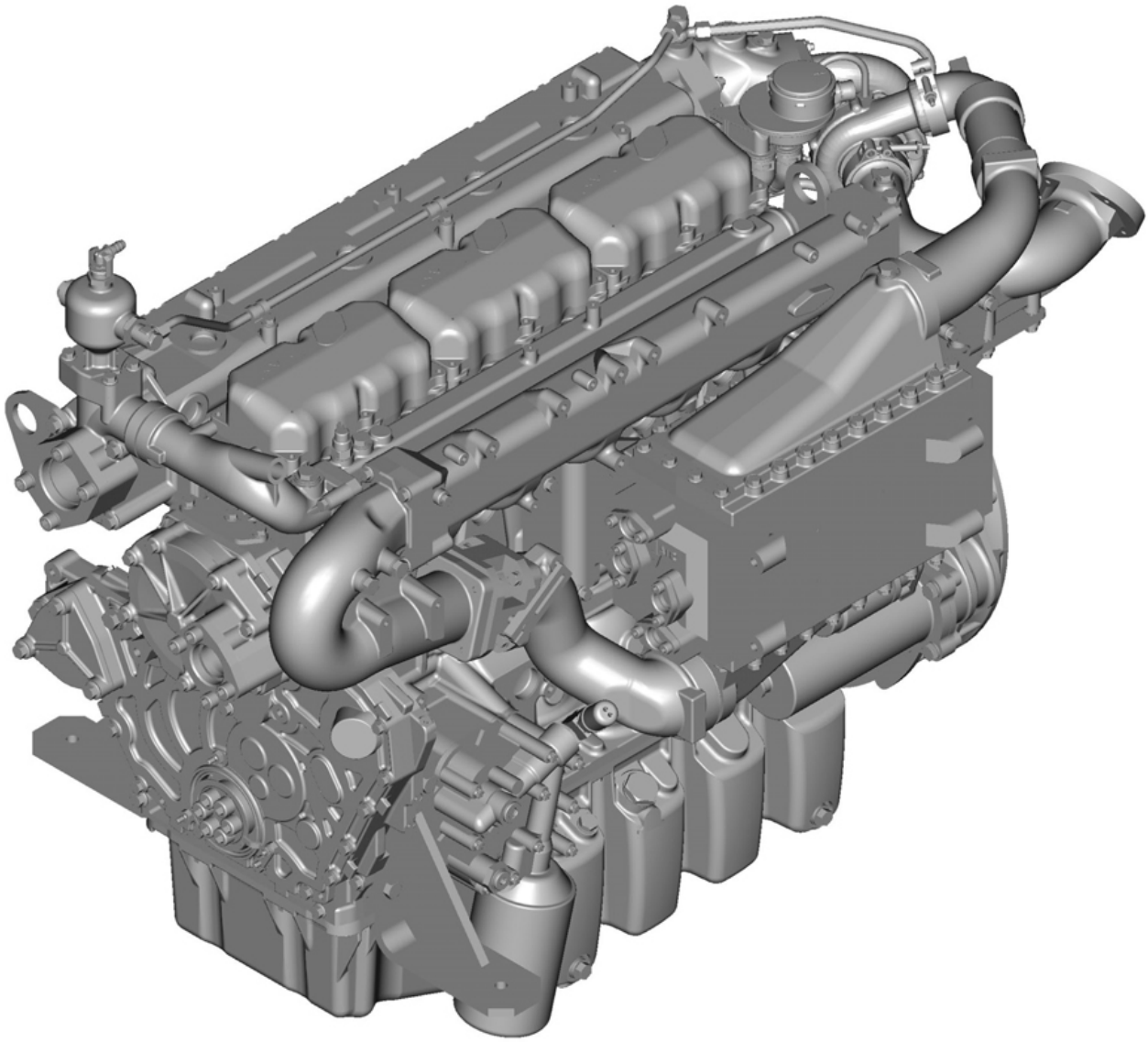


Operating Instruction

MAN Industrial Gas Engines

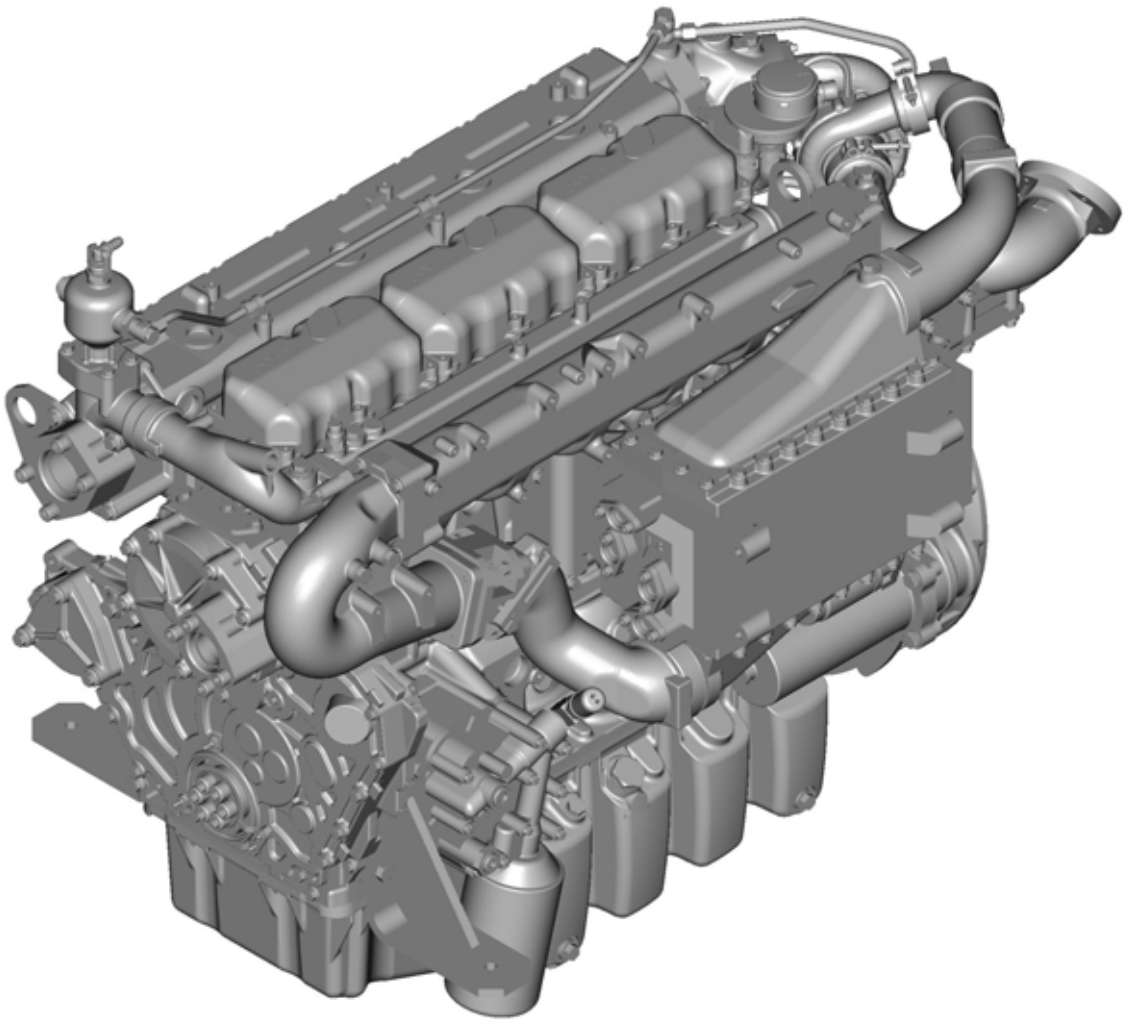
E0834 LE302/312/322 / E0836 LE202/302

MAN Engines
A Division of MAN Truck & Bus

Operating Instructions

MAN Industrial Gas Engines

E0834 LE302 / 312/ 322
E0836 LE202/ 302



51.99493-8538
Version 07

"Translation of the original operating instructions"

Information and Copyright

Subject to change.

MAN Truck & Bus AG
Vogelweiherstraße 33
90441 Nuremberg
Germany

Tel.: +49 911 / 420-1745
Fax: +49 911 / 420-1932

Email: Engine-Documentation@man.eu
Internet: www.man-engines.com

Technical status: 08.2018

51.99493-8538

Table of Contents

Table of Contents

1 Preface

1.1 Information about Operating Instructions

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

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

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

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

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

Economical operation helps to conserve our resources and our environment.

1.1.1 Publications belonging to the Operating Instructions

The following publications belong to the Operating Instructions
- Fluids and Lubricants for MAN Gas Engines
- Assembly Instructions

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

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

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

1.1.2 Additional Publications for the Engines

The following instructions supplement the Operating Instructions for the engines:

For the operator, maintenance and service personnel

- Spare Parts Catalogue (included)

For the service personnel

- Repair Instructions

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

1.2 Key to Symbols

Warnings

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

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

DANGER!

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

WARNING!

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

CAUTION!

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

IMPORTANT!

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

Tips and Recommendations

NOTE!

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

General Information

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

1. This symbol indicates a sequence of actions.

(1) In the text, this symbol indicates a position in a graphic.

1.3 Limitation of Liability

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

MAN is not liable for damages resulting from:

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

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

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

1.4 Copyright

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

NOTE!

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

1.5 Other Applicable Documents

Supplier components are installed in the engine. Risk assessments have been carried out on these parts by the suppliers.
The compliance of construction with the existing European and national legislation has been declared by the respective suppliers of the components.

1.6 Spare Parts

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

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

WARNING!

Risk of injury from incorrect spare parts!
Incorrect or faulty spare parts can lead to damage, malfunctions or total failures and interfere with safety.

For this reason:
- Only use MAN genuine parts

NOTE!

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

Order spare parts through an authorised dealer or directly from MAN.
For addresses, see page 3.

1.7 Disposal

Dispose in accordance with national regulations.

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

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

1.8 Warranty Terms

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

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

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

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

1.9 Service

Our MAN product support is available for technical information.

NOTE!

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

Information about contact persons can always be called up by telephone, fax, email or over the Internet. For addresses see page 3.

2 General Safety Instructions

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

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

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

2.1 Intended Use

The engine is built exclusively to drive generators or for the coupling of heat exchangers within the limits of technical data
Any other use is considered as "not intended".
MAN is not liable for any damage resulting from use that is not intended. The risk is entirely borne by the operator.

Intended use also includes compliance with the country-specific, local environmental regulations.
This in particular concerns the compliance with the applicable legal exhaust emission limits.
Furthermore, the engine operating parameters according to the technical data sheets currently in effect must also be adhered to.
The mixture generating and control system, as well as - if needed - the exhaust aftertreatment system must be prepared by the manufacturer of the complete machine to meet these criteria.

Intended use also includes compliance with the prescribed operating, maintenance and repair work.
The engine may only be used, maintained and repaired by persons who are familiar with the engine and have been informed of the hazards.

Unauthorised modifications to the engine shall void any liability for any resulting property damage and personal injury.
Likewise, the manipulation of the control system could affect the performance and emission characteristics of the engine. Compliance with the statutory environmental requirements can therefore no longer be guaranteed.

DANGER!

Danger from not using the product as intended!
Any use that exceeds the intended use and/or any different use of the engine can lead to dangerous situations which will invalidate the operating permit.

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

NOTE!

Observe the following information when operating the engine:
- The safety information in these Operating Instructions and in the supplier's operating instructions.
- The “Technical Data" chapter in these Operating Instructions and in the supplier's operating instructions.
- Country-specific regulations.

2.2 Contents of the Operating Instructions

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

Reading and understanding the Operating Instructions is thus mandatory.

2.3 Modifications and Conversions to the Engine

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

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

2.4 Responsibility of the Operator

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

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

In particular:

- The operator must be knowledgeable about the valid occupational health and safety regulations and be able to assess, in a risk analysis, the dangers that are present in the specific working conditions at the operating site of the engine. He must then implement these safety regulations in the form of operating instructions for the operation of the engine.
- During the entire period of operation of the engine the operator must check whether the operating instructions he created meet the most current standards for regulations and revise them if necessary.
- The operator must clearly define and regulate the responsibilities for installation, operation, maintenance and cleaning of the product.
- The operator must ensure that all staff who deal with the engine have read and understood the Operating Instructions.
  In addition, the operator must periodically train the staff and inform them about hazards.
- The operator must provide the personnel with the necessary protective equipment.
- The operator must limit access to the operating room.
- The operator must ensure proper ventilation of the operating room.
- These operating instructions must be kept in the immediate vicinity of the engine and be readily accessible at any time to those persons working on and with the engine.

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

In particular:

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

2.5 Personnel Requirements

2.5.1 Qualifications

WARNING!

Risk of injury caused by insufficient qualifications!
Improper handling can result in significant personal injury and property damage

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

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

- **Instructed Persons**
  Have been instructed in a briefing about the possible dangers of improper handling in their tasks.
- **Qualified Personnel**
  Due to their technical training, knowledge and experience and knowledge of the relevant regulations they can properly perform the tasks assigned to them.
- **Electric Specialist**
  Is capable of performing work on electrical systems due to his/her technical education/training, knowledge and experiences as well as knowledge of the respective standards and regulations and can recognise and avoid any possible dangers.
  The electric specialist is trained for the specific operating site in which he/she works and knows the relevant standards and regulations.

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

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

2.5.2 Unauthorised Persons

WARNING!

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

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

2.5.3 Instructions

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

2.6 Personal Protective Equipment

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

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

Protective Clothing

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

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

Protective Helmet

To protect the head from falling or flying objects.

Safety Shoes

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

Safety Gloves

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

To be worn when performing specific types of work

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

Safety Glasses

To protect the eyes from flying objects and spraying fluids.

Hearing Protection

To protect the ears from damage by loud noises.

2.7 Specific Dangers

The following section describes residual risks which have been identified.

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

Electrical Current

DANGER!

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

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

DANGER!

Risk of death caused by electrical current!
Do not touch or pull on the following parts of the ignition system when the engine is in operation:

- Ignition coils and caps
- Wires of the high voltage circuit
- Wires of the low voltage circuit
- Connectors of the output and input wires

Moving Parts

WARNING!

Risk of injury caused by moving parts!
Rotating or linear moving parts can cause serious injuries.

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

Multi-engine plants

WARNING!

Risk of injury caused by engines!
Persons in the operating room are at a risk if engine damage occurs.

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

Exhaust gases

WARNING!

Risk of health hazard caused by exhaust gases!
Leaks in the exhaust system can cause dangerous exhaust gases to leak into the engine room.

For this reason:
- Ensure sufficient ventilation.
- Immediately shut down engines with exhaust leaks.

Highly Flammable Substances - Gaseous Fuels, Oils and Grease

WARNING!

Fire hazard caused by gaseous fuels!

For this reason:
- No smoking and no open flames.
- The regulations for gas installations must to be observed.
- Leaks in the gas supply system are an explosion hazard and are to be rectified immediately.

Conduct when gas leaks
- Close shutoff valve for gas supply
- Switch off master switch for electrical system
- Block off the hazard area. Keep all uninvolved persons out of the hazard area
- If gas leaks, immediately notify those responsible and start repairs

Conduct in case of fires
- Alert fire department
- Administer first aid to the injured and, if necessary, notify the paramedics
- When gas leaks from a system and catches fire, the flames cannot be easily extinguished. Try to cool the burning object (e.g. by reducing the surrounding oxygen: close doors and windows).
  Burning gas = Controlled gas!
- Prevent the flames from spreading to the surroundings
- If the flames spread to the surroundings, fight resulting fires using fire extinguishers
- Keep calm!

WARNING!

Risk of fire caused by highly flammable substances!
Highly flammable materials (lubricating oils, greases) can catch fire and cause serious to deadly injuries.

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

Coolants - Antifreeze, Anticorrosion Agents

WARNING!

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

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

Hot Fluids and Lubricants

WARNING!

Risk of burns caused by hot fluids and lubricants!
Fluids and lubricants can reach high temperature while in operation and cause burns when coming into contact with them.

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

Hot Surfaces

CAUTION!

Risk of burns caused by hot surfaces!
Contact with hot components can cause burns.

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

Noise

WARNING!

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

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

Sharp Edges and Corners

CAUTION!

Risk of injury cause by sharp edges and corners!
Sharp edges and corners can cause cuts and scrapes to the skin.

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

Dirt and Objects

CAUTION!

Risk of tripping caused by dirt and objects!
Dirt and objects can cause a person to slip or trip which can cause considerable injuries.

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

Strong magnetic fields

WARNING!

Risk of death caused by strong magnetic fields!
Strong magnetic fields can cause serious injuries and death as well as considerable property damage.

For this reason:
- Persons with cardiac pacemaker must not remain in the vicinity of the engine.
  The operation of the cardiac pacemaker could be negatively affected.
- Persons with metal implants must not remain in the vicinity of the engine. Metal implants could heat up or be attracted to the magnetic source.
- Keep ferromagnetic materials and electromagnets away from magnetic sources. These materials can be magnetically attracted and can fly through the room and injure people or cause death. Keep a minimum distance of 3 m.
- Take off all metal objects (jewellery, watches, pens, etc.) before starting any maintenance work.
- Do not take any electronic devices near the magnetic source. They could be damaged.
- Dot not take any memory devices, credit cards, etc. near the magnetic source. Data could be erased.

2.8 Safety Equipment

The operator must have the following safety equipment in place:

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

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

The emergency-off equipment must always be freely accessible.

WARNING!

Risk of death caused by non-operational safety equipment!
Safety equipment ensures maximum safety during operation. Even if they may make working more complicated, they must not be overridden. Safety can only be guaranteed if the safety equipment is intact and operational.

For this reason:

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

2.9 Conduct in Dangerous Situations and When Accidents Occur

Preventative Measures

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

In the case of an accident: Act accordingly

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

CAUTION!

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

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

2.10 Signs

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

WARNING!

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

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

Electric Voltage

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

Unauthorised persons may not enter these rooms.

Hot Surfaces

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

2.11 Environmental Protection

CAUTION!

Environmental hazard caused by incorrect handling!
Incorrect handling of environmentally hazardous substances, especially when incorrectly disposed of, can cause considerable damage to the environment.

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

The following environmentally hazardous substances are used:

Lubricants

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

Coolants

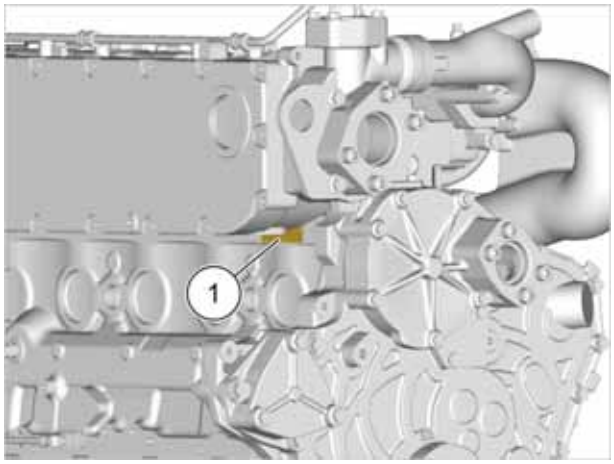
Coolants can contain poisons and environmentally hazardous substances. They must not be allowed to be released into the environment. Disposal must be performed by a qualified disposal company.

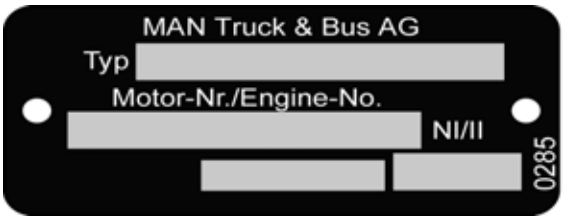
3 Engine Model Plate

Always specify the engine typeand engine number when sending messages and making queries.

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

Engine model plate (1) is installed on the crankcase.





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

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

3.2 Explanation of Model Designation

Model designation	Explanation	Example
E	Fuel type	Natural gas (or biogas)
08	Figure + 100	108 mm bore
3	Stroke figure (rounded)	125 mm stroke
4 / 6	Number of cylinders	4, 6 cylinders
L	Charging	with charger and charge air cooling
E	Engine installation	Installation engine for power generation plants
202 / 302	Model designation identification	202 = Development number 302 = Development number

4 Design and Function

4.1 Engine, General

The 4 and 6 cylinder engines described here is liquid-cooled 4-cycle spark ignition engine with turbocharging and intercooling.

Engine Monitoring

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

E = Eingang (Input)
V = Verarbeitung (Processing)
A = Ausgang (Output)

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

Engine Lubrication

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

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

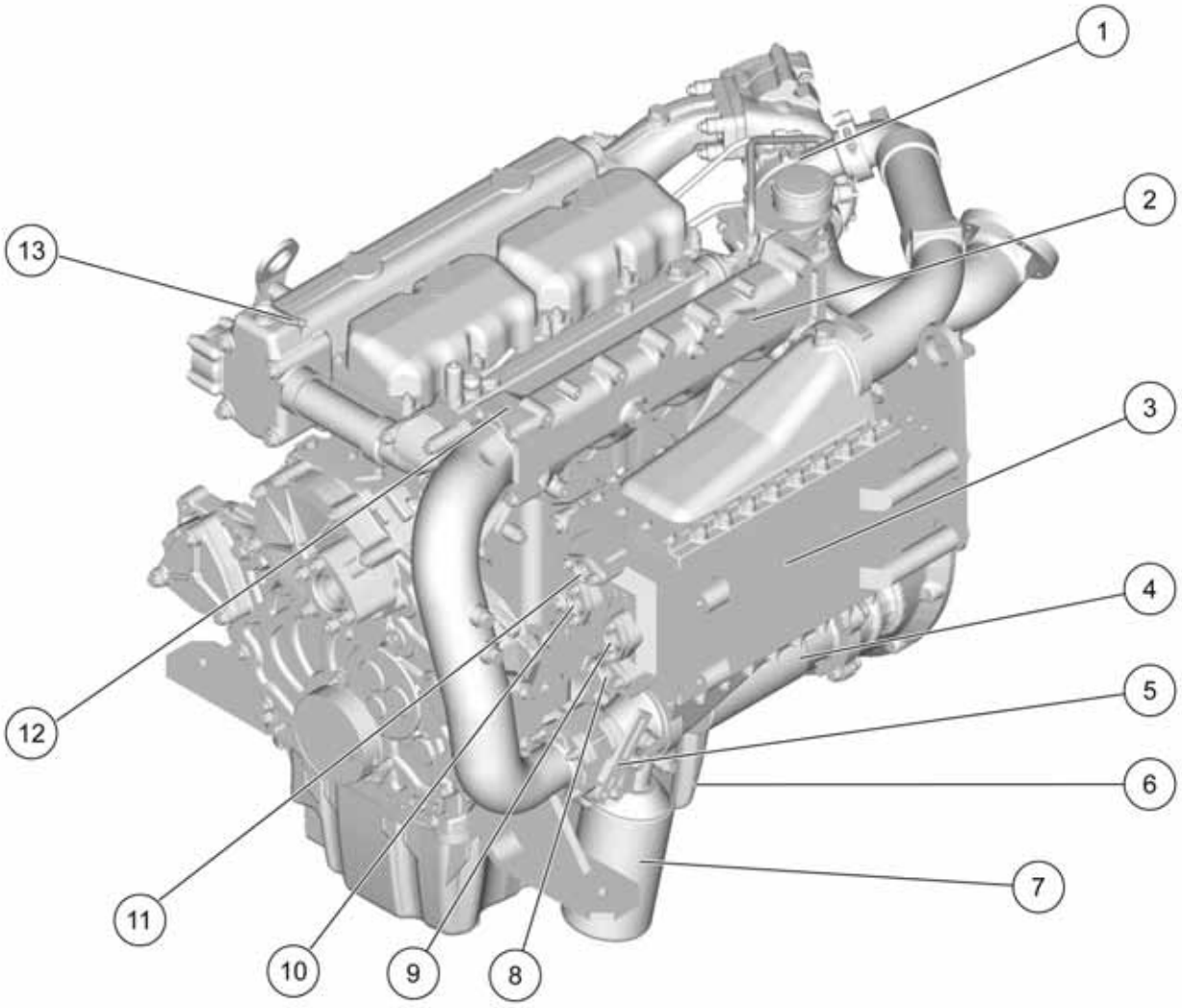
Intake and Exhaust System

The dry exhaust pipes are mounted to the cylinder heads. From the high-pressure stage the exhaust is guided through the turbochargers.
The turbochargers are lubricated by the engine's main-flow oil circuit connected to the pressure connections onthe turbochargers.

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

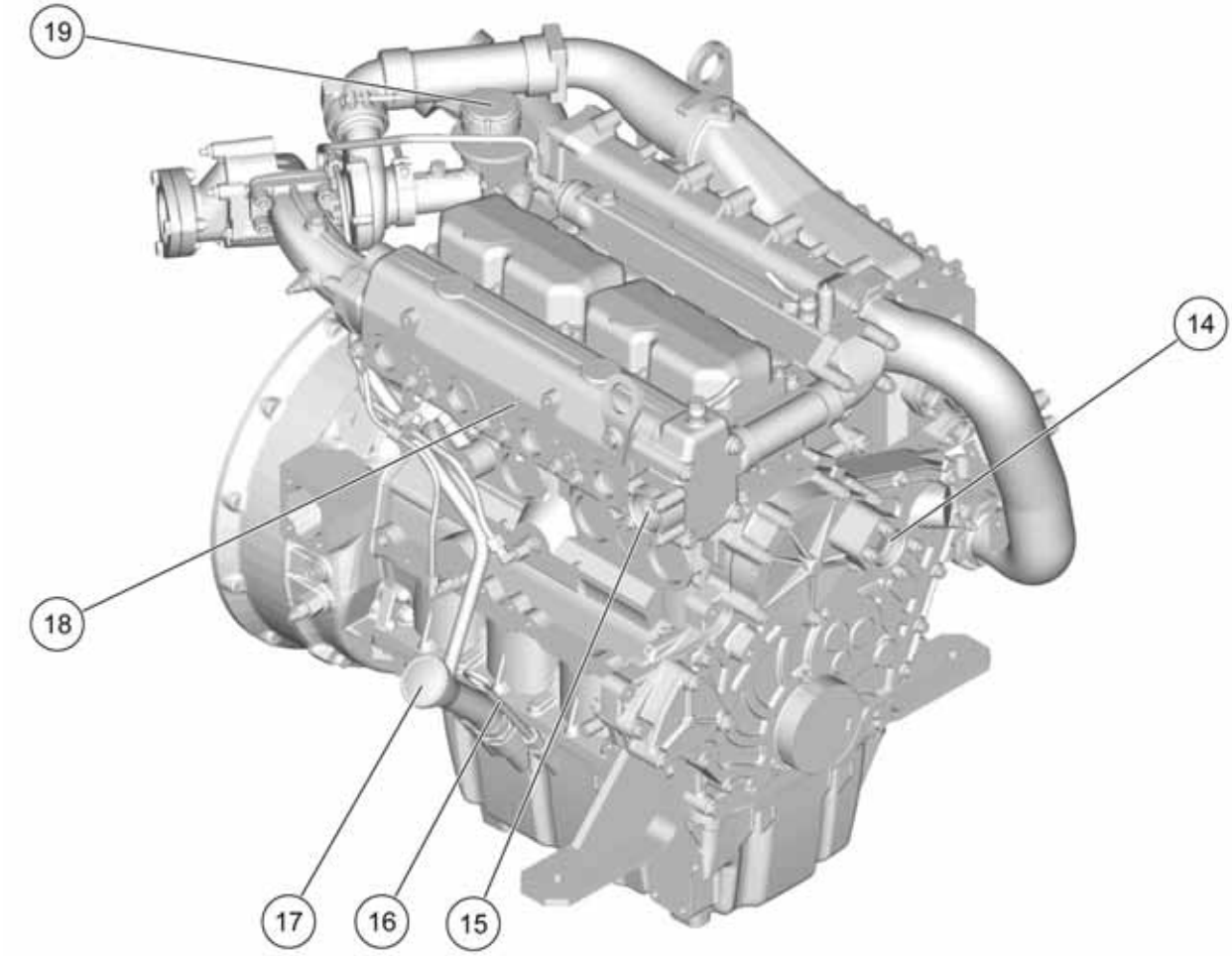
4.2 Engine Views E0834 LE302/ 312/ 322

4.2.1 Front Left View



(1) Turbocharger
(2) Intake manifold
(3) Charge mixture cooler
(4) Starter
(5) Throttle valve
(6) Oil drain screw
(7) Oil filter
(8) Coolant inlet, low-temperature stage
(9) Coolant outlet, low-temperature stage
(10) Coolant inlet, high-temperature stage
(11) Coolant outlet, high-temperature stage
(12) Flame protection filter
(13) Ventilation connection for coolant to separate ventilation reservoir

4.2.2 Front Right View



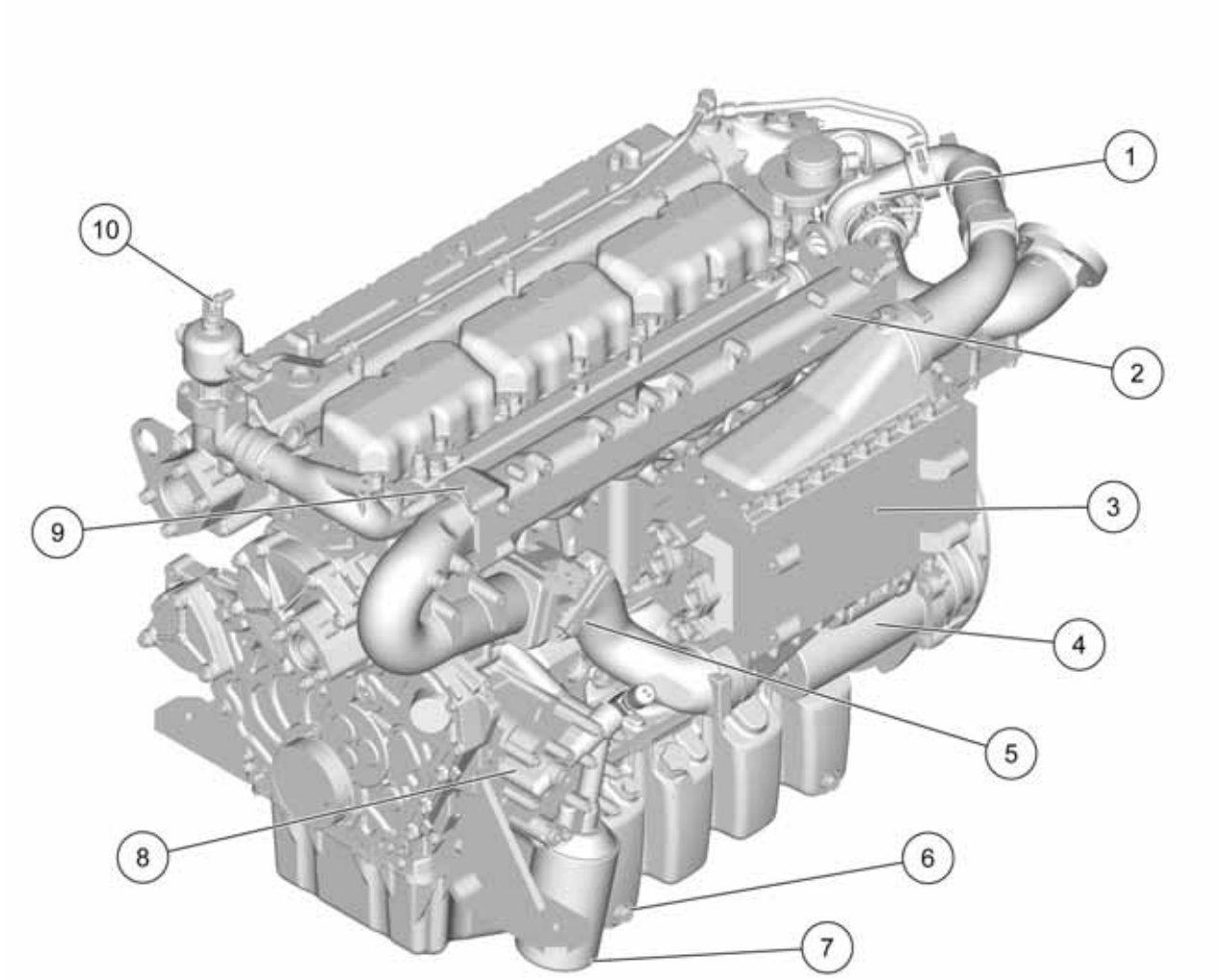
(14) Coolant inlet
(15) Coolant outlet
(16) Oil dipstick
(17) Oil filler neck
(18) Exhaust pipe
(19) Crankcase ventilation

NOTE!

The gas supply line consisting of the ball valve, gas filter, solenoid valves, gas pressure regulator, gas mixer and air filter are not included in the MAN scope of delivery.

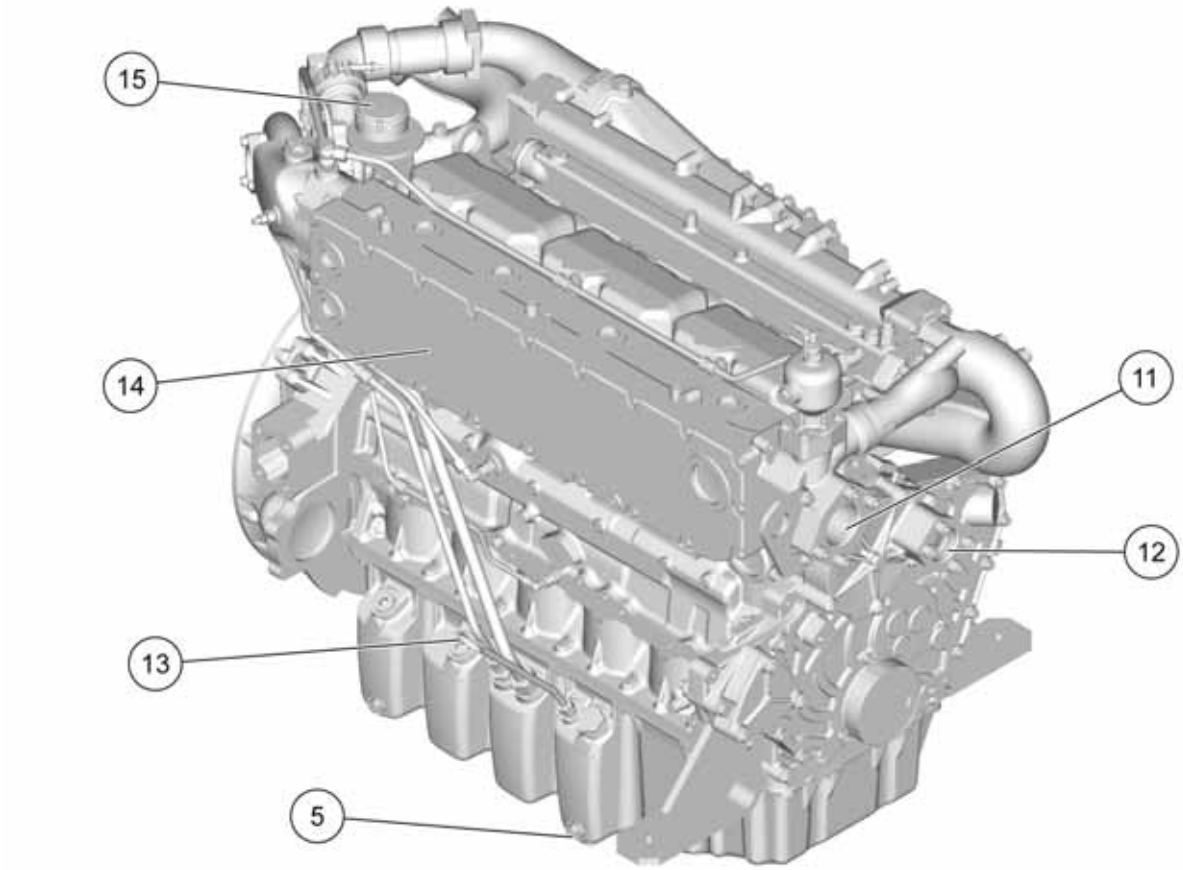
4.3 Engine Views E0836 LE202

4.3.1 Front Left View



(1) Turbocharger
(2) Intake manifold
(3) Charge mixture cooler
(4) Starter
(5) Throttle valve
(6) Oil drain screw
(7) Oil filter
(8) Oil cooler
(9) Flame protection filter
(10) Ventilation connection for coolant to separate ventilation reservoir

4.3.2 Front Right View



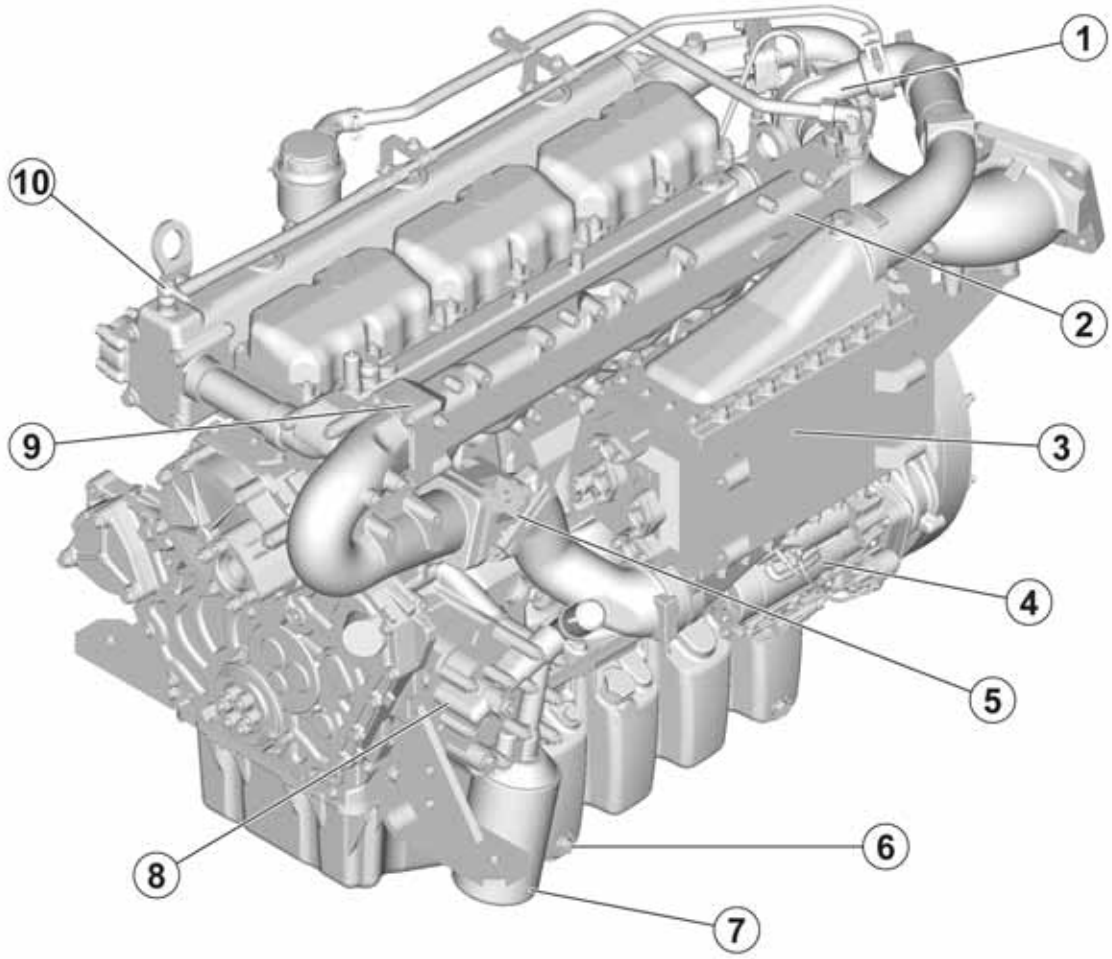
(5) Oil drain screw
(11) Coolant outlet
(12) Coolant inlet
(13) Oil dipstick
(14) Exhaust pipe
(15) Crankcase ventilation

NOTE!

The gas supply line consisting of the ball valve, gas filter, solenoid valves, gas pressure regulator, gas mixer and air filter are not included in the MAN scope of delivery.

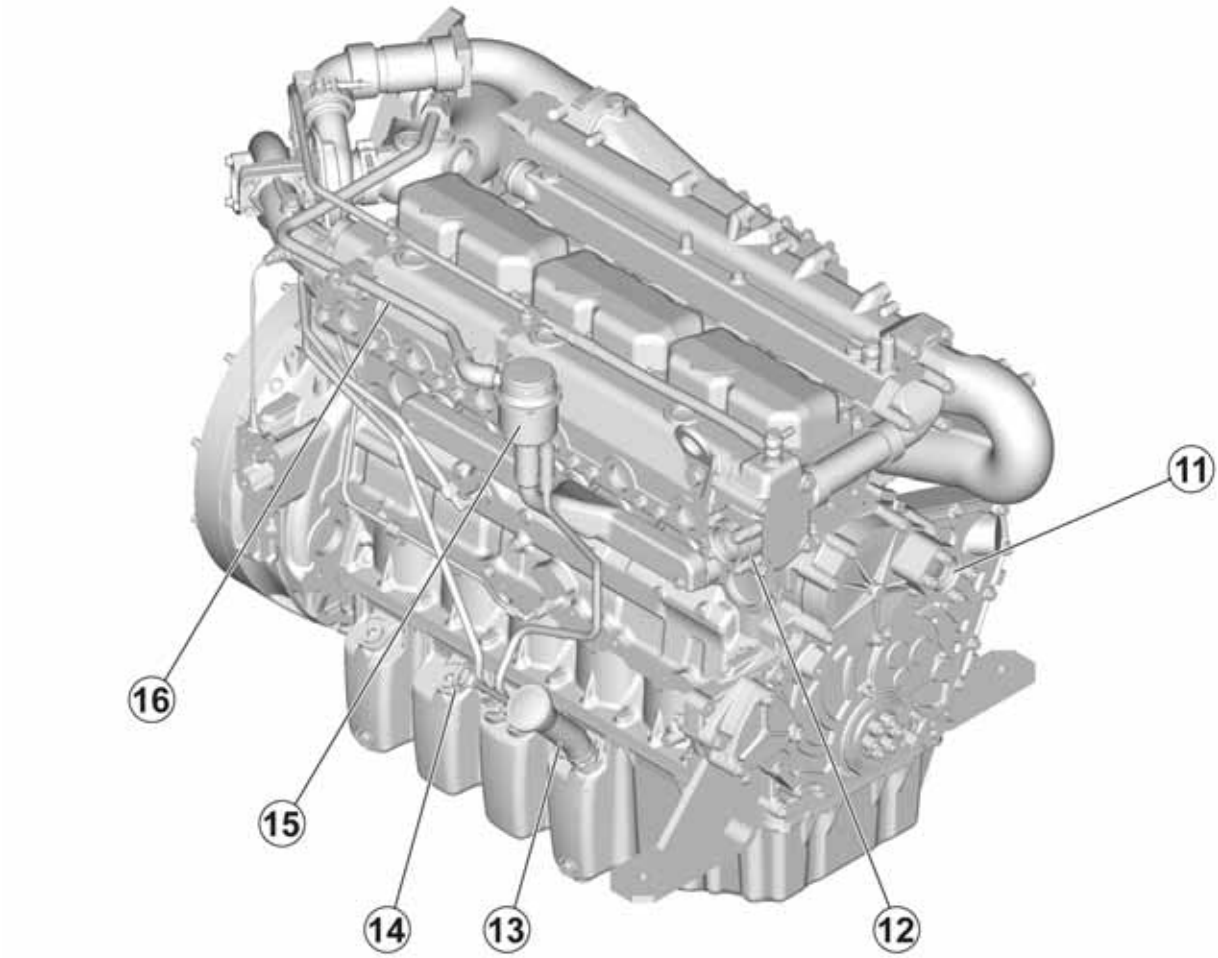
4.4 Engine Views E0836 LE302

4.4.1 Front Left View



(1) Turbocharger
(2) Intake manifold
(3) Charge mixture cooler
(4) Starter
(5) Throttle valve
(6) Oil drain screw
(7) Oil filter
(8) Oil cooler
(9) Flame protection filter
(10) Ventilation connection

4.4.2 Front Right View



(11) Coolant inlet
(12) Coolant outlet
(13) Oil filler neck
(14) Oil dipstick
(15) Oil separator
(16) Bleeder line

NOTE!

The gas supply line consisting of the ball valve, gas filter, solenoid valves, gas pressure regulator, gas mixer and air filter are not included in the MAN scope of delivery.

5 Transport, Packaging and Storage

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

NOTE!

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

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

5.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.
Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

Personal Protective Equipment

The following protective equipment must be worn:

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

5.2 Safety Instructions

Heavy Suspended Loads

WARNING!

Risk of death caused by heavy suspended loads!
During lifting operations, loads can swing out and fall down. This can cause serious injury and even death.

For this reason:

- Do not stand under or remain in the swivel range of the suspended load.
- Only move the load under supervision.
- Only use approved lifting equipment and accessories with sufficient load capacity.
- Never use torn or scuffed lifting equipment such as ropes or straps.
- Do not let lifting equipment such as rope or straps come into contact with sharp edges and corners and do not twist or knot them.
- Before leaving the work area, lower load to ground.

Off-Centre Point of Gravity

WARNING!

Risk of injury caused by falling or tipping packages!
Packages can have a centre of gravity that is off-centre. If the lifting equipment is not hooked up properly, these packages could tip over and fall causing serious injuries.

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

Swingout of Packages being Transported

WARNING!

Risk of injury caused by packages swing out during transportation!
When transporting the packages with a crane, the packages can swing out and cause serious injuries and significant property damage.

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

Unauthorised Transport

IMPORTANT!

Risk of property damage if packages are transported by untrained personnel!
Unauthorised transport by untrained personnel can cause packages to fall or tip over. This could cause considerable property damage.

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

Improper Transport

IMPORTANT!

Risk of property damage caused by improper transport!
Improper transport can cause packages to fall or tip over. This could cause considerable property damage.

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

5.3 Transport Inspection

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

If external signs of transport damage are apparent:

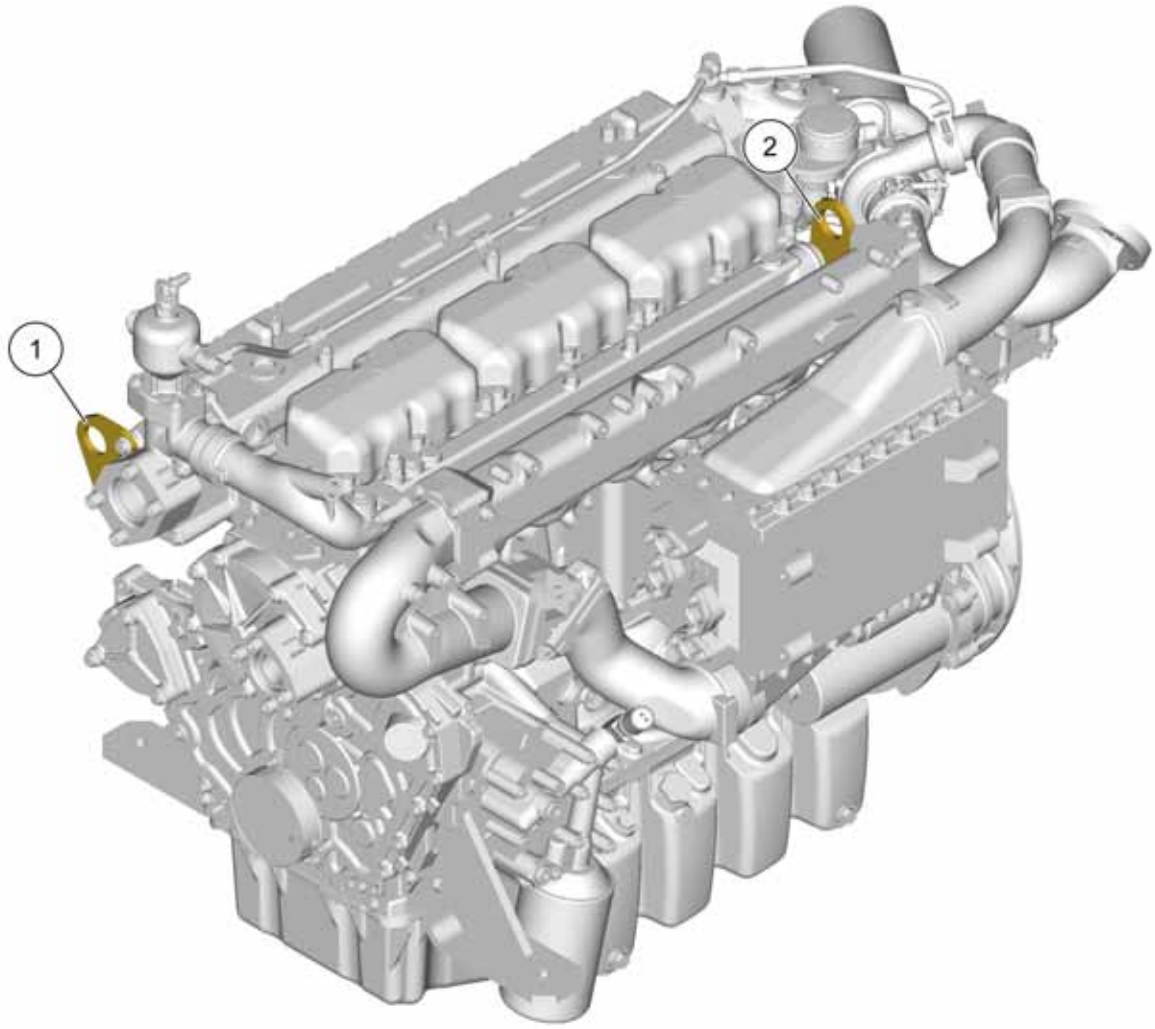
- Do not accept delivery or only accept under written protest.
- List scope of damage on the transport documents or on the transportation company's packaging slip.
- Initiate a claims process.
- Get engine checked by an expert before it is placed into commission.

NOTE!

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

5.4 Transport

Lifting Points



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

WARNING!

Risk of death caused by the load falling!
During lifting operations, loads can fall down. This can cause serious injury and even death.

For this reason:

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

Transport with Crane

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

- The crane and the lifting equipment must be designed for the weight of the engine.
- The operator must be qualified for operating the crane.

1. Attach the ropes, straps or multipoint lifting equipment according to the picture.
2. Ensure that the package is hanging straight or compensate for the off-centre point of gravity.
3. Start the transport.

Transport with Forklift

The engine can be transported 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 pallet must not be damaged.
- 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 and transport it to the desired location.

5.5 Packaging

Packaging

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

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

Handling Packing Material

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

IMPORTANT!

Risk of hazard to the environment caused by incorrect disposal!
Packaging materials are valuable raw materials and can in many cases continue to be used or can be processed and recycled. Incorrect disposal of packaging materials may cause an environmental hazard.

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

5.6 Storage

Storage of packages

Store packages under the following conditions:

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

NOTE!

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

6 Installation and Commissioning

6.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.
Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Safety Shoes
- Safety Gloves

6.2 Safety Instructions

Personnel

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

WARNING!

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

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

Ground Rules

WARNING!

Risk of injury caused by improper installation and commissioning!
Improper installation and commissioning can cause serious personal injury or considerable property damage.

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

- Before commissioning the engine, carefully read the Operating Instructions and familiarise yourself with the “critical” subjects.
- It is absolutely necessary to observe the “Assembly Instructions” for the installation and commissioning of a new or reconditioned engine.

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

6.3 Installation - Engine

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

6.3.1 Safety Equipment

WARNING!

Risk of death caused by the absence of safety equipment!
An emergency-off button, for shutting down the system or engine in an emergency, must be installed for each engine.

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

WARNING!

Risk of death caused by faulty operation!
At excessive loads or if malfunctions occur the engine can overheat and suddenly seize.

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

The following sensors are installed in the engine:
- Exhaust temperature
- Oil pressure
- Coolant temperature

6.3.2 Engine Model Plate Data

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

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

6.4 Commissioning

New or reconditioned engines must not be operated during the first operating hours at loads higher than 3/4 power.

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

IMPORTANT!

Termination of liability for material defects by use of non-approved fluids and lubricants!
Liability of material defects is terminated if non-approved fluids and lubricants are used.

For this reason:
- Only use approved fluids and lubricants (see “Fluids and Lubricants ..." publication).
- The requirements on the quality of gas are specified in “MAN data sheet - Minimum requirement on the quality of gas for MAN gas engines"

6.4.1 Gas System

NOTE!

The gas supply line is not included in MAN's scope of delivery. Commissioning, operation, monitoring of operating conditions, and maintenance of the gas system are all to be performed as described in the manufacturer's instructions.

Setting for commissioning

For commissioning the engine is to be set for the use of a suitable gas/air mixture. Any deviations from this will negatively influence the output power, the engine efficiency and the exhaust emissions.

The requirements on the quality of gas are specified in ”MAN data sheet - Minimum requirement on the quality of gas for MAN gas engines".

The operating pressure of the natural gas in the gas line must be at least 20 mbar.
The gas pressure should be steady within this range.

To get a correct gas/air mixture the air in the engine room must have a temperature of between 10° and 30°C.
The gas must not contain any condensation when it enters the gas mixer, see “MAN data sheet - Minimum requirement on the quality of gas for MAN gas engines".

Faults

We urgently recommend that you have faults rectified only at an authorised specialist workshop.

Air filter

The maximum pressure differential up and downstream of the filter may not exceed the following:

New ≥ 10 hPA
Dirty ≦ 30 hPA
The filter element must therefore be changed as stated in the maintenance instructions.

Gas filter

The gas filter must filter grain size ≦ 6 μm.

6.4.2 Filling Coolant

NOTE!

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

The engine's cooling system is to be filled with a mixture of tap water and antifreeze (ethylene glycol or anticorrosion agent). Coolant must be filled according to the filling specifications of the BHKW (combined heat and power plant) manufacturer.

For suitable antifreeze agents see approved Fuels, Lubricants and Coolants according to MAN 324 NF and MAN 248.

Coolant may **only be filled at the filler neck**.

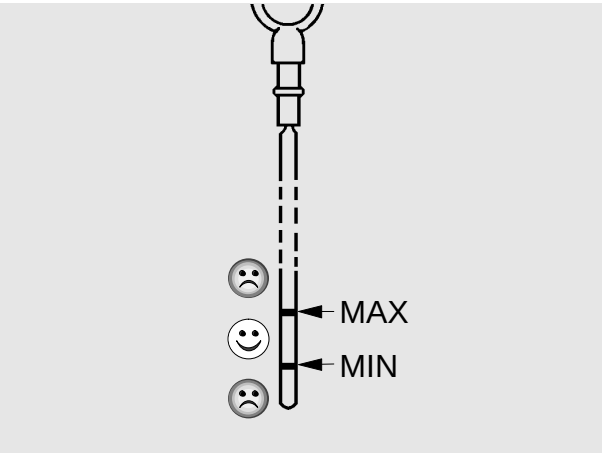
- Remove cap.
- Slowly fill coolant.
- Close expansion reservoir.
- Run engine for approx. 15 minutes at rated speed.
- Shut off engine and carefully unscrew cap with safety valve to the first stop to release pressure, then carefully open. Add coolant if necessary.
- When adding coolant, do not add cold coolant to a warmed-up engine. Ensure that the proper mixing ratio of “water/antifreeze" is met.
- Check coolant before the next commissioning (with engine cold). Add coolant if necessary.
- Repeat this procedure until coolant can no longer be added.

6.4.3 Filling Engine Oil

IMPORTANT!

Component damage caused by over filling!
Engine damage can occur if engine oil is filled to above the max. mark on the oil dipstick.

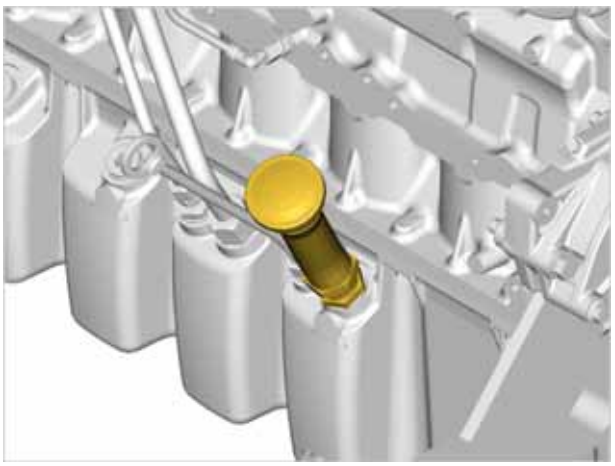
For this reason:
- Do not fill engine oil above the max. mark on the oil dipstick



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

For oil filling capacity, see “Technical Data” page 68.

3. Reinstall cap.



7 Operation

7.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.
Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Safety Shoes
- Safety Gloves

7.2 Safety Instructions

Personnel

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

Ground Rules

WARNING!

Danger caused by faulty operation!
Improper operation can cause serious personal injury or considerable property damage.

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

WARNING!

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

For this reason:
- Ensure sufficient ventilation.
- Limit time spent in the engine area to the absolute minimum.

7.3 Preparations before Operation

DANGER!

Danger caused by damaged engines!
Damaged engines can be dangerous to persons.

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

Before each operation check the engine's coolant and oil level.
If necessary add coolant and engine oil.

IMPORTANT!

Termination of liability for material defects by use of non-approved fluids and lubricants!
Liability of material defects is terminated if non-approved fluids and lubricants are used.

For this reason:
- Only use approved fluids and lubricants (see “Fluids and Lubricants ..." publication).

7.3.1 Check Gas Quality, Open Gas Supply

WARNING!

Risk of fire caused by highly flammable substances!
Highly flammable substances, fluids or gases can catch on fire and cause serious or deadly injuries.

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

1. Check the quality of the gas, see “MAN data sheet - Minimum requirement on the quality of gas for MAN gas engines".
2. Open gas supply.

7.3.2 Checking Coolant

WARNING!

Risk of scalding!
The cooling system is under pressure and the coolant is hot.

For this reason:
- Let engine cool down.

NOTE!

The cooling system is not included in MAN's scope of delivery.
Check the coolant level according to the manufacturer's operating manual.

7.3.3 Refilling Coolant

NOTE!

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

IMPORTANT!

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

For this reason:
- Do not fill with cold coolant.

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

NOTE!

The cooling system is not included in MAN's scope of delivery.
Add coolant according to the manufacturer's operating manual.

7.3.4 Checking Engine Oil Level

NOTE!

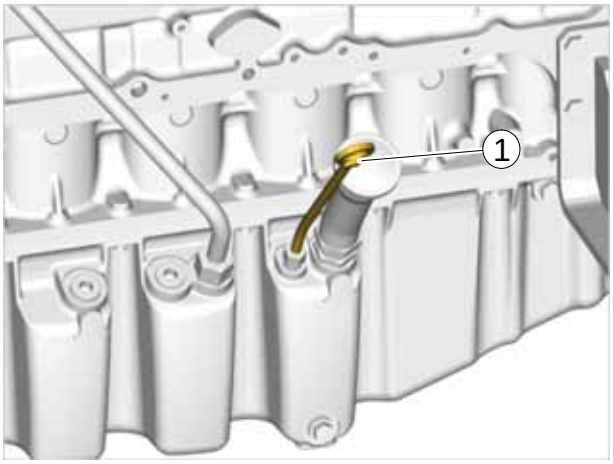
Check the oil level when the engine is horizontal and only after at least 20 minutes have passed since the engine was switched off.

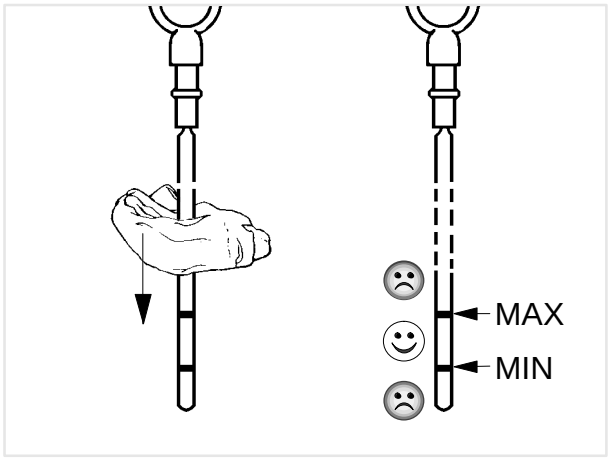
1. Pull out oil dipstick (1).
2. Wipe off oil dipstick (1) with a lint-free, clean cloth.
3. Reinsert the oil dipstick (1) all the way.
4. Pull out oil dipstick (1) again and check oil level.

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

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

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



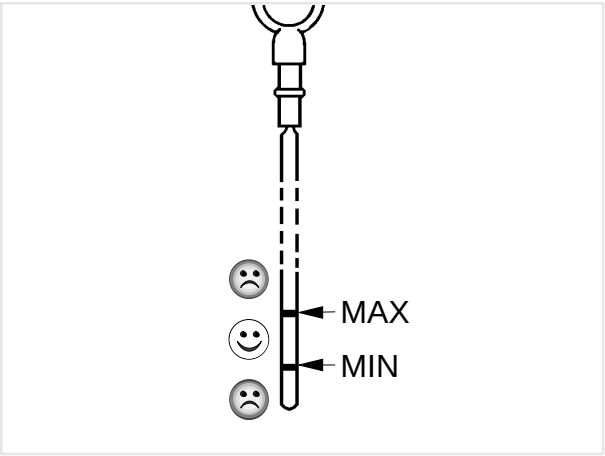


7.3.5 Refilling Engine Oil

IMPORTANT!

Component damage caused by over filling!
Engine damage can occur if engine oil is filled to above the max. mark on the oil dipstick.

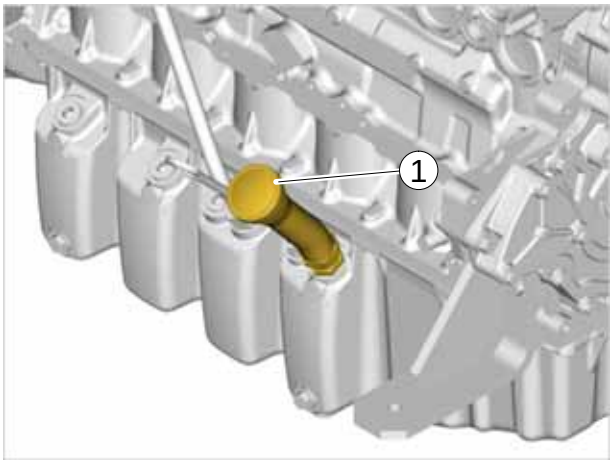
For this reason:
- Do not fill engine oil above the max. mark on the oil dipstick



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

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

3. Reinstall cap (1).
4. Check engine oil level.



7.4 Operation

DANGER!

Risk of injury caused by mechanical movements, gases and noise.
There is a risk of injury during engine operation caused by moving engine parts and from engine emissions.

For this reason:
- Access to operating room is only allowed for maintenance/repairs.
- Access to operating room is prohibited when engine is running.
- Ensure that no persons are in the operating room and secure it from unauthorised access.

7.4.1 Starting Engine

DANGER!

Risk of injury caused by moving parts!
Rotating or linear moving parts can cause serious or deadly injuries.

For this reason:
- Before starting engine check whether all protective equipment have been properly installed.
- Remove tools and aids out of the hazard area.
- Before starting make sure that no-one is in the engine's danger area.

The electronic ignition system is a high-voltage condensator ignition system (based on crankshaft rotation) with a microprocessor control.
The ignition system muss be parameterized before commissioning. For further information please refer to the operating manual of the ignition system and to the assembly instructions.

Turn on coolant pump before starting engine.

Turn on starter and run for at least 3 seconds to ensure engine is purged with air.

After purging engine with air the ignition system and the gas supply line can be turned on (this is usually done automatically).

NOTE!

A start phase consists of a maximum 3 consecutive start attempts each lasting 12 seconds. If no rpm signal is detected within 3 seconds, the start process is to be cancelled. The pauses between 2 start attempts must be at least 30 seconds. A pause of at least 300 seconds must be maintained until the initiation of the next start phase.

When the rated speed has been reached, the plant can then be operated under load.
Acceleration of the engine from 0% to 100% is made over a time interval of 3 minutes.
This minimises the thermal load on the engine block.

The oil-pressure gauge must indicate the lubrication oil pressure. If this is not the case, immediately shut off engine.

7.4.2 Monitoring Operation

IMPORTANT!

Do not overload engine.
If faults occur, investigate and solve them immediately to prevent major damage from occurring!

The oil pressure and the coolant temperature are constantly monitored during engine operation.

If the limits are exceeded or gone below, the engine will be automatically shut off.

7.4.3 Stopping in an Emergency

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

7.4.4 Engine Shut Off

Deceleration of the engine from 100% to 0% is made using a ramp in a time interval of at least 3 minutes. This minimises the thermal load on the engine block.

DANGER!

Risk of fire caused by unburned gases!
The gas supply is always to be turned off before the ignition system is turned off. This ensures that no unburned gas can reach the exhaust system.

For this reason:
- If there is damage to the engine shutoff device, do not shut off engine by shutting off ignition system.
- Close main gas valve.
- Turn off ignition system after engine is at a standstill.
- Ensure that the engine cannot be started by unauthorised persons.

1. Shut off gas supply.
2. The engine stops running.
3. After waiting 5 seconds, turn off ignition system and control system.

NOTE!

The coolant pump will run on for approx. 5 minutes after engine has stopped.
This minimises the thermal load to the engine block.

8 Maintenance and Care

WARNING!

Risk of injury to incorrectly executed maintenance
Improper maintenance can case serious injuries or considerable property damage.

For this reason:
- Before carrying out maintenance work, read the maintenance instructions carefully.
- Perform all maintenance steps in accordance with the maintenance instruction.

8.1 Maintenance instructions

Maintenance instructions for the engines are available to supplement these operating instructions.
It contains a discription of all due turnaround maintenace work.

Maintenance instruction see leaflet “Maintenance Instruction MAN Industriel Gas Engines”

8.2 Maintenance Schedule

The Maintenance schedule for the engines are available to supplement the maintenance instructions.
The maintenance schedule contains all the maintenance work, which has to be carried out at specified time intervals or on reaching a specified number of operating hours.

Maintenance Schedule see leaflet “Maintenance Record MAN Industriel Gas Engines”

8.3 Repair instructions

The repair instructions contain a detailed description of all installation and adjustment actions required on the engine. This work must only be undertaken by specialist personnel trained for the repair work.

9 Faults

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

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

9.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.
Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

9.2 Safety Instructions

Personnel

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

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Safety Shoes
- Safety Gloves

Ground Rules

WARNING!

Risk of injury caused by improper rectification of faults!
Improper rectification of faults can case serious injuries or considerable property damage.

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

9.3 Fault Table

Fault	Possible cause	Remedy
Engine does not start	● Shutoff solenoid valve of gas supply closed/does not open	
	● Zero pressure regulator of gas supply not correctly set or faulty	
	● Air filter clogged	
	● Exhaust clogged (exhaust back pressure too high)	
	● Electric circuit interrupted	● Set main switch to "on" ● Replace faulty fuses ● Repair any loose, corroded and broken wires and contacts
	● Battery dead	● See information at "Starter"
	● Starter/solenoid switch faulty	
	● Ignition system control unit faulty	● Clearance incorrectly set
	● Impulse sensor faulty	
	● Spark plugs faulty or worn	
	● Spark plug connectors wet	
	● Ignition timing incorrect	
	● Gas inlets in gas mixer (venturi pipe) clogged/oiled	● A faulty tank system can cause oil to get into the pressure gas system. Clean entire system.
	● Valves do not close or are stuck	
	● Crank assembly is externally blocked	● Remove objects that interfere with the movement of the fan, power output, alternator, etc.
	● Engaging lever/bearing pin of engaging lever broken	
	● Internal engine damage (piston seizure, maybe due to incorrect oil type)	● Remedy from manufacturer service
Engine starts but does not reach idle speed or stalls	● Quality of gas does not meet the specifications or is contaminated	● See "Fluids and Lubricants...."
	● Throttle valve does not open/actuation level sticks/actuator is de-energized or faulty	● Remedy from manufacturer service
	● Air filter clogged	
Engine does not start or poorly starts in warmed up condition	● Spark plug faulty	
	● Ignition cable faulty	
	● Ignition coil faulty	
	● Ignition timing incorrectly set	● Remedy from manufacturer service
	● Insufficient compression in cylinder or more than 3-4 bar pressure difference between the cylinders	

Fault	Possible cause	Remedy
Engine does not start or poorly starts in cold condition	• Spark plug faulty • Ignition cable faulty • Ignition coil faulty • Ignition timing incorrectly set • Starter turns slowly • Check quality of gas	• Remedy from manufacturer service • Battery with insufficient charge or damaged • Voltage drop between battery and starter too high
Rough idling with engine warm, misfiring	• Spark plug faulty • Ignition cable faulty • Ignition coil faulty • Ignition timing incorrectly set • Valve clearance not OK • Zero pressure regulator of gas supply not correctly set or faulty • Insufficient compression in cylinder or more than 3-4 bar pressure difference between the cylinders	• Remedy from manufacturer service
Engine speed fluctuations during operation	• Spark plug faulty • Ignition cable faulty • Ignition coil faulty • Ignition timing incorrectly set • Shutoff solenoid valve of gas supply closed/does not open • Tachometer faulty • Gas pressure regulator faulty • Oxygen sensor faulty	• Remedy from manufacturer service
Poor performance	• Spark plug faulty • Ignition cable faulty • Ignition coil faulty • Ignition timing incorrectly set • Throttle valve not in full throttle position, actuation linkage sticks, throttle valve incorrectly adjusted • Zero pressure regulator of gas supply not correctly set or faulty • Gas metering valve faulty • Gas/air mixture too rich or too lean • Too much power is demanded from the engine than it can produce • Gas quality does not meet the regulations • Cross section of oxygen regulation valve is not set to the current gas quality • Oil level in oil pan too high	• See "Fluids and Lubricants..." • Remedy from manufacturer service • Check whether the guide tube is correctly installed and the correct oil dipstick is being used • If coolant is discovered in the engine oil, check cylinder head gasket, cylinder liner gasket and piston rings

Fault	Possible cause	Remedy
Poor performance	● Air filter clogged ● Exhaust pipe clogged ● Air intake pipe leaks ● Charge mixture cooler dirty/leaks ● Charge mixture ducting leaks ● Turbocharger leaks, faulty, dirty ● Insufficient compression in cylinder or more than 3-4 bar pressure difference between the cylinders	● Remedy from manufacturer service
Coolant temperature too high, loss of coolant	● Coolant level too low ● Air in coolant circuit ● Radiator very dirty, fins clogged ● V-belt for coolant pump not correctly tightened (slips) ● Cap with work valves on expansion reservoir/radiator is faulty or leaks ● Temperature display faulty ● Coolant pump leaks, defective (bearing damage) ● Thermostat faulty, does not open ● Coolant lines leak, clogged or twisted	● Remedy from manufacturer service
Lube-oil pressure too low	● Oil level in oil pan too low ● Engine temperature to high ● Oil pressure indicator faulty ● Selected oil viscosity is inappropriate for ambient temperature (too thin) ● Oil in oil pan is too thin (contains condensation) ● Bearing heavily worn ● Oil pump gears heavily worn ● Safety valve in oil circuit faulty (does not close, spring is worn or broken)	● See "Fluids and Lubricants..." ● Remedy from manufacturer service
Lube-oil pressure too high	● Engine cold ● Selected oil viscosity is inappropriate for ambient temperature (too thick) ● Oil pressure indicator faulty ● Safety valve in oil circuit faulty (does not open) ● Oil lines/oil ducts clogged	● See "Fluids and Lubricants..." ● Remedy from manufacturer service

Fault	Possible cause	Remedy
Lube-oil consumption too high	● Lube-oil quality does not meet the regulations ● Oil level in oil pan too high ● Leaks in lube-oil circuit especially at the turbocharger and oil cooler ● Piston rings heavily worn ● Valve stems heavily worn, bent ● Crankcase breather clogged	● See "Fluids and Lubricants..." ● Check whether the guide tube is correctly installed and the correct oil dipstick is being used ● If coolant is discovered in the engine oil, check cylinder head gasket, cylinder liner gasket and piston rings ● Remedy from manufacturer service
Gas consumption too high	● Gas quality does not meet the regulations ● Ignition timing incorrectly set ● Charge mixture cooler dirty/leaks ● Charge mixture ducting leaks ● Valve seat leaks ● Air filter clogged ● Exhaust gas recirculation cooler dirty	● See "Fluids and Lubricants..." ● Check intake vacuum ● Remedy from manufacturer service ● Check exhaust back pressure
Blue smoke	● Lube oil penetrates into combustion chamber (pistons/piston rings worn or piston rings broken) ● Turbine and compressor impeller in turbocharger dirty (rough running, out of balance) ● Valve stem/guide worn	● Remedy from manufacturer service
White smoke	● Coolant penetrates into combustion chamber (cylinder head/gasket leaks)	
Engine knocking	● Ignition timing incorrectly set ● Valve clearance not OK ● Valves stick ● Piston pin or crankshaft bearing loose ● Piston ring broken	● Check thermostat ● Remedy from manufacturer service
Engine too "loud"	● Intake or exhaust pipe leaks ● Timing gears worn, gear backlash too large ● Valve clearance too large ● Turbine and compressor impeller in turbocharger dirty (rough running, out of balance) ● Poly-V-belt slips ● Engine bearing not suitable/worn	● Remedy from manufacturer service
Exhaust temperature/ exhaust back pressure too high (thermal overload)	● Unsuitable exhaust piping; heat exchanger and catalytic converter have too high resistance	● Remedy from manufacturer service

Starter

Fault	Possible cause	Remedy
		To be repaired by a vehicle electrician or by the manufacturer service
● Pinion gear does not turn or turns slowly	● Battery has insufficient charge ● Terminal is loose, oxidised, poor connection to ground ● Starter terminal or carbon brushes are short circuited to ground ● Carbon brushes stick or have poor contact	
● Pinion gear does not engage	● Pinion gear or starter ring gear are very dirty or damaged	
● Pinion gear engages, but stops turning	● Solenoid switch faulty ● Overrunning clutch slips	
● Pinion gear continues to turn after starter switch is released	● Starter switch faulty ● Solenoid switch faulty	
● Pinion gear does not disengage after engine starts	● Starter faulty	● Immediately shut down engine

10 Decommissioning and Recommissioning

10.1 Prerequisite

Before starting any work read and observe the General Safety Instructions and the safety information in this chapter.
Strictly observe these instructions and act prudently to avoid accidents, personal injury and property damage.

Personal Protective Equipment

The following protective equipment must be worn:

- Protective Clothing
- Safety Shoes
- Safety Gloves

10.2 Safety Instructions

Personnel

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

Ground Rules

WARNING!

Risk of injury caused by improper work.
Improper work can case serious injuries or considerable property damage.

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

10.3 Temporary Decommissioning of Engines

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

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

NOTE!

A proper and careful recommissioning of new or operated engines has a great impact on the operating safety and remaining life of the engines.
In general the goal is to preserve the decommissioned engines or new engines (after the factory tests).

If the engine was not preserved before decommissioning, there is a risk that the cylinder liners, piston rings and valves will corrode, especially when the intake and exhaust opening are not closed off or when the engine is stored in the open.
Foreign matter, rain water and similar conditions require a complete disassembly of the engine.

10.4 Recommissioning of Decommissioned Engines

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

1. Remove external preservation. Never use a high pressure cleaner for this.
2. Remove caps from intake and exhaust openings.
3. Check cooling system; add antifreeze according to the Fluids and Lubricants list (see “Fluids and Lubricants ..."); check concentration and correct.
4. Check engine oil level and add fresh approved engine oil if necessary.
5. Check the operation of the monitoring and emergency shut off equipment.
6. Check condition and proper installation of elastic fasteners, such as V-belts, coolant hoses and charge air hoses. Retighten if necessary.
7. Rotate engine with gas supply turned off until oil pressure builds up. Operate starter no more than 12 seconds for this.
8. Open gas supply and start engine. After engine is running, operate engine above idle speed to avoid insufficient lubrication of the cylinder liners.
9. Check engine for leaks, unusual noises and observe the oil pressure and all temperatures. Increase engine speed in steps.
10. After a max. of 25 operating hours, drain preservation oil from engine and change oil filter; fill engine with fresh approve engine oil.

10.4.2 Commissioning of Non-Preserved Engines

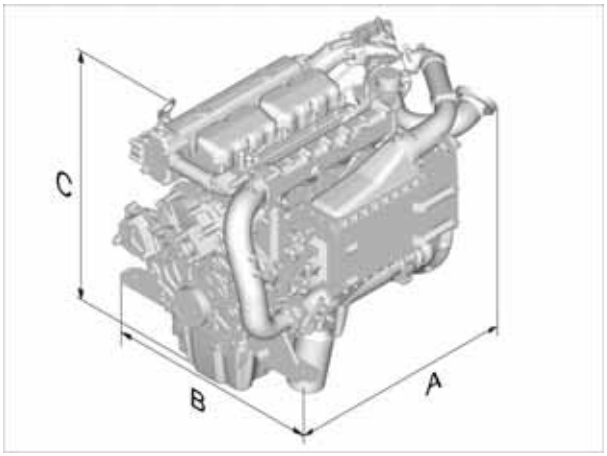
In addition to the work steps for a preserved engine, the commissioning of a non-preserved engine requires the following extra work depending on the possible nonuse damages.

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

11 Technical Data

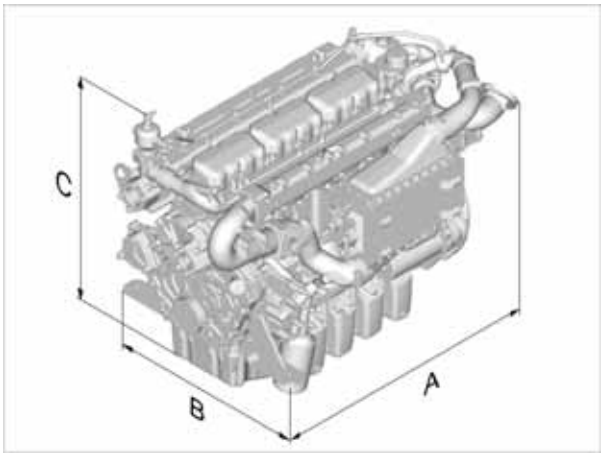
11.1 Dimensions and Weights

11.1.1 E0834 LE302



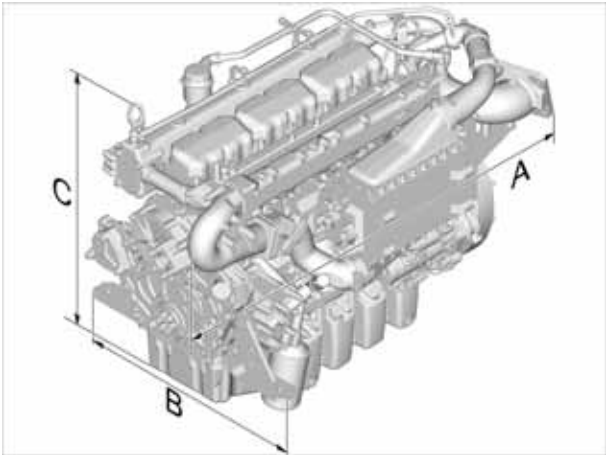
Specification	Value	Unit
Weight (dry)		
E0834 LE302	495	kg
A	1055	mm
B	809	mm
C	866	mm

11.1.2 E0836 LE202



Specification	Value	Unit
Weight (dry)		
E0836 LE202	605	kg
A	1300	mm
B	740	mm
C	1030	mm

11.1.2 E0836 LE302



Specification	Value	Unit
Weight (dry)		
E0836 LE202	605	kg
A	1300	mm
B	740	mm
C	1030	mm

11.2 Installation Location and Space Requirements

Observe the information in the Assembly Instructions.

11.3 Engine Data

11.3.1 E0834 LE302

Engine model	**E0834 LE302**
Design	Inline engine
Operating Principle	4-cycle spark ignition engine
Number of cylinders	4
Bore	108 mm
Stroke	125 mm
Displacement	4,580 cm^3
Compression	11:1
Rating for natural gas operation	68 kW / 92 HP at 1500 rpm The power output specifications are valid for operation with natural gas with a calorific value of 36,350 kJ/m3 and a methane number > 80. For higher calorific values, the engine is to be set so that the specified engine power is not exceeded. For lower calorific values a correspondingly lower engine power will be the result. A new engine setup will be needed to achieve the rated output.
Rating for biogas operation	66 kW / 90 HP at 1500 rpm The power output specifications are valid for operation with biogas (60% CH_4, 40% CO_2 with a calorific value of 17,600 kJ/m3 and a methane number 140. For higher calorific values, the engine is to be set so that the specified engine power is not exceeded. For lower calorific values a correspondingly lower engine power will be the result. A new engine setup will be needed to achieve the rated output.
Firing order	1-3-4-2
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.50 mm
Valve timing Intake opens Intake closes Exhaust opens Exhaust closes	 6° before TDC 38° after BDC 56° before BDC 12° after TDC

Ignition timing in ° KW before TDC	Natural gas operation	Biogas operation
1500 rpm, 50°C mixture temperature	16°	18°
1800 rpm, 50°C mixture temperature	--	--

Engine lubrication	Force feed lubrication	
Lubrication oil pressure during operation (depends on engine speed, oil temperature and engine load)	must be monitored via an oil pressure monitor or a display device	
Oil filter	Single-use main flow filter (easy-change filter)	
Oil capacity in oil sump (litres)	min.	max.
half deep	17 l	25 l
Oil change quantity (with filter)	26 l	
Engine cooling system	Liquid cooling	
Coolant temperature		
Inlet temperature	min. 80°C	
Outlet temperature	max. 88°C	
Coolant filling capacity	in engine approx. --	
Electrical equipment		
Starter	24 V; 4 KW	
Test values		
	Natural gas operation	Biogas operation
Lambda (oxygen)	1.62	1.42

11.3.1 E0834 LE312

Engine model	**E0834 LE312**		
Design	Inline engine		
Operating Principle	4-cycle spark ignition engine		
Number of cylinders	4		
Bore	108 mm		
Stroke	125 mm		
Displacement	4,580 cm^3		
Compression	11:1		
Rating for natural gas operation	68 kW / 92 HP at 1500 rpm The power output specifications are valid for operation with natural gas with a calorific value of 36,350 kJ/m3 and a methane number > 80. For higher calorific values, the engine is to be set so that the specified engine power is not exceeded. For lower calorific values a correspondingly lower engine power will be the result. A new engine setup will be needed to achieve the rated output.		
Firing order	1-3-4-2		
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.50 mm		
Valve timing Intake opens Intake closes Exhaust opens Exhaust closes	 6° before TDC 38° after BDC 56° before BDC 12° after TDC		
Ignition timing in ° KW before TDC		Natural gas operation	Biogas operation
1500 rpm, 50°C mixture temperature		16°	18°
1800 rpm, 50°C mixture temperature		--	--

Engine lubrication	Force feed lubrication	
Lubrication oil pressure during operation (depends on engine speed, oil temperature and engine load)	must be monitored via an oil pressure monitor or a display device	
Oil filter	Single-use main flow filter (easy-change filter)	
Oil capacity in oil sump (litres)	min.	max.
half deep	17 l	25 l
Oil change quantity (with filter)	26 l	
Engine cooling system	Liquid cooling	
Coolant temperature		
Inlet temperature	min. 80°C	
Outlet temperature	max. 88°C	
Coolant filling capacity	in engine approx. --	
Electrical equipment		
Starter	24 V; 4 KW	
Test values		
	Natural gas operation	Biogas operation
Lambda (oxygen)	1.62	1.42

11.3.1 E0834 LE322

Engine model	**E0834 LE322**
Design	Inline engine
Operating Principle	4-cycle spark ignition engine
Number of cylinders	4
Bore	108 mm
Stroke	125 mm
Displacement	4,580 cm^3
Compression	11:1
Rating for natural gas operation	80 kW / 109 HP at 1500 rpm
The power output specifications are valid for operation with natural gas with a calorific value of 36,350 kJ/m3 and a methane number > 80. For higher calorific values, the engine is to be set so that the specified engine power is not exceeded. For lower calorific values a correspondingly lower engine power will be the result. A new engine setup will be needed to achieve the rated output.	
Firing order	1-3-4-2
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.50 mm
Valve timing Intake opens Intake closes Exhaust opens Exhaust closes	 6° before TDC 38° after BDC 56° before BDC 12° after TDC

Ignition timing in ° KW before TDC	Natural gas operation	Biogas operation
1500 rpm, 50°C mixture temperature	16°	18°
1800 rpm, 50°C mixture temperature	--	--

Engine lubrication	Force feed lubrication	
Lubrication oil pressure during operation (depends on engine speed, oil temperature and engine load)	must be monitored via an oil pressure monitor or a display device	
Oil filter	Single-use main flow filter (easy-change filter)	
Oil capacity in oil sump (litres)	min.	max.
half deep	17 l	25 l
Oil change quantity (with filter)	26 l	
Engine cooling system	Liquid cooling	
Coolant temperature		
Inlet temperature	min. 80°C	
Outlet temperature	max. 88°C	
Coolant filling capacity	in engine approx. --	
Electrical equipment		
Starter	24 V; 4 KW	
Test values		
	Natural gas operation	Biogas operation
Lambda (oxygen)	1.62	1.42

11.3.2 E0836 LE202

Engine model	**E0836 LE202**		
Design	Inline engine		
Operating Principle	4-cycle spark ignition engine		
Number of cylinders	6		
Bore	108 mm		
Stroke	125 mm		
Displacement	6,870 cm^3		
Compression	11:1		
Rating for natural gas operation	110 kW / 150 HP at 1500 rpm and 1800 rpm The power output specifications are valid for operation with natural gas with a calorific value of 36,350 kJ/m3 and a methane number > 80. For higher calorific values, the engine is to be set so that the specified engine power is not exceeded. For lower calorific values a correspondingly lower engine power will be the result. A new engine setup will be needed to achieve the rated output.		
Rating for biogas operation	110 kW / 150 HP at 1500 rpm The power output specifications are valid for operation with biogas (60% CH_4, 40% CO_2 with a calorific value of 17,600 kJ/m3 and a methane number 140. For higher calorific values, the engine is to be set so that the specified engine power is not exceeded. For lower calorific values a correspondingly lower engine power will be the result. A new engine setup will be needed to achieve the rated output.		
Firing order	1-5-3-6-2-4		
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.50 mm		
Valve timing Intake opens Intake closes Exhaust opens Exhaust closes	 18° before TDC 32° after BDC 63° before BDC 1° after TDC		
Ignition timing in ° KW before TDC		Natural gas operation	Biogas operation
1500 rpm, 50°C mixture temperature		17°	17°
1500 rpm, 80°C mixture temperature		13°	14°
1800 rpm, 50°C mixture temperature		17°	17°
1800 rpm, 80°C mixture temperature		17°	17°

Engine lubrication	Force feed lubrication	
Lubrication oil pressure during operation (depends on engine speed, oil temperature and engine load)	must be monitored via an oil pressure monitor or a display device	
Oil filter	Single-use main flow filter (easy-change filter)	
Oil capacity in oil sump (litres)	min.	max.
half deep	24 l	34 l
Oil change quantity (with filter)	35 l	
Engine cooling system	Liquid cooling	
Coolant temperature		
Inlet temperature	min. 80°C	
Outlet temperature	max. 88°C	
Coolant filling capacity	in engine approx. 16 l	
Electrical equipment		
Starter	24 V; 4 KW	
Test values		
	Natural gas operation	Biogas operation
Lambda (oxygen)	1.6	1.4

11.3.2 E0836 LE202

Engine model	**E0836 LE302**		
Design	Inline engine		
Operating Principle	4-cycle spark ignition engine		
Number of cylinders	6		
Bore	108 mm		
Stroke	125 mm		
Displacement	6,870 cm^3		
Compression	11:1		
Rating for natural gas operation	110 kW / 150 HP at 1500 rpm and 1800 rpm The power output specifications are valid for operation with natural gas with a calorific value of 36,350 kJ/m3 and a methane number > 80. For higher calorific values, the engine is to be set so that the specified engine power is not exceeded. For lower calorific values a correspondingly lower engine power will be the result. A new engine setup will be needed to achieve the rated output.		
Rating for biogas operation	110 kW / 150 HP at 1500 rpm The power output specifications are valid for operation with biogas (60% CH_4, 40% CO_2 with a calorific value of 17,600 kJ/m3 and a methane number 140. For higher calorific values, the engine is to be set so that the specified engine power is not exceeded. For lower calorific values a correspondingly lower engine power will be the result. A new engine setup will be needed to achieve the rated output.		
Firing order	1-5-3-6-2-4		
Valve clearance (cold engine) Intake Exhaust	 0.50 mm 0.50 mm		
Valve timing Intake opens Intake closes Exhaust opens Exhaust closes	 18° before TDC 32° after BDC 63° before BDC 1° after TDC		
Ignition timing in ° KW before TDC		Natural gas operation	Biogas operation
1500 rpm, 50°C mixture temperature		17°	17°
1500 rpm, 80°C mixture temperature		13°	14°
1800 rpm, 50°C mixture temperature		17°	17°
1800 rpm, 80°C mixture temperature		17°	17°

Engine lubrication	Force feed lubrication	
Lubrication oil pressure during operation (depends on engine speed, oil temperature and engine load)	must be monitored via an oil pressure monitor or a display device	
Oil filter	Single-use main flow filter (easy-change filter)	
Oil capacity in oil sump (litres)	min.	max.
half deep	24 l	34 l
Oil change quantity (with filter)	35 l	
Engine cooling system	Liquid cooling	
Coolant temperature		
Inlet temperature	min. 80°C	
Outlet temperature	max. 88°C	
Coolant filling capacity	in engine approx. 16 l	
Electrical equipment		
Starter	24 V; 4 KW	
Test values		
	Natural gas operation	Biogas operation
Lambda (oxygen)	1.6	1.4

12 Indices

12.1 Abbreviations

A . . . . . Amps
Ah . . . . . Amp hours
bzw. . . . . Respectively
C . . . . . Celsius
cm^3 . . . . . Cubic centimetre
evtl. . . . . Possibly
Fa. . . . . Company
ggf. . . . . If necessary
h . . . . . Hours
Chap. . . . . Chapter
kg . . . . . Kilogram
kW . . . . . Kilowatt
m . . . . . Metre
MAX . . . . . Maximum
min . . . . . Minutes
MIN . . . . . Minimum
mm . . . . . Millimetre
Nm . . . . . Newton meter
TDC . . . . . Top dead centre
Pot . . . . . **Pot**enti**i**ometer
Prio . . . . . **Prio**rity
usw. . . . . and so on (etc.)
BDC . . . . . Bottom dead centre
V . . . . . Volt
W . . . . . Watt
e.g. . . . . For example
zul. . . . . Permitted (per.)
> . . . . . Greater than
< . . . . . Less than
rpm . . . . . Revolutions per minute

12.2 Technical Terms

12.3 Index

13 Notes

MAN Truck & Bus AG
Vogelweiherstraße 33
90441 Nürnberg
Germany

A member of the MAN Group

Printed in Germany 51.99493-8538

MAN Truck & Bus AG
Vogelweiherstraße 33
90441 Nuremberg
Germany
man-engines@man.eu
www.man-engines.com