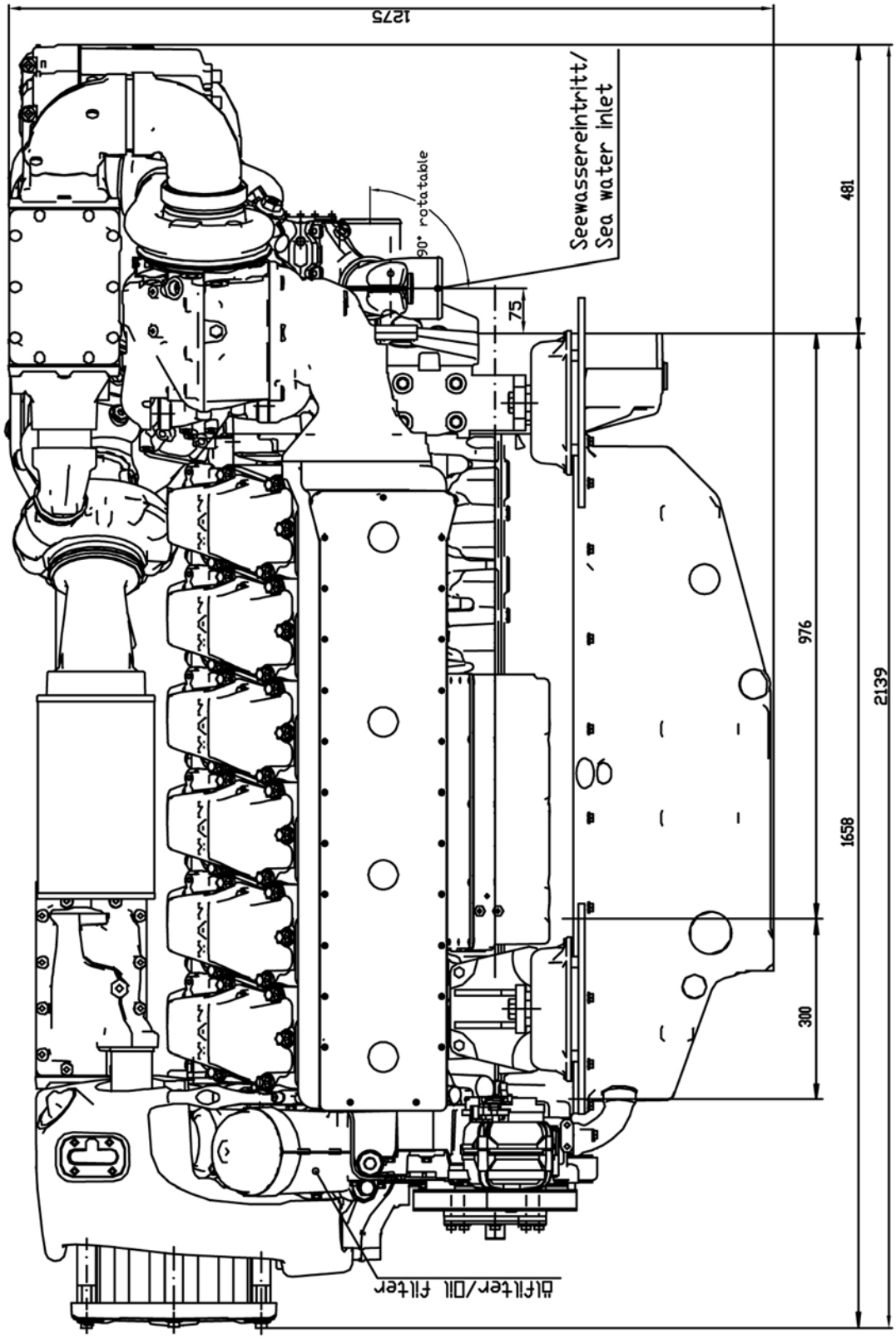
Identification number for installation drawing: 51.00508-7126,
drawn on 08.11.2012

13 Installation drawings V12-1800 (D2862 LE436)



Identification number for installation drawing: 51.00512-7136,
drawn on 22.10.2012

Installation drawings V12-1800



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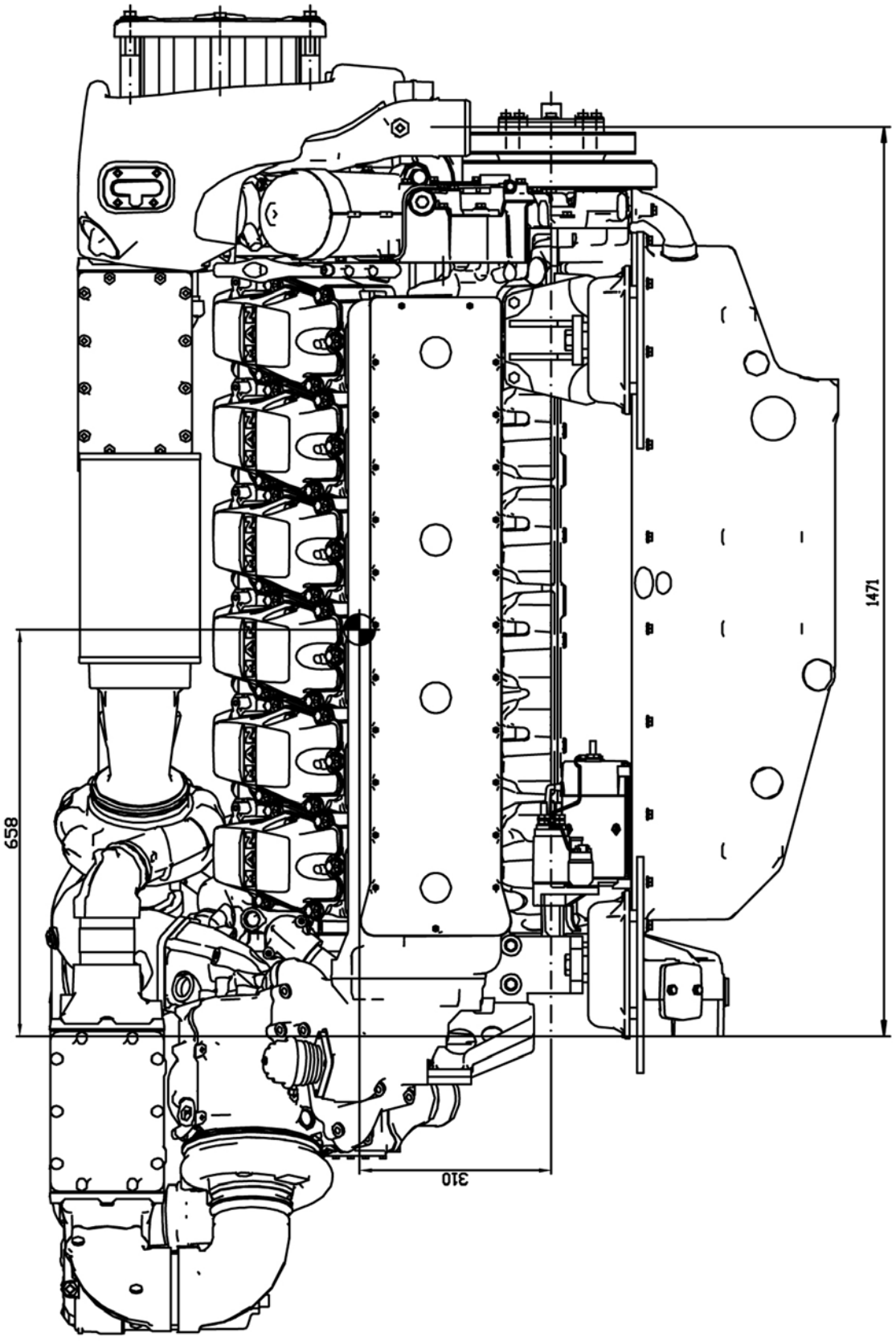

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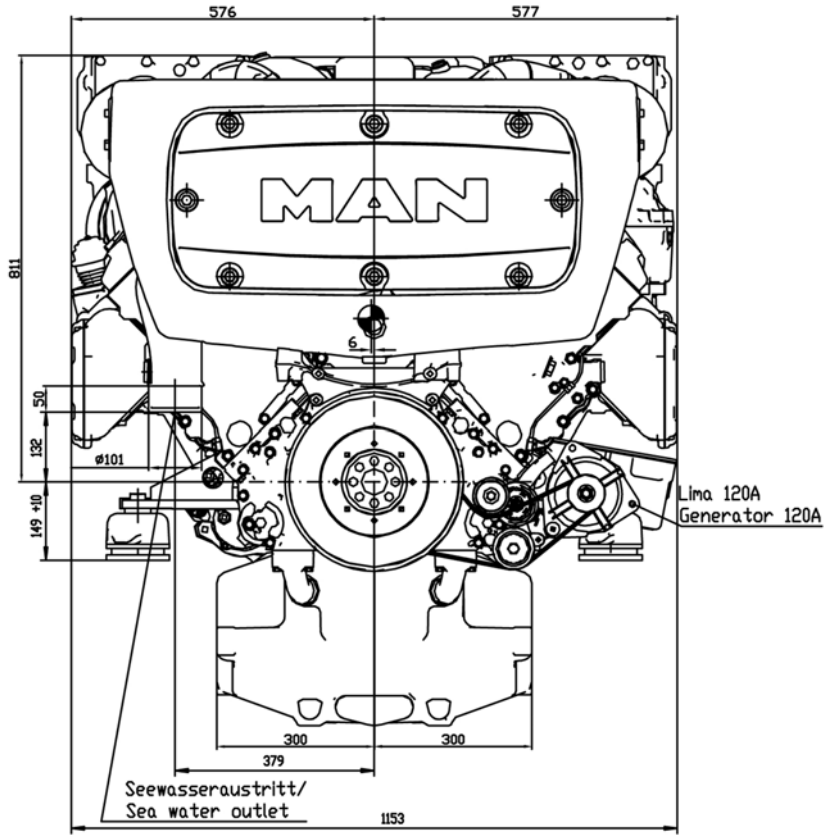

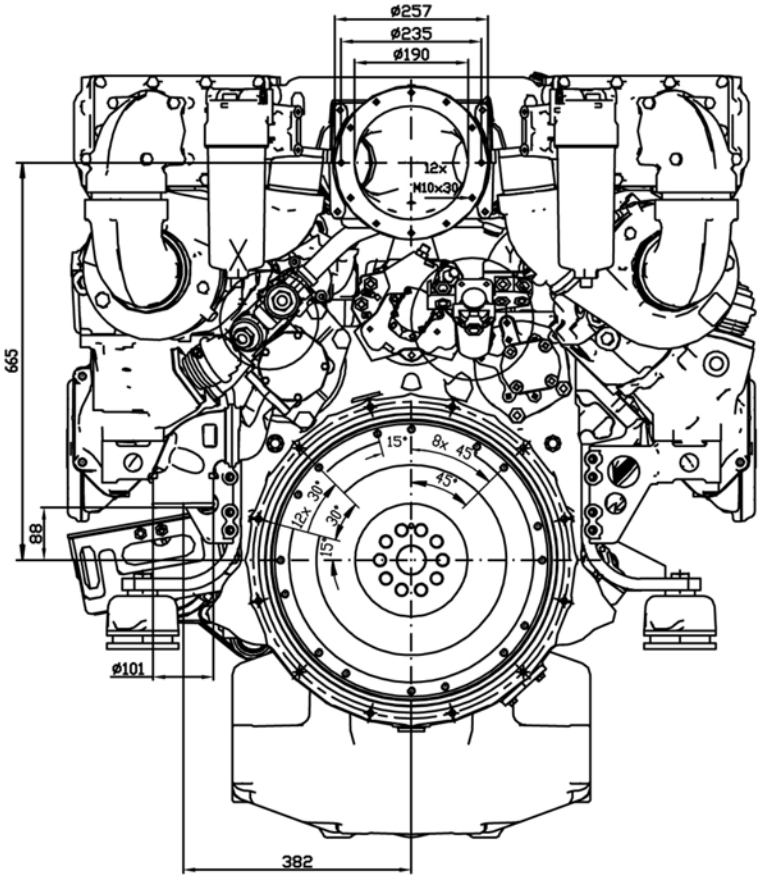

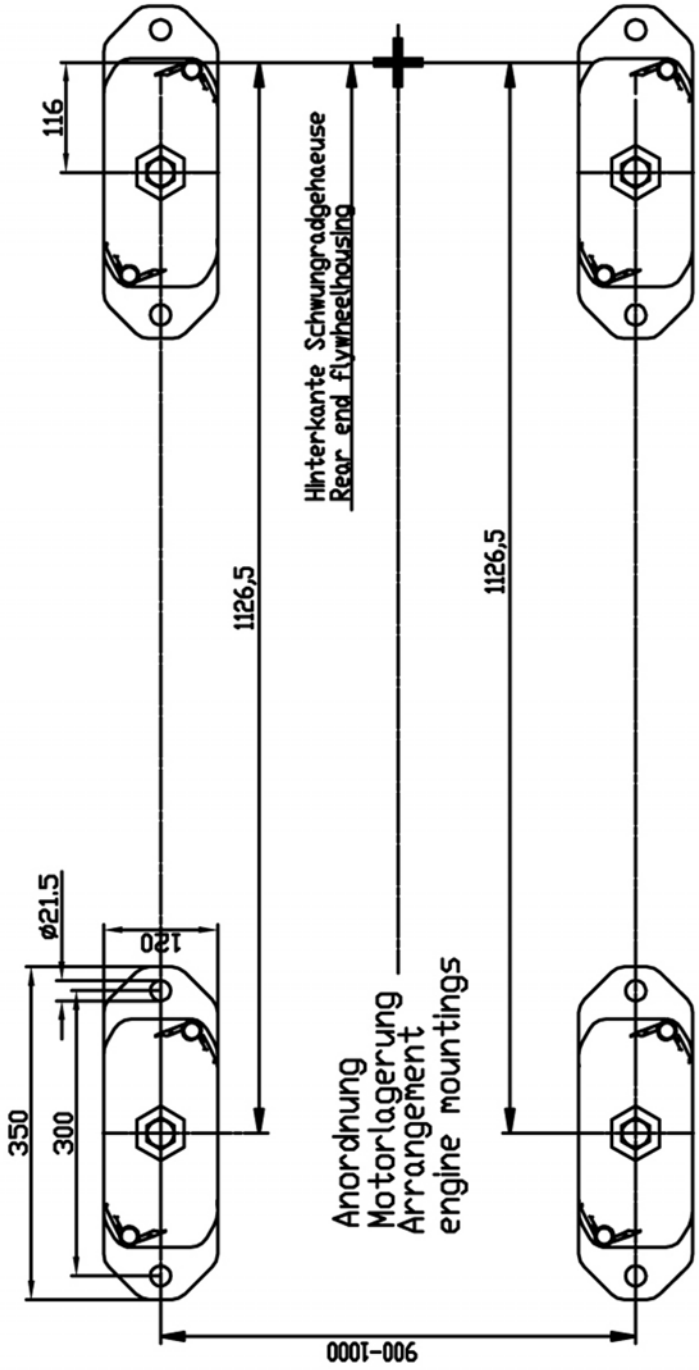

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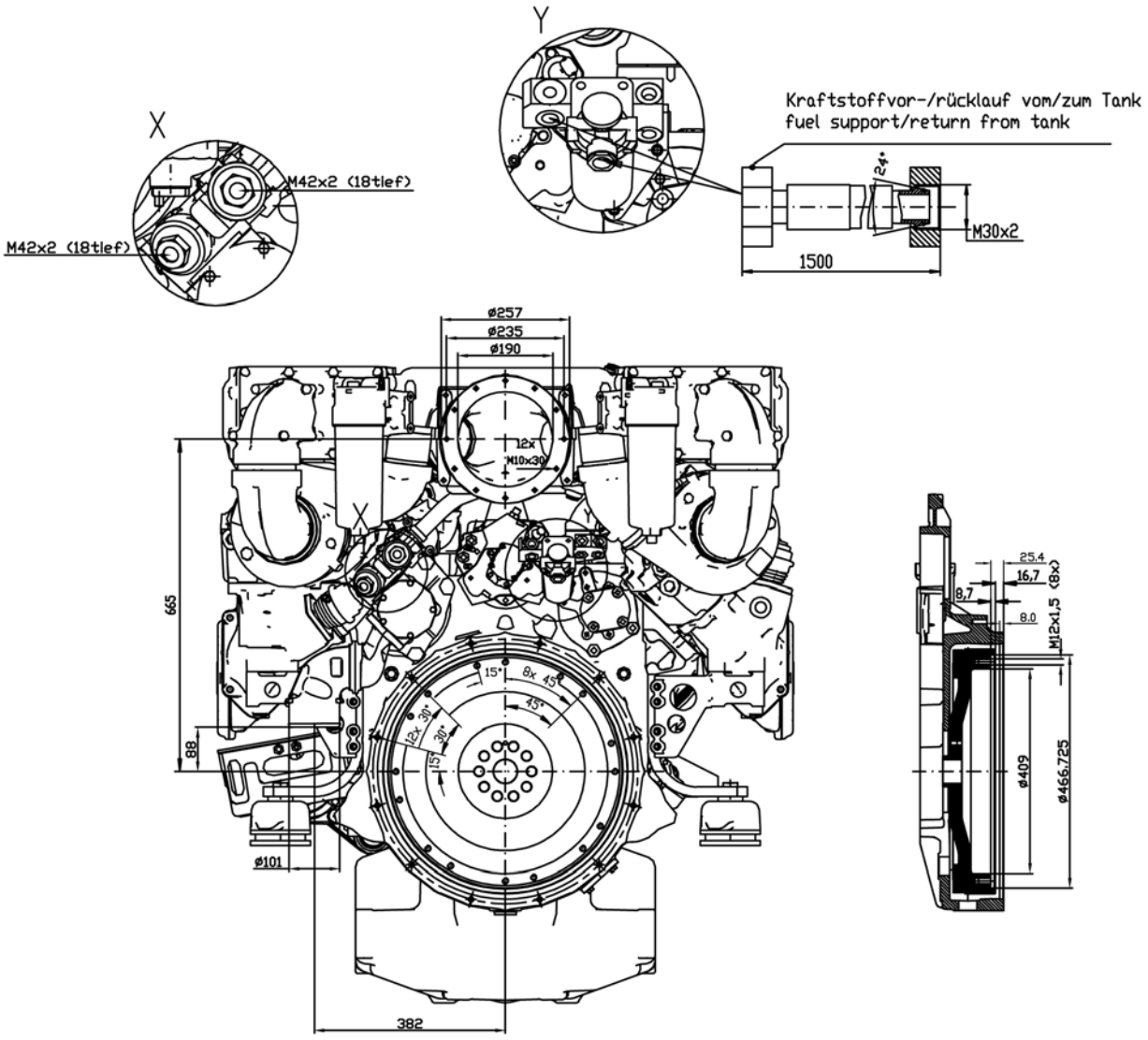
drawn on 22.10.2012

Installation drawings V12-1800



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drawn on 22.10.2012

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14.1 Abbreviations

A . . . . . Ampere

Ah . . . . . Ampere hours

bzw. . . . . Respectively

C . . . . . Celsius

ca. . . . . Approx.

CAN . . . . . Network for control units, in-vehicle data bus system (Controller Area Network)

CR . . . . . Common Rail

cc . . . . . Cubic centimetres

EDC . . . . . Electronic Diesel Control

evtl. . . . . Possibly

Fa. . . . . Company

ggf. . . . . As necessary

h . . . . . Hour

kg . . . . . Kilogram

Term. . . . . **T**erminal

kW . . . . . Kilowatt

LCD . . . . . **L**iquid **C**rystal **D**isplay

LED . . . . . **L**ight **E**mitting **D**iode

m . . . . . Metre

MAN-cats . **MAN-c**omputer **a**ssisted **t**esting and diagnostic **s**ystem)

MAX . . . . . Maximum

MFR . . . . . **E**ngine **M**anagement **C**omputer

MMDS . . . . **MAN Monitoring and Diagnostic System**

min . . . . . Minutes

MIN . . . . . Minimum

mm . . . . . Millimetre

Nm . . . . . Newtonmetre

TDC . . . . . Top Dead Centre

U_{Bat} . . . . . Battery voltage

usw. . . . . and so on (etc.)

BDC . . . . . Bottom Dead Centre

V . . . . . Volt

W . . . . . Watt

e.g. . . . . For example

Perm. . . . . Permissible

> . . . . . Greater than

< . . . . . Less than

rpm . . . . . Revolutions per minute

SFFR . . . . . **S**chiffs**F**ahrzeug**F**ührungs**R**echner (ship management computer)

SPN . . . . . **S**uspect **P**arameter **N**umber

Carefully read through the Operating Instructions before starting any work!
This particularly applies to the General Safety Instructions section
and the safety instructions in the various chapters.

14.2 Technical lexicon

CAN, Controller Area Network, developed by Bosch in the early 1980s, was specially developed for fast serial data interchange between electronic control units in motor vehicles. With CAN, each message to be sent is clearly identified by a message code.
In contrast to station addressing, the message itself is addressed rather than the control unit. Consequently, a message is essentially available to each CAN bus station for receipt. The transfer of a message depends solely on the decision of the control units. It is therefore possible for a message to be accepted by one, several or all control units for further processing.

CR, common rail. Whereas conventional diesel models with direct injection build up the fuel pressure from scratch for each injection, the common-rail system builds it up regardless of the injection sequence so that it is permanently available in the fuel line. Pressurisation and injection are two separate processes. This technology allows injection on demand, which has a favourable effect on fuel consumption and exhaust emissions.

EDC, Electronic Diesel Control. This system has a positive effect on fuel consumption, economy, emissions and noise.

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