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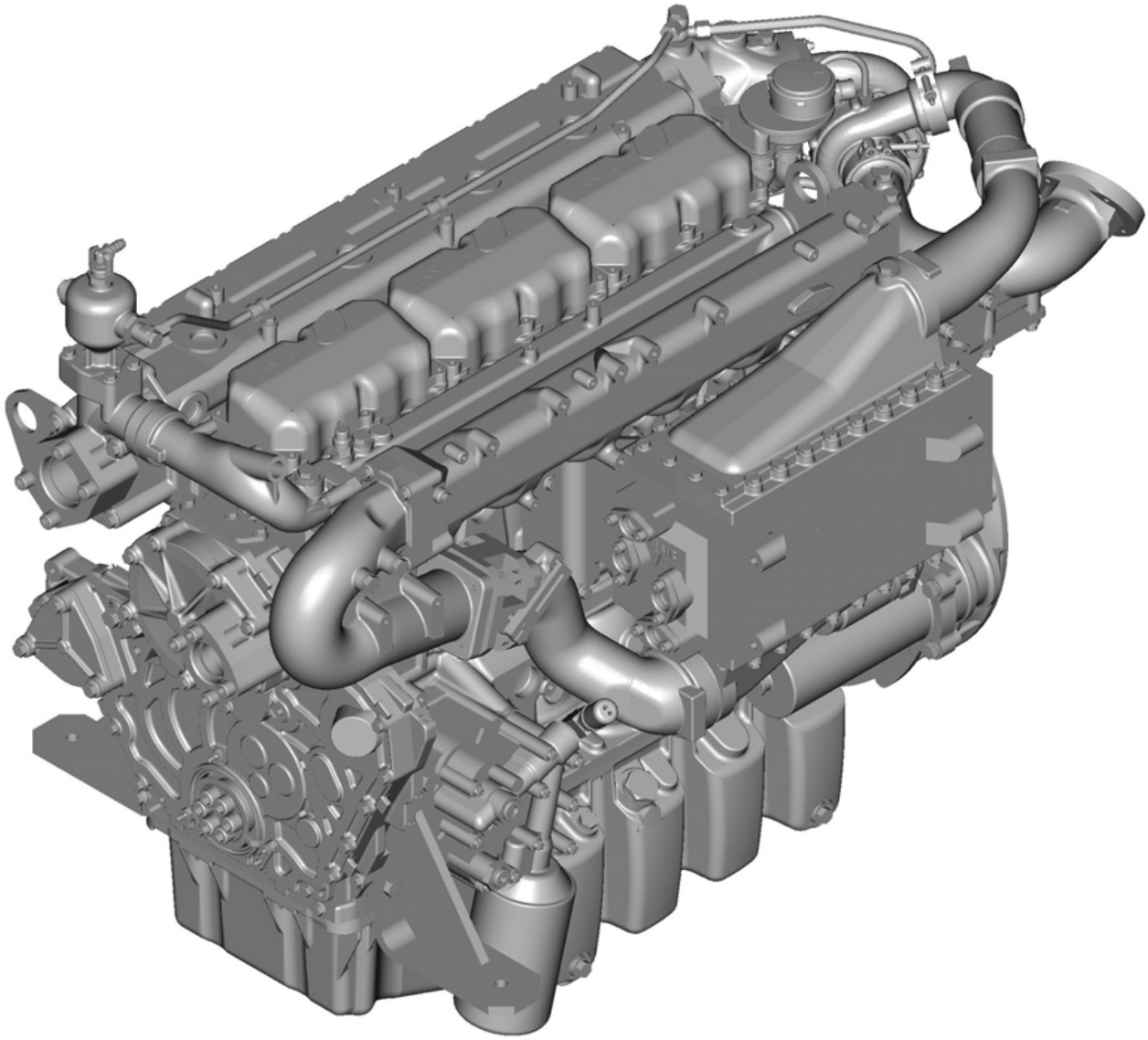

Assembly Instruction

MAN Industrial Gas Engines

E0834 LE302/312/322 / E0836 LE202/302

MAN Engines
A Division of MAN Truck & Bus

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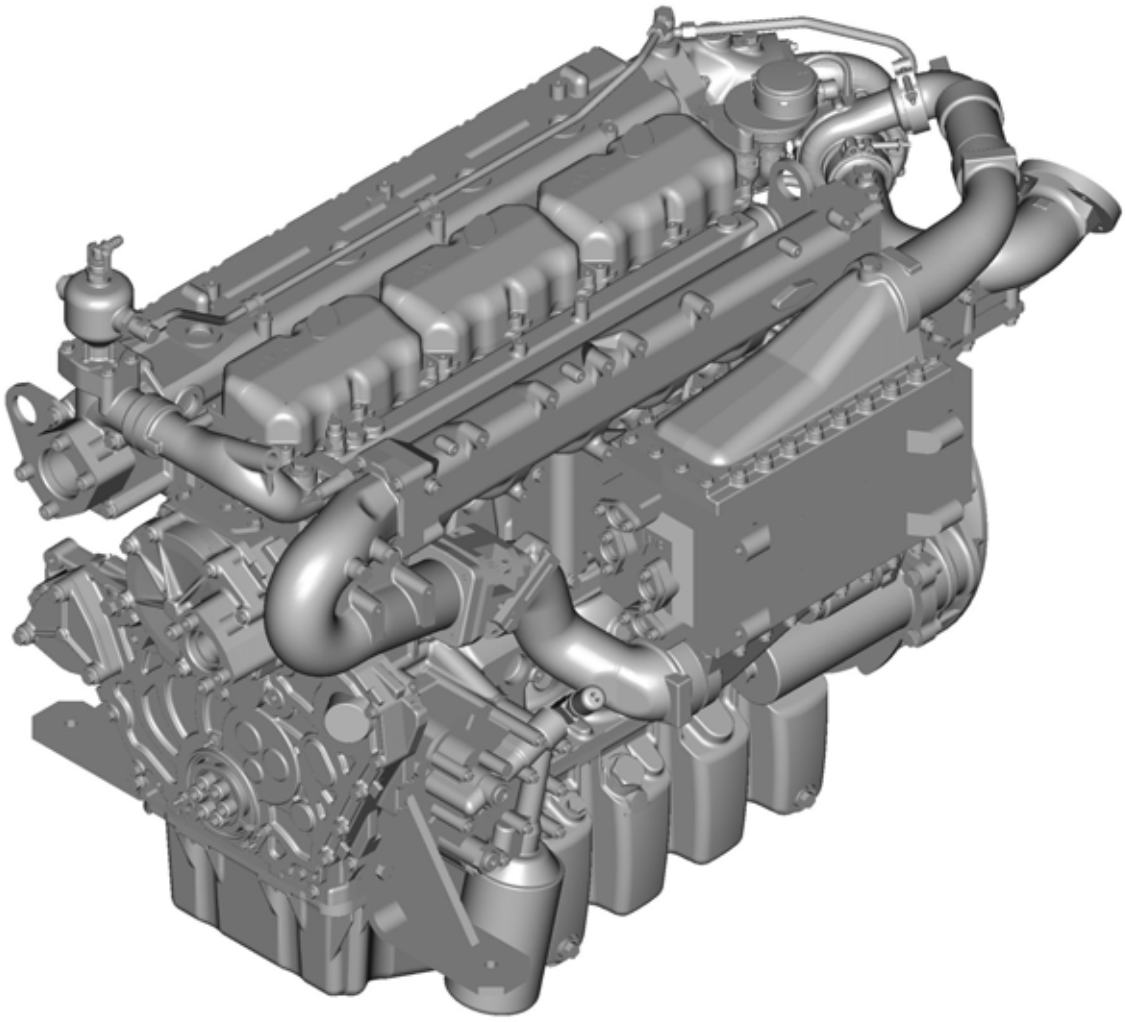
Assembly Instructions

MAN Industrial Gas Engines

E0834 LE302/ 312/ 322
E0836 LE202/302



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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.

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1 Preface

1.1 Validity of the Assembly Instructions

These Assembly Instructions provide important information for setting up stationary MAN Industrial Gas Engines of the model series E0834 LE / E0836 LE after being delivered from the manufacturing plant in Nuremberg.

NOTE!

Planning of the installation of the engines must have already been made in the project phase, the basis for which are the Installation Instructions for MAN Industrial Gas Engines for Cogeneration Power Stations (51.99496-8142). These Assembly Instructions are only valid after the installation planning has been completed and the engine is ready to be installed into the plant (cogeneration power station, power generator).

All open questions about the installation of the engine are to be clarified during planning (project phase). The scope of delivery will also be determined in this project phase. After the engine is delivered according to the job specifications, installation in the plant can be started.

Compliance with all safety precautions and handling instructions are prerequisites for safe working conditions. Furthermore, the valid local accident prevention regulations for the engine's area of application and the general safety regulations must be followed.

1.1.1 Important Additional Information to the Assembly Instructions

- Installation drawing
- Component drawing of the sensors
- Shipping documents for engine

1.1.2 Supplementary Information to the Assembly Instructions

- Operating instructions (included in delivery)
- Fluids and Lubricants for MAN Industrial Gas Engines (included in delivery)

For the service personnel

- Repair instructions
- Spare parts catalogue (included in delivery)

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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.

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1.3 Limitation of Liability

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

MAN is not liable for damages resulting from:

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

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

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

1.4 Copyright

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

NOTE!

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

1.5 Other Applicable Documents

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

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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 .23

1.7 Disposal

Dispose in accordance with national regulations.

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

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

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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 Assembly Instructions and any accompanying supplier assembly 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 .23

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

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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 for exclusive use in cogeneration power stations or power generators.
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 mixture and control system could affect the performance and emission characteristics of the engine. Compliance with the statutory environmental requirements can therefore no longer be guaranteed.

DANGER!

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

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

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2.2 Contents of the Assembly Instructions

Any person who is instructed to perform assembly work, must have read and understood these Assembly 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 Assembly 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 Assembly 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!

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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.

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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.

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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.

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Multiengine 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!

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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.

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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.

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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.

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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..

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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.

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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.

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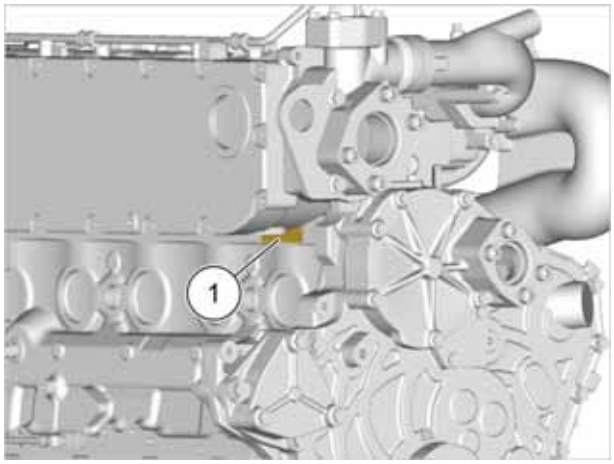
3 Engine Model Plate

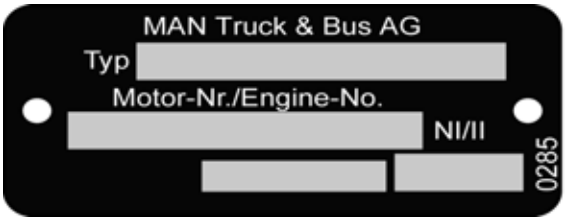
The engines may only be used in accordance with their use laid down in the planning stage, also see chapter “General Safety Instructions”, section 2.1.

Therefore, it is important for the plant manufacturer technician to be able to reliably identify each engine.

A clear identification is only possible using the information on the engine model plate.

Engine model plate (1) is installed on the charge mixture cooler.





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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	Declaration	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 intercooling
E	Installation engine	Installation engine for power generation plants
202 / 302	Model designation identification	202 = Development number 302 = Development number 312 = Development number 322 = Development number

Carefully read the Assembly 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.

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4 Transport, Packaging and Storage

It is absolutely necessary to observe the “Installation 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.

4.1 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

4.2 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.

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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.

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4.3 Transport Inspection

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

If external signs of transport damage are apparent:

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

NOTE!

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

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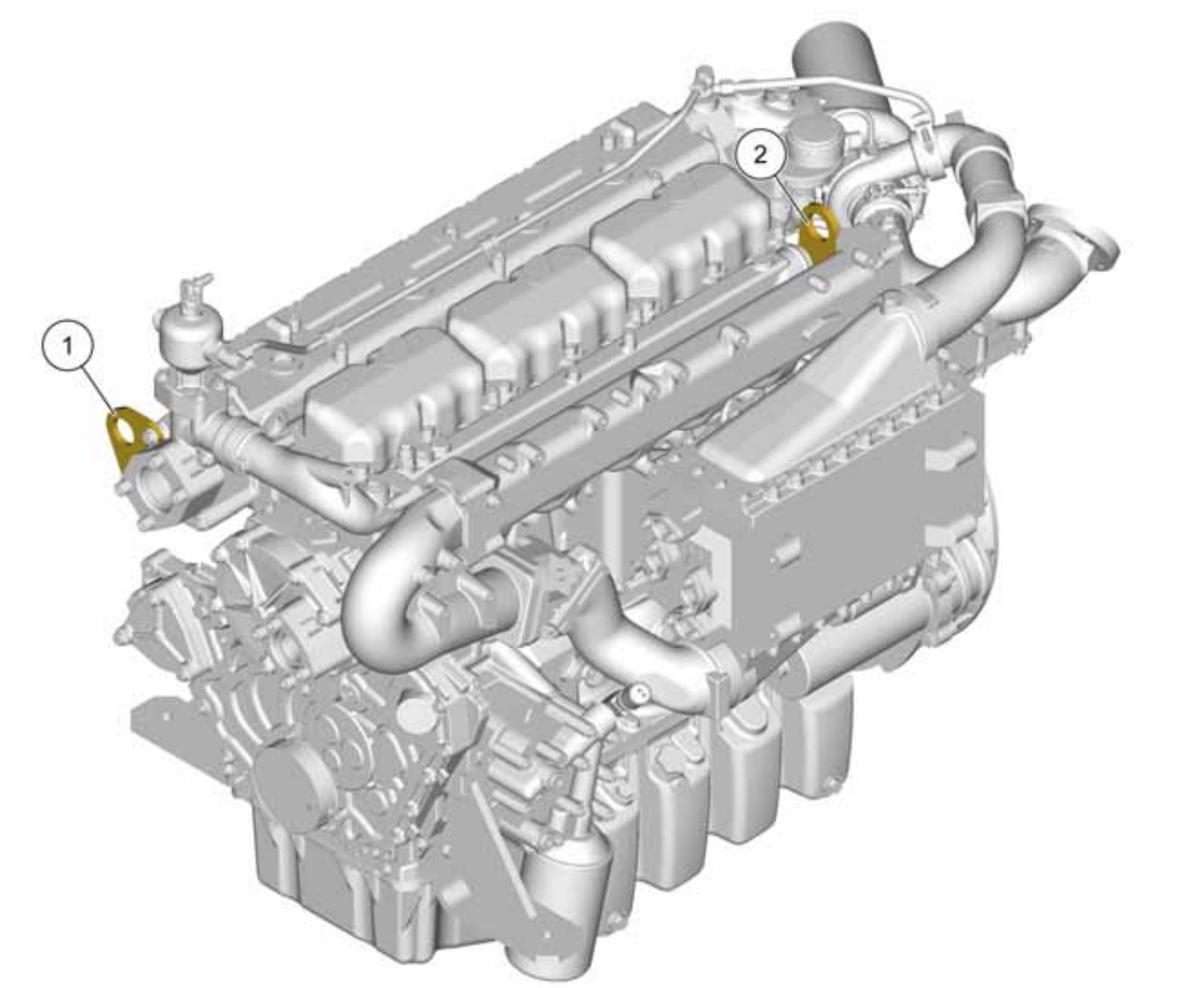
4.4 Transport

Lifting Points



There are 2 lifting lugs (1) and (2) 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.

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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.
- Make sure ropes and chains do not pull crookedly 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 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 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.

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4.5 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.

4.6 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.

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5 Installation

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
- Safety Shoes
- Safety Gloves

5.2 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!
Installation requires 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 trained and qualified personnel.

Ground Rules

WARNING!

Risk of injury caused by improper installation!
Improper installation can case serious injuries 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.

- It is absolutely necessary to observe the “Installation Instructions” for the commissioning of a new or reconditioned engine.

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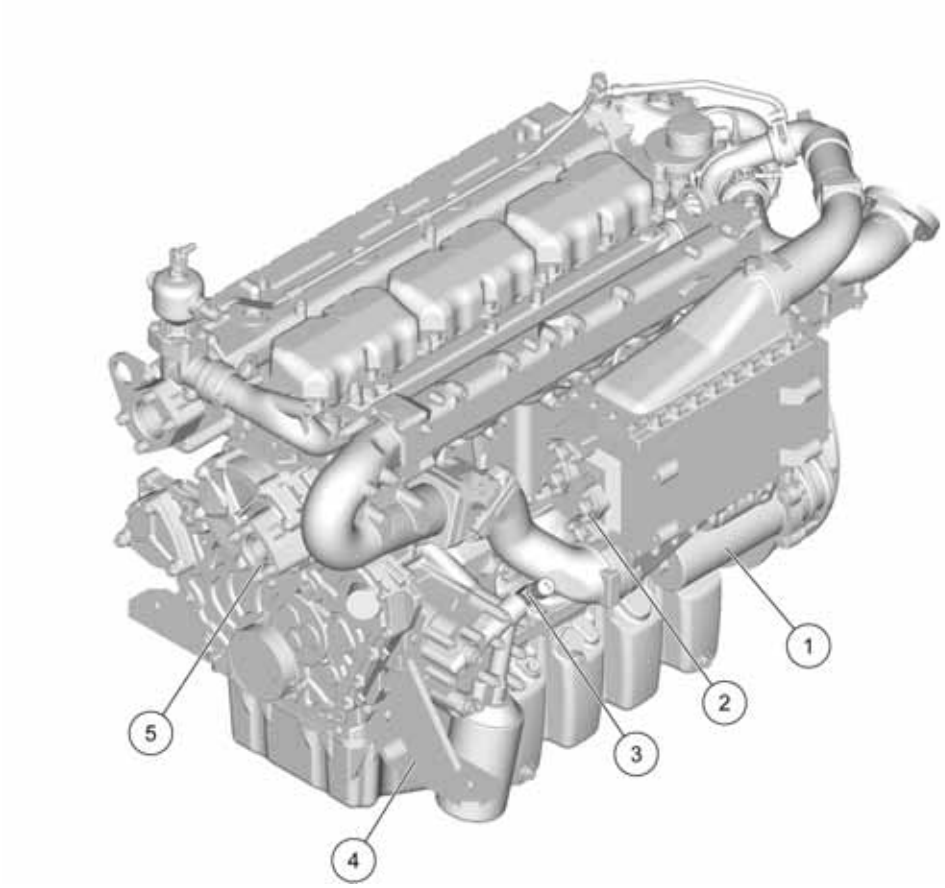
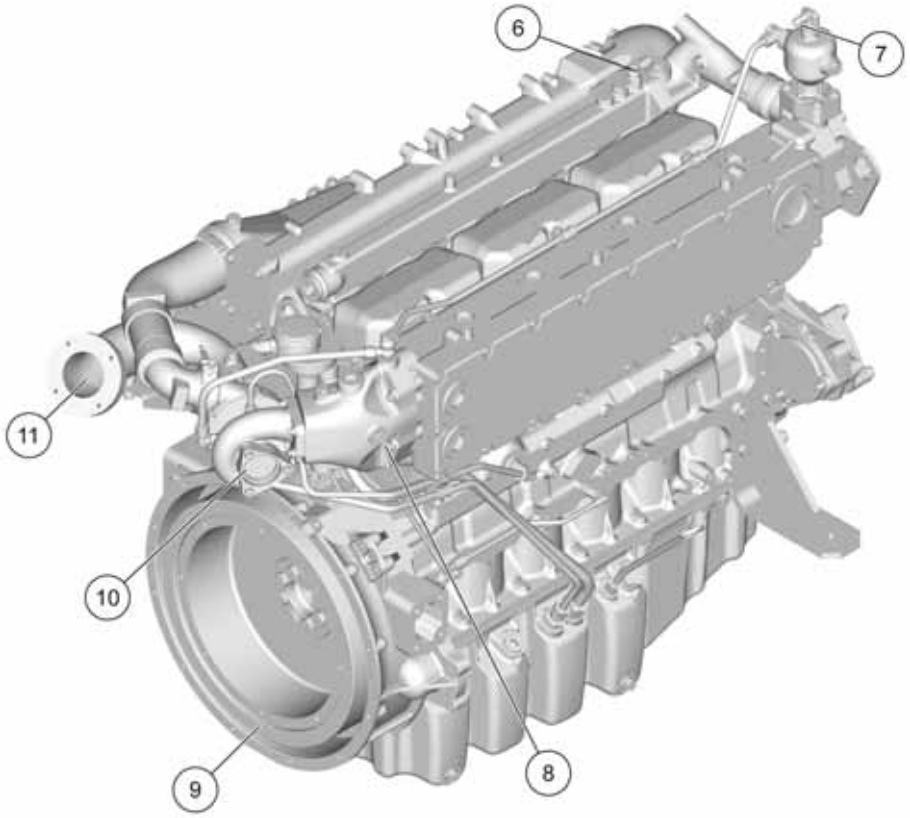
5.3 Interfaces between Engine and Plant (E0836 LE202)





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The engine is a component of the entire plant (cogeneration power station, power generator). The following assembly work is to be made to the interfaces between the engine and the plant when installing the engine:

1 Connect starter (electrical system), see page 44
2 Connect coolant lines for mixture cooling, see page 40
3 Connect oil pressure sensor, see page 46
4 Bolt engine mounts to plant frame, see page 39
5 Connect coolant lines for engine cooling, see page 40
6 Connect coolant temperature sensor, see page 46
7 Connect ventilation of cooling system to expansion reservoir
8 Connect exhaust temperature sensor, see page 46
9 Install generator, see page 37
10 Install exhaust system, see page 42
11 Install gas mixer, see page 41

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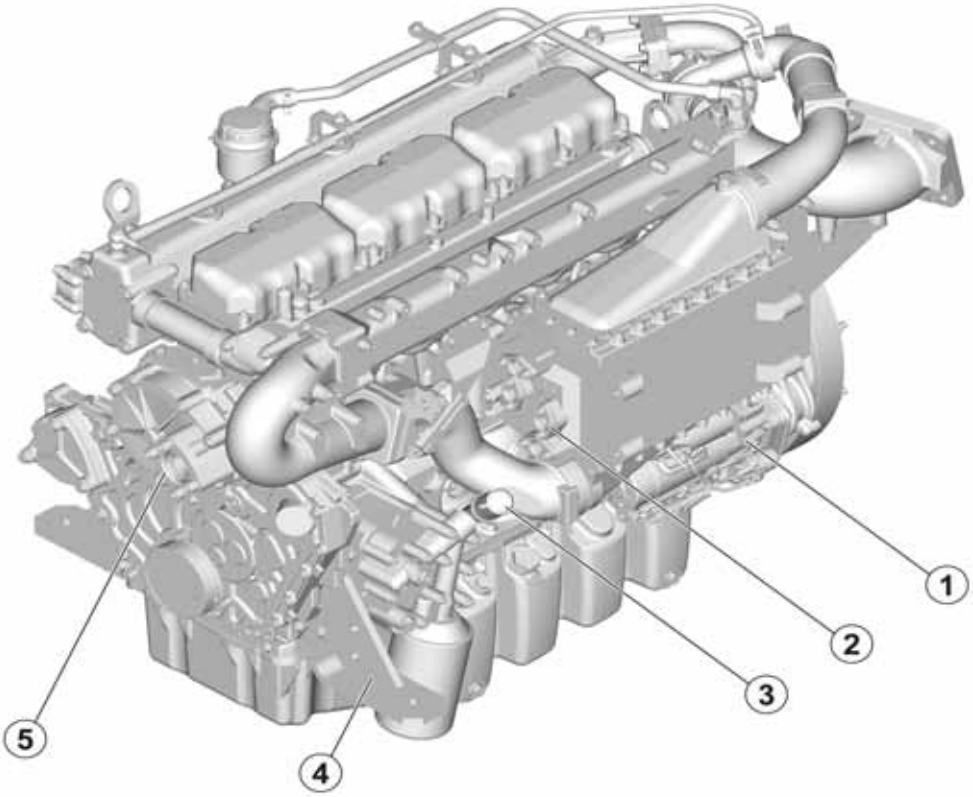
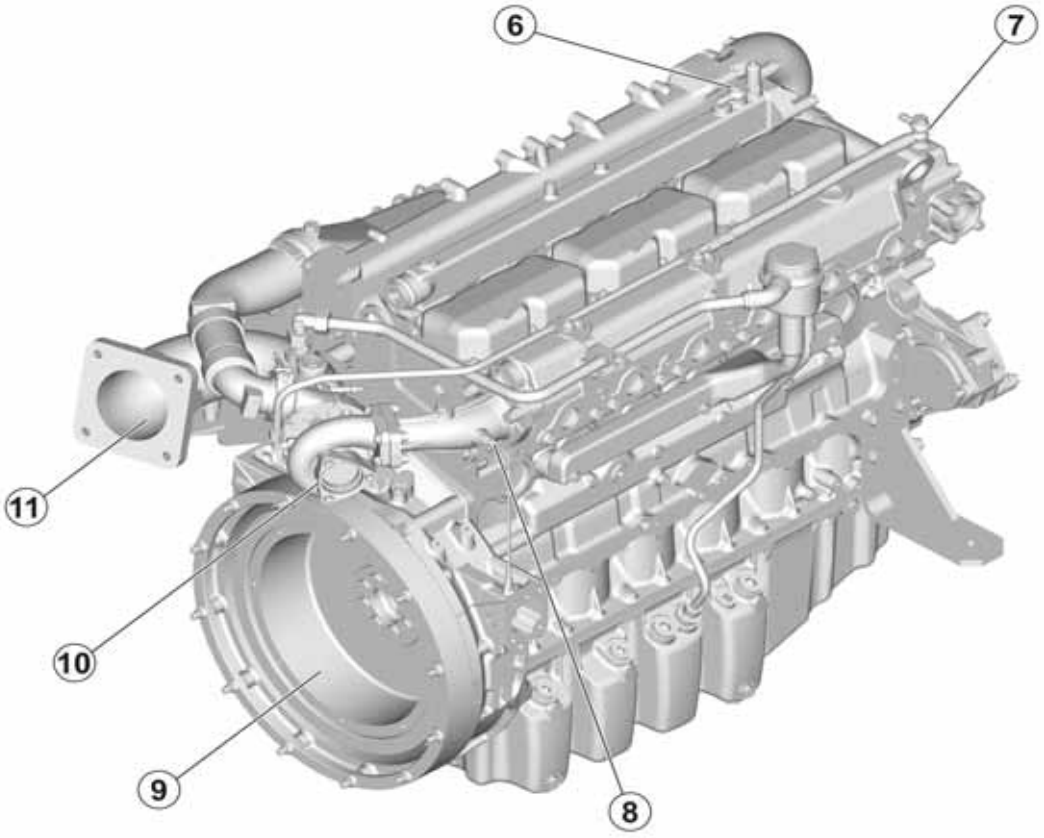
5.3 Interfaces between Engine and Plant (E0836 LE302)





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The engine is a component of the entire plant (cogeneration power station, power generator). The following assembly work is to be made to the interfaces between the engine and the plant when installing the engine:

1 Connect starter (electrical system), see page 44
2 Connect coolant lines for mixture cooling, see page 40
3 Connect oil pressure sensor, see page 46
4 Bolt engine mounts to plant frame, see page 39
5 Connect coolant lines for engine cooling, see page 40
6 Connect coolant temperature sensor, see page 46
7 Connect ventilation of cooling system to expansion reservoir
8 Connect exhaust temperature sensor, see page 46
9 Install generator, see page 37
10 Install exhaust system, see page 42
11 Install gas mixer, see page 41

5.3.1 Installation drawing

IMPORTANT!

The installation drawing forms the basis for the installation of the engine in the plant (cogeneration power station, power generator). It specifies the types of connections and the interface dimensions.

For this reason:
- Please observe the installation drawing for each of the following assembly operations listed.

5.3.2 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 48.

IMPORTANT!

Damage to components caused by incorrectly tightened threaded connections

For this reason:
- If an impact wrench is used for the initial tightening, then the bolts may only be tightened with a max. of 50% of the specified tightening torque.
- The final tightening stage may only be performed manually using a torque wrench.

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5.4 Completing the Engine and Assembling the Plant

5.4.1 Installing Ignition System

NOTE!

The engines are delivered from the factory with no ignition system installed (except for the spark plugs).

The ignition system can be ordered from the usual manufacturers to fit the MAN Industrial Gas Engines. Installation of the ignition system is to be made according to the relevant manufacturer's guidelines.

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5.4.2 Installing Generator

IMPORTANT!

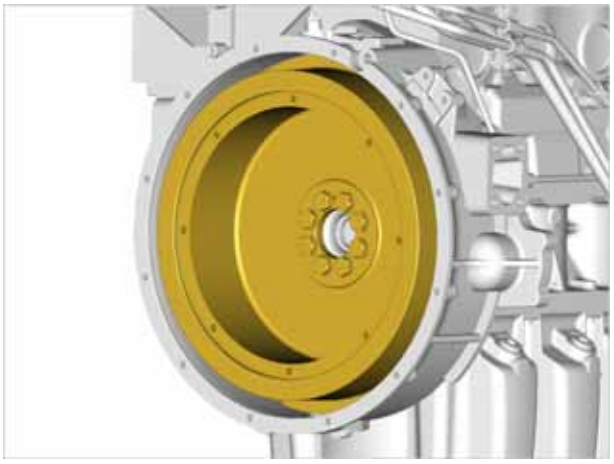
There are a variety of generators (single or dual bearing generators) and resilient couplings available on the market.

For this reason:
- Observe the installation instructions of the relevant manufacturer!

Flywheel

The interface dimensions of the flywheel are indicated in the installation drawing.

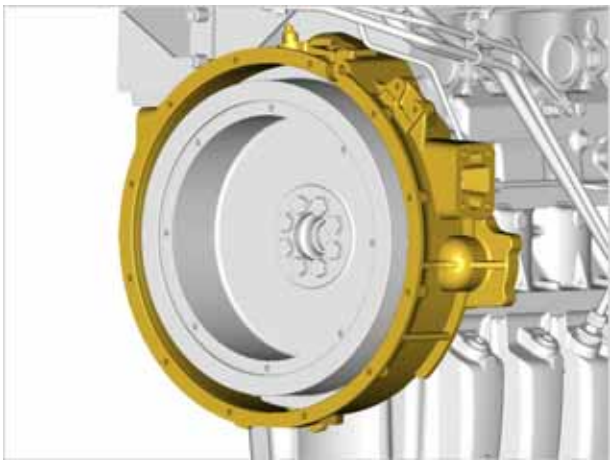
Remove any oil, grease or conservation agents from the fly wheel.



NOTE!
There are 2 different versions of the flywheel depending on the application. For example, a supplementary centrifugal mass is required for speeds of 1500 rpm to improve the control response.

Flywheel housing

The interface dimensions of the flywheel housing are indicated in the installation drawing.



NOTE!

The flywheel housing has interface dimensions according to SAE1.

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5.4.3 Checking Axial Play of Crankshaft

IMPORTANT!

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

For this reason:

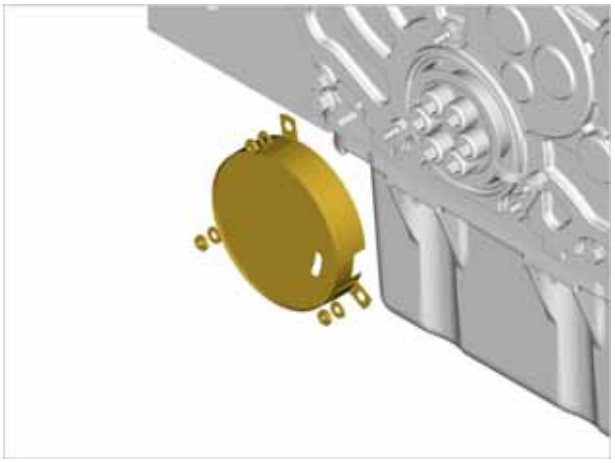
- It is essential to record the axial play of the crankshaft **before** and **after** any components are installed by using a dial indicator held by a magnetic stand.

The crankshaft axial play is to be measured **before** and **after** installing the generator or other assemblies onto the engine.

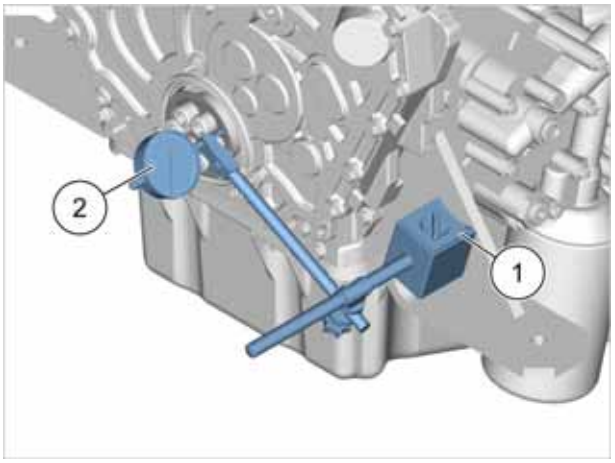
•Remove crankshaft cover

- Place holder (1) and dial indicator (2) onto engine so that the probe of the dial indicator is under tension
  on the dial
- Press crankshaft all the way in the axial direction to the flywheel housing
- Set dial indicator to zero
- Pull crankshaft all the way in the axial direction from the flywheel housing
- Read off dial indicator

If the results of both measurements do not match or if the crankshaft springs back after being pushed, check the installation.



Engines	Crankshaft axial play
E0834 / 36LE-engines, all types	0.200-0.395 mm



Carefully read the Assembly 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.

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5.5 Installing Engine in a Cogeneration Power Station

NOTE!

Before placing the engine in the plant with the aid of the installation drawing, check whether the interface dimensions of the lines (coolant, exhaust, etc.) to the connections at the engine fit.

WARNING!

Protective equipment is installed on the engine for safety reasons to prevent the touching of hot or rotating parts (contact protection of exhaust manifold (hot!)) and on the front side of the engine (rotating crankshaft!)

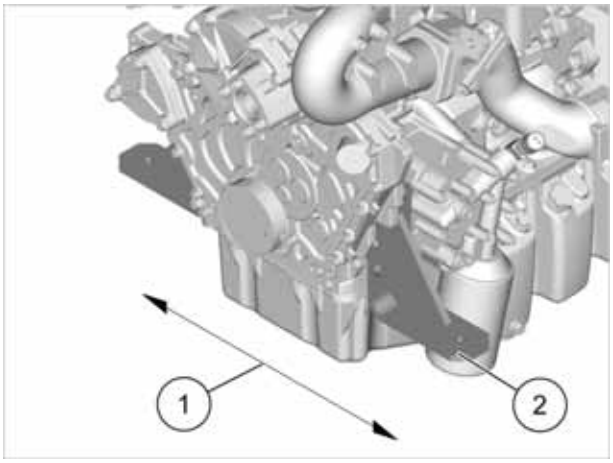
For this reason:

- This protective equipment must not be removed!

5.5.1 Bolting Engine to Base Frame

The installation drawing gives information on the location and drilling pattern (1) of the engine mounts. Mounting of the generator is to be made by the plant manufacturer.

1. Place engine and generator on base frame (using resilient mounts where applicable).
2 Bolt engine mounts and generator mounts to the base frame. The bolt diameter (2) is specified in the installation drawing.



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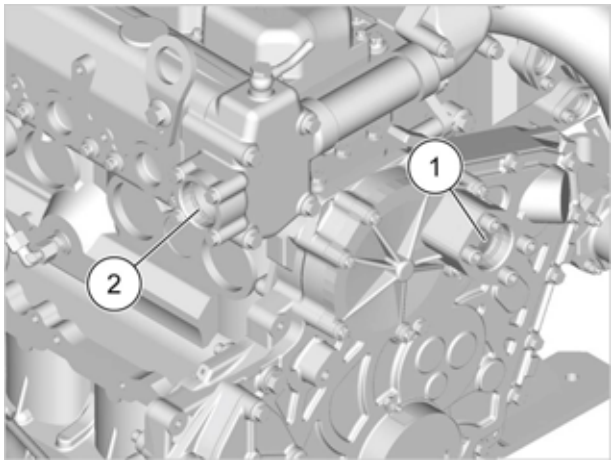
5.6 Installing Cooling System

5.6.1 Connecting Coolant Lines for Engine Cooling

The installation drawing specifies the implementation of the coolant connections.

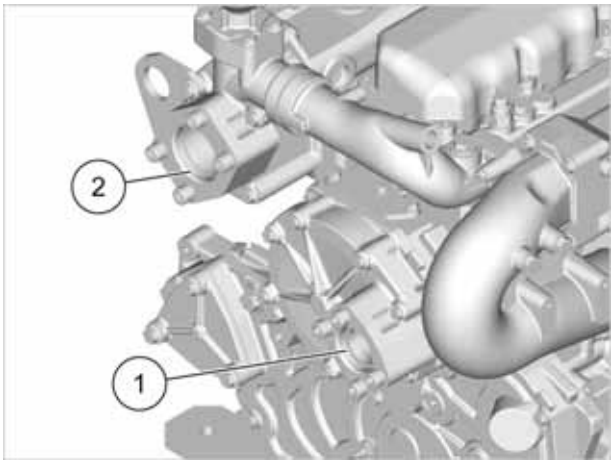
E0834 LE302

1. Connect coolant inlet (1)
2 Connect coolant outlet (2)



E0836 LE202

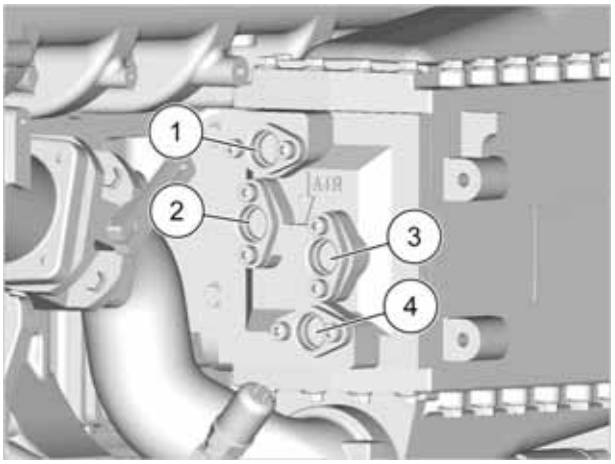
1. Connect coolant inlet (1)
2 Connect coolant outlet (2)



5.6.2 Connecting Coolant Lines for Mixture Cooling

The installation drawing specifies the implementation of the coolant connections.

1. Connect coolant inlet of high temperature stage (2)
2. Connect coolant outlet of high temperature stage (1)
3. Connect coolant inlet of low temperature stage (4)
4. Connect coolant outlet of low temperature stage (3)



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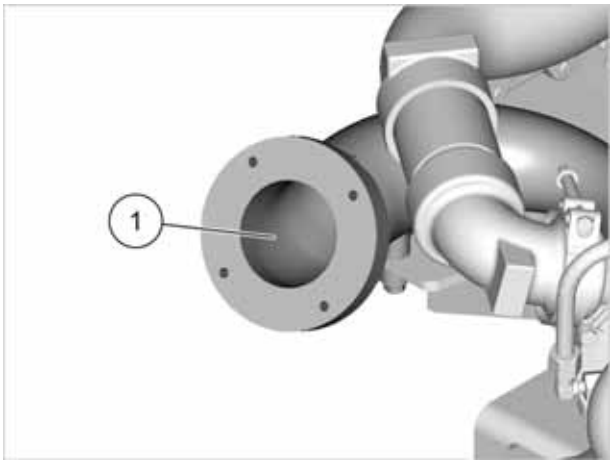
5.7 Installing Intake System

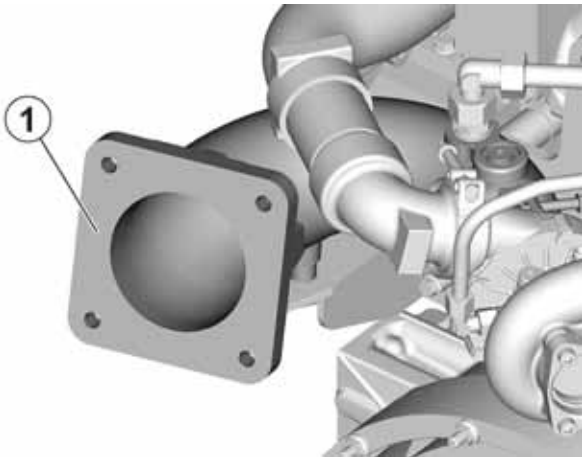
5.7.1 Installing Gas Mixer (E0836LE202)

The location of the gas inlet at the engine (1) and the drilling pattern of the flange are both specified in the installation drawing.



5.7.2 Installing Gas Mixer (E0836LE302)

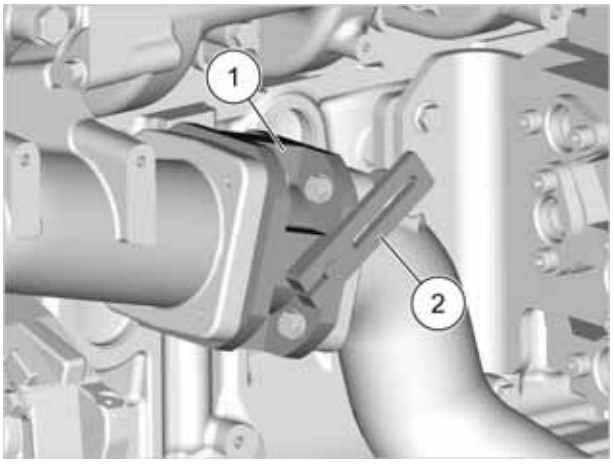
The location of the gas inlet at the engine (1) and the drilling pattern of the flange are both specified in the installation drawing.



5.7.3 Installing Actuation Linkage for Throttle Valve

The throttle valve (1) is actuated by an actuator motor and linkage. The linkage is attached to a lever (2) mounted on the throttle valve shaft. A detailed depiction of the throttle valve can be found in the installation drawing.

Make sure that the throttle valve can be completely opened and completely closed.



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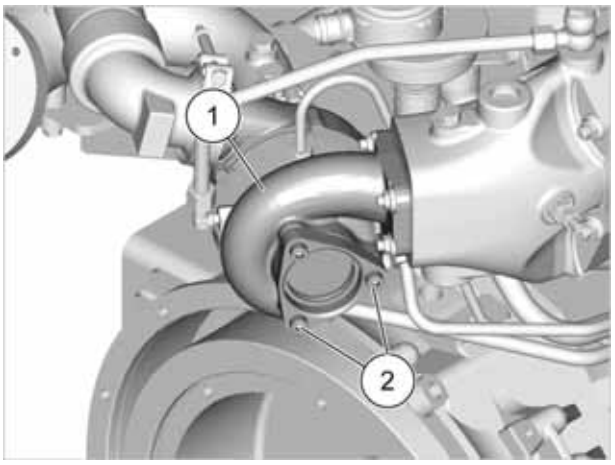
5.8 Installing Exhaust System

5.8.1 Installing Exhaust Line (E0836LE202)

Install exhaust manifold at turbocharger (1).

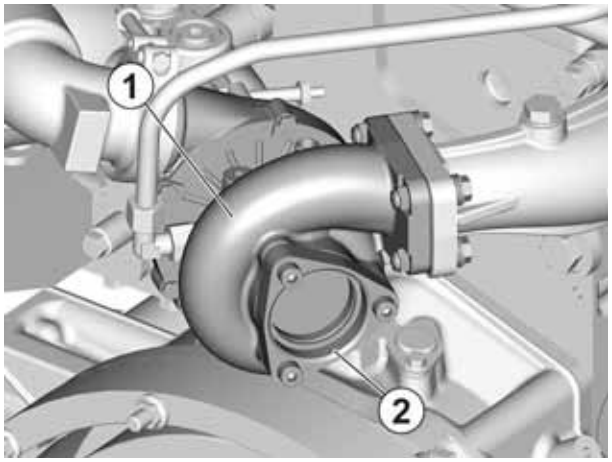
There is a counter flange (weld flange) at the exhaust outlet of the turbocharger (2) to connect the exhaust system. The dimensions are specified in the installation drawing.



5.8.1 Installing Exhaust Line (E0836LE302)

Install exhaust manifold at turbocharger (1).

There is a counter flange (weld flange) at the exhaust outlet of the turbocharger (2) to connect the exhaust system. The dimensions are specified in the installation drawing.



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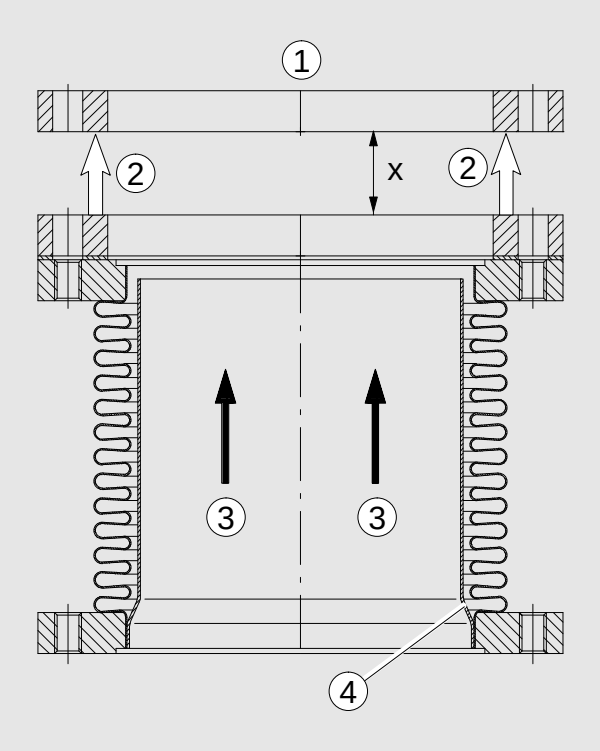
5.8.2 Installing Exhaust Pipe Bellows

Install the exhaust pipe bellows as vertical as possible to support the rest of the exhaust line. The position of the guide pipe (4) determines the flow direction of the exhaust.

Install exhaust pipe bellows under tensile prestress (2). A tensile prestress means that before the bellows are bolted, the distance X between the flange of the bellows and the counter flange of the rest of the exhaust pipe (1) should measure 10-15 mm.



IMPORTANT!
Damage of the exhaust pipe bellows caused by incorrect installation

For this reason:
- Observe the flow direction (3) of the exhaust through the bellows!
- Install the bellows in a vertical position!

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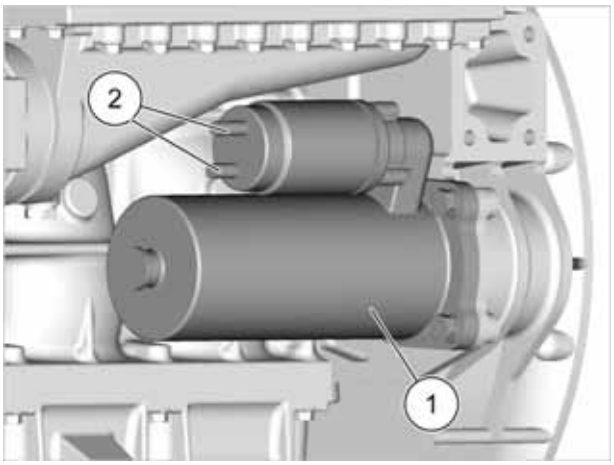
5.9 Connecting Electrical System

5.9.1 Connecting Starter (BOSCH)

The threads of the cable connection (2) of the starter (1) are specified in the installation drawing.

Battery capacity, cable length and cable cross-section should be selected to match.

The required starter cable cross-section, which depends on the recommended starter cable lengths, are listed in the following table.



Engine models		**E0834 LE302 / E0836 LE202**		
Starter type		Bosch		
Rated voltage	V	24		
Rated output	kW	4		
Permitted battery capacity[1)]	Ah	66	88	110
Starter short circuit current at 20 °C with a feed cable of 1mΩ/m	A	940	1050	1100
Required starter cable cross-section (copper)	mm^2	Recommended starter cable lengths in meters (valid for the cables to and from, voltage loss: max. 4% based on 0.5 x starter short circuit current)		
50 70 95 120 140 (2 x 70)		5.7 7.9 10.8 13.6 15.9	5.0 7.1 9.6 12.2 14.2	4.8 6.8 9.2 11.6 13.6
Control cable between starter switch and starter terminal 50	mm^2	Max. permitted line length in meters		
2.5 4.0 6.0		9.8 15.7 23.6		

1) Batteries according to DIN 72 311. The largest capacity listed for each starter must not be exceed to prevent damage to the starter and starter ring gear.

Carefully read the Assembly 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.

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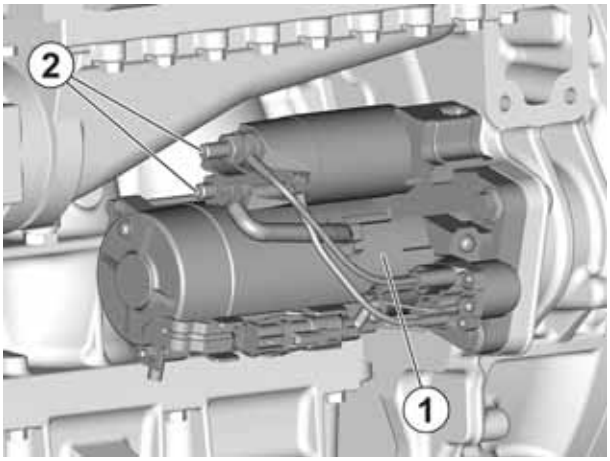
5.9.1 Connecting Starter (MITSUBISHI)

The threads of the cable connection (2) of the starter (1) are specified in the installation drawing.

Battery capacity, cable length and cable cross-section should be selected to match.

The required starter cable cross-section, which depends on the recommended starter cable lengths, are listed in the following table.



Engine models		**E0834 LE302 / E0836 LE202 /E0836 LE302**		
Starter type		Mitsubishi		
Rated voltage	V	24		
Rated output	kW	5		
Permitted battery capacity[1)]	Ah	66	88	110
Starter short circuit current at 20 °C with a feed cable of 1mΩ/m	A	940	1050	1100
Required starter cable cross-section (copper)	mm^2	Recommended starter cable lengths in meters (valid for the cables to and from, voltage loss: max. 4% based on 0.5 x starter short circuit current)		
50		5.7	5.0	4.8
70		7.9	7.1	6.8
95		10.8	9.6	9.2
120		13.6	12.2	11.6
140 (2 x 70)		15.9	14.2	13.6
Control cable between starter switch and starter terminal 50	mm^2	Max. permitted line length in meters		
2.5		9.8		
4.0		15.7		
6.0		23.6		

1) Batteries according to DIN 72 311. The largest capacity listed for each starter must not be exceed to prevent damage to the starter and starter ring gear.

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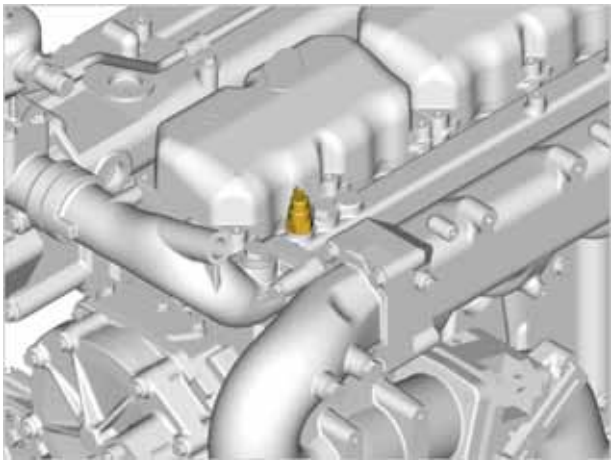
5.9.2 Connecting Sensors

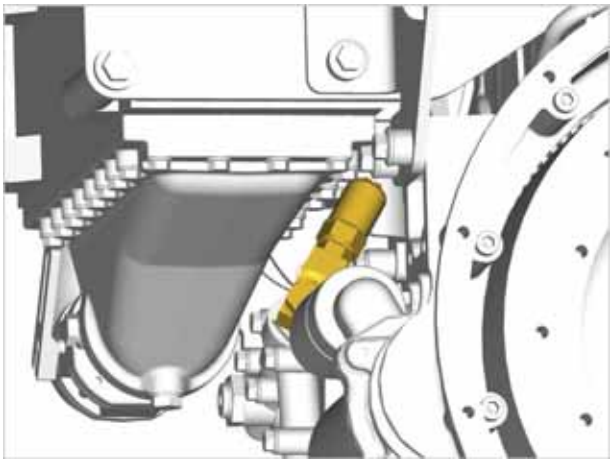
NOTE!

The location of sensors on the engine is shown in the installation drawing.
Each sensor's drawing gives information on the pin assignment.
To request drawings see page 3 for contact addresses.

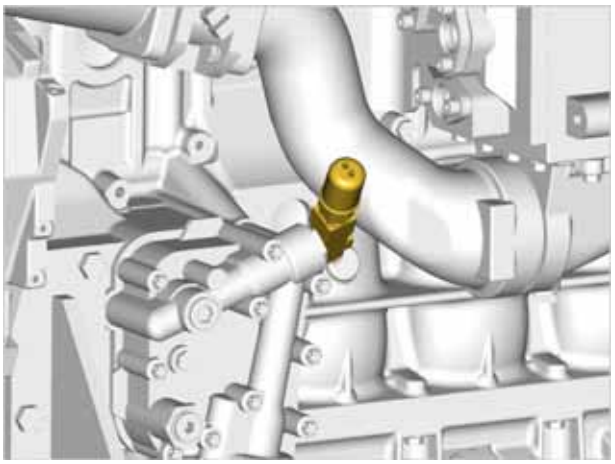
Coolant temperature sensor



Oil pressure sensor (E0834 LE302/312/322)



Oil pressure sensor (E0836 LE202)



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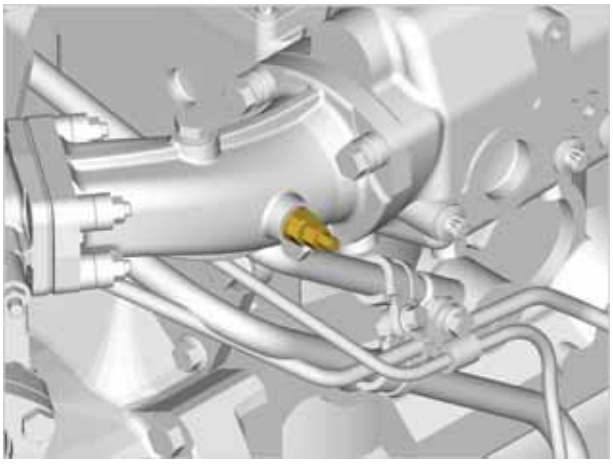
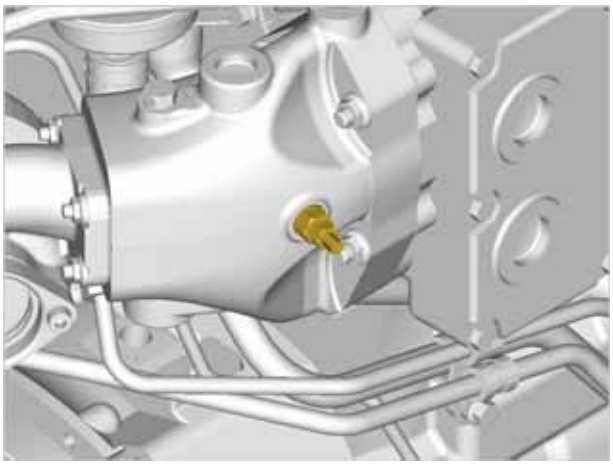
Exhaust temperature sensor
(E0834 LE302/312/322 E0836 LE302)



Exhaust temperature sensor (E0836 LE202)



IMPORTANT!

The purpose of the sensors is to monitor important operating parameters.
Sensors that are not connected or are inoperative can lead to damage to the engine.

For this reason:
- Connect sensors to the engine monitoring system and check for proper operation.

5.9.3 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.

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Tightening torques according to plant standard M 3059
Bolt / nut with Allen or hexagon head with no 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	8.0	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	67.0	75.0
M10x1	50.0	70.0	85.0
M12	75.0	110.0	125.0
M12x1.5	75.0	115.0	130.0
M12x1.25	80.0	120.0	135.0
M14	115.0	175.0	200.0
M14x1.5	125.0	185.0	215.0
M16	180.0	265.0	310.0
M16x1.5	190.0	280.0	330.0
M18	260.0	365.0	430.0
M18x2	270.0	385.0	450.0
M18x1.5	290.0	405.0	480.0
M20	360.0	515.0	600.0
M20x2	380.0	540.0	630.0
M20x1.5	400.0	565.0	670.0
M22	490.0	700.0	820.0
M22x2	510.0	725.0	860.0
M22x1.5	540.0	750.0	900.0
M24	620.0	890.0	1040.0
M24x2	680.0	960.0	1130.0
M24x1.5	740.0	1030.0	1220.0

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6 Commissioning

WARNING!

Danger caused by faults during commissioning!
Commissioning requires trained qualified personnel with sufficient experience. Faulty commissioning can cause life threatening situations and considerable property damage.

For this reason:
Commissioning is only to be performed by trained and qualified personnel.

Ground Rules

WARNING!

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

For this reason:
- Before commissioning the engine, carefully read the Operating Instructions and familiarise yourself with the “critical” subjects.
- It is absolutely necessary to observe the “Installation Instructions” for the commissioning of a new or reconditioned engine.
- Make sure work space is kept clean and orderly!

6.1 Filling Fluids and Lubricants

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).“

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6.1.1 Filling Engine Oil

IMPORTANT!

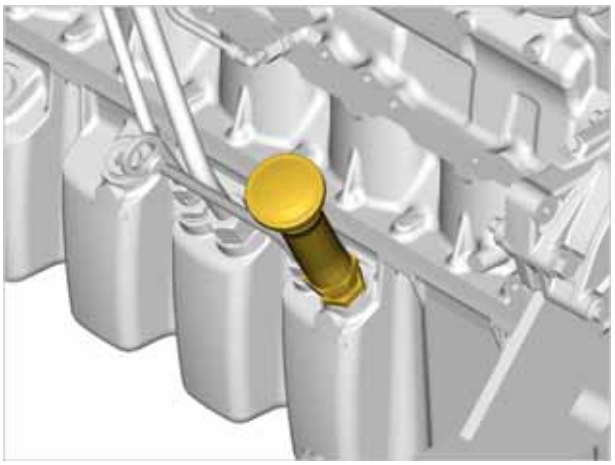
Engine oil **is harmful to the environment.**

For this reason:

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

The engines are as a rule supplied without oil.
Fill engine with lubricating oil via the oil filler neck,

Oil capacity in oil sump (litres)	min. Litre	max. Litre
E0834 LE 302/312/322	17	25
E0836 LE202	24	34



IMPORTANT!

Engine damage will occur if engine oil level is too low or too high!

For this reason:

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

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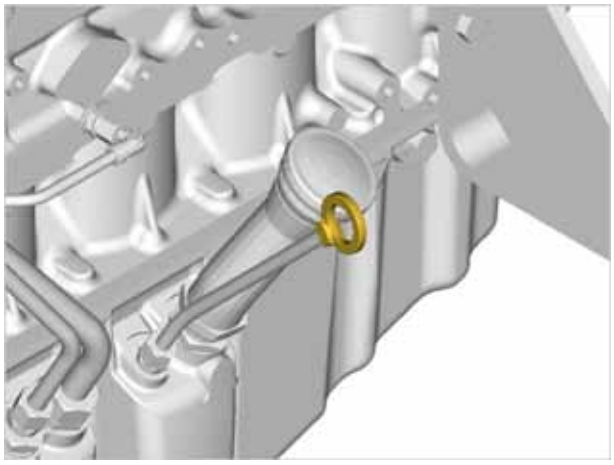
6.1.2 Checking Engine Oil Level

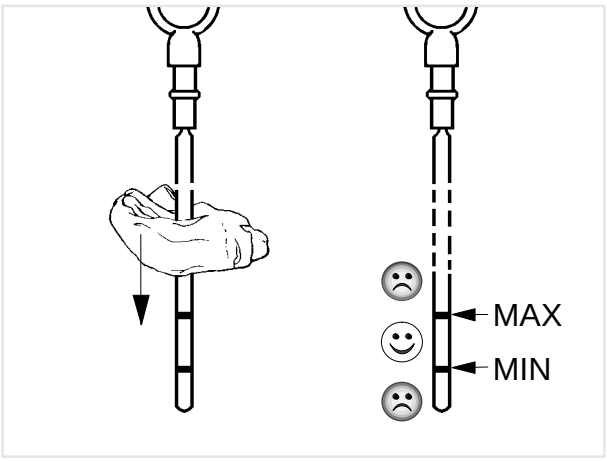
Check engine oil level 30 minutes after filling engine with oil.

- Remove oil dipstick
- Wipe off with lint-free cloth
- Reinsert up to stop
- Pull out dipstick again

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

Ensure utmost cleanliness when handling engine oils.





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6.1.3 Filling Coolant

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

IMPORTANT!

Coolant is harmful to the environment.

For this reason:
- Do not let coolant spill when filling. Do not let coolant leak out onto the ground or into bodies of water.

For more information on the preparation of the coolant, refer to “Fuels, Lubricants and Coolants for MAN Industrial Gas Engines”. The amount of coolant to be prepared is given by the total filling capacity of the cooling system.

For the design of the engine cooling system see the installation instructions.

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

- Remove cap
- Slowly add coolant
- Close expansion reservoir
- Run engine for approx. 15 minutes at rated speed
- Turn off engine. Carefully turn cap with safety valve to the first indent and release pressure. Then carefully open cap and, if necessary, add coolant
- 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 level again (with engine cold) before the engine's next use. Refill if necessary
- Repeat this procedure until coolant can no longer be added.

Carefully read the Assembly 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.

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6.2 Commissioning Coolant System

When inspecting the coolant circuit make sure that

- The coolant circuit can be quickly filled (≥ 8 l/min);
- The coolant circuit is completely vented;
- No vacuum can be produced ahead of coolant pump (cavitation);
- A system pressure is achieved in the cooling circuit (0.4-0.5 bar static) and is maintained after engine is turned off;
- The required coolant flow rate is achieved in the coolant circuit at max. permissible coolant temperature and with mixture valve completely opened;
- No coolant leaks out of coolant circuit even when engine is turned off at a high temperature;
- Approx. 10% of the coolant quantity can be drained from the expansion reservoir until air is swept along in the filling line;
- The coolant circuit including engine and heat exchanger can be completely drained;
- Air bubbles are released from the coolant;
- No air pockets are present in cooling system;
- Hose connections are accessible for maintenance.

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6.3 Commissioning Exhaust System

6.3.1 Measuring Exhaust Back Pressure

The exhaust back pressure must be measured during commissioning.

The measuring point of the exhaust back pressure (threads e.g. M14x1.5) must be selected in a straight part of the exhaust pipe.

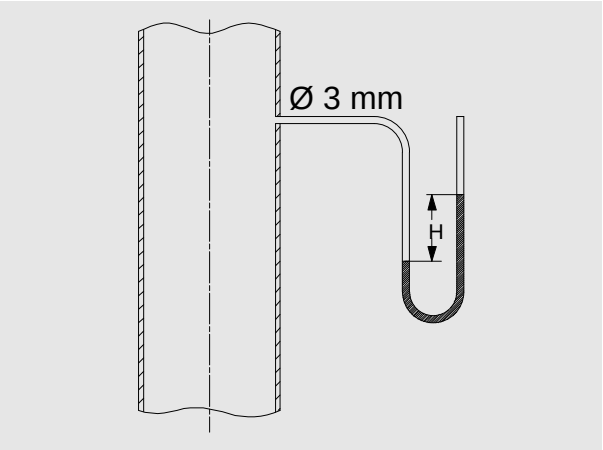
Measurements take directly downstream of the turbocharger will have distorted results by approx. 20 mbar.

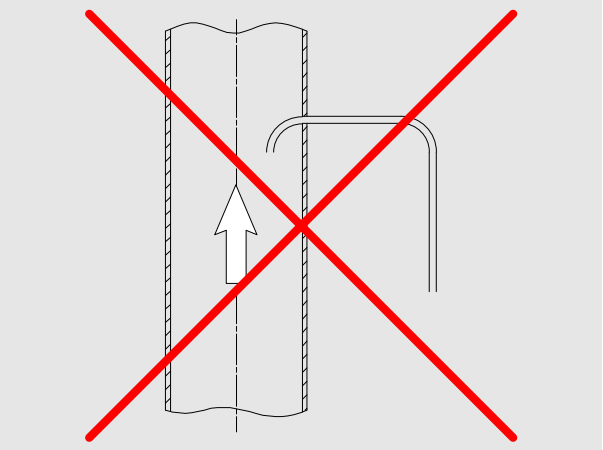
The static pressure is measured, i.e. the measuring connection must be flush with the inner pipe walls.

Measurement of the head pressure and measurements taking in bends will created incorrect results.

The engine is to be operated at full power and rated speed during the measurement.

The simplest measuring instrument is a slack tube pressure gauge filled with water
(1 hPa = 10 mm Ws)





6.3.2 Measuring Exhaust Temperature

IMPORTANT!

The max. permissible exhaust temperatures are specified in the installation instructions. Excessive exhaust temperatures lead to serious engine damage.

For this reason:

- Continuous monitoring of the exhaust back pressure is mandatory.

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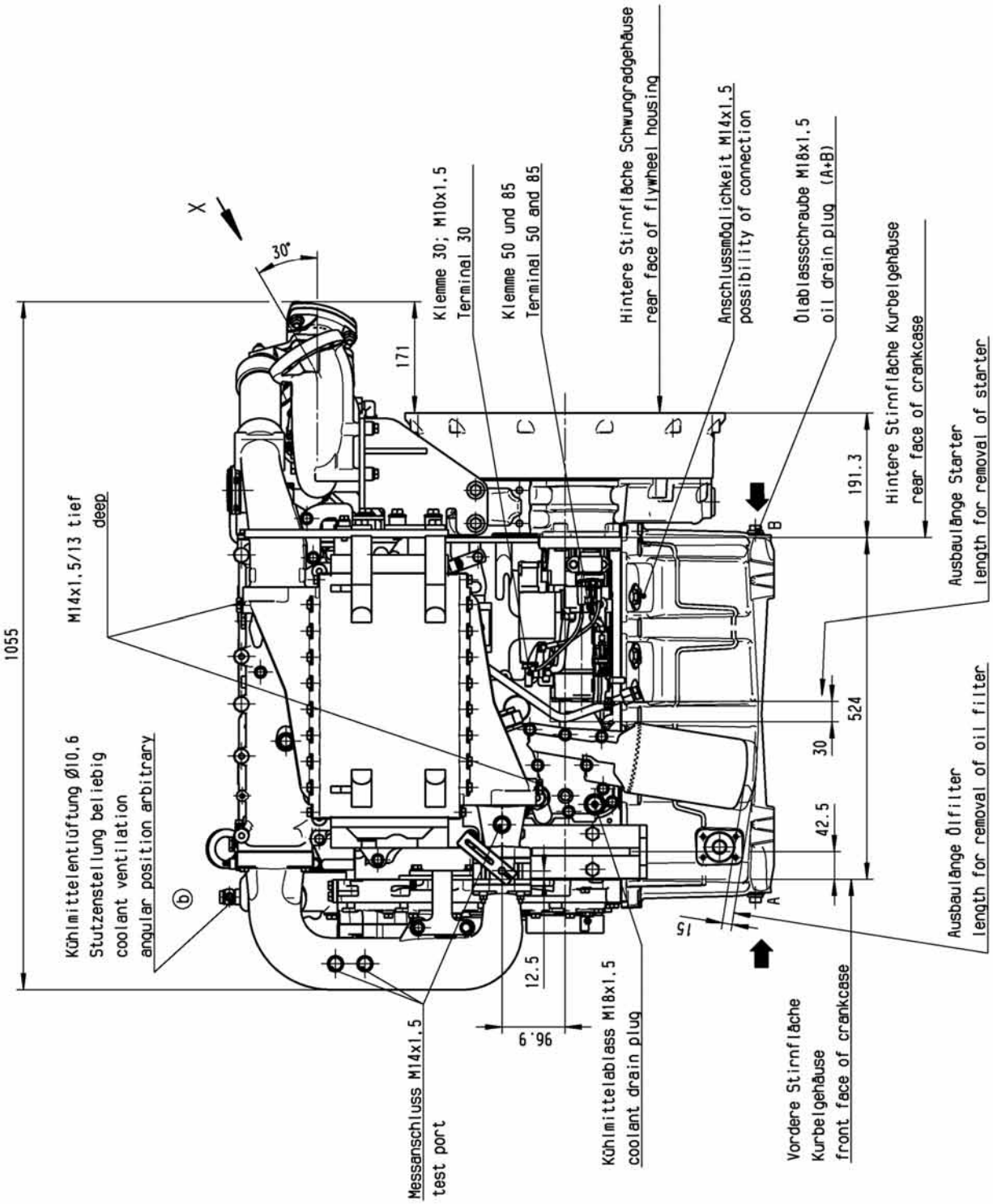

Identification no. of installation drawing: 51.00504-7109,
drawn September 03, 2012

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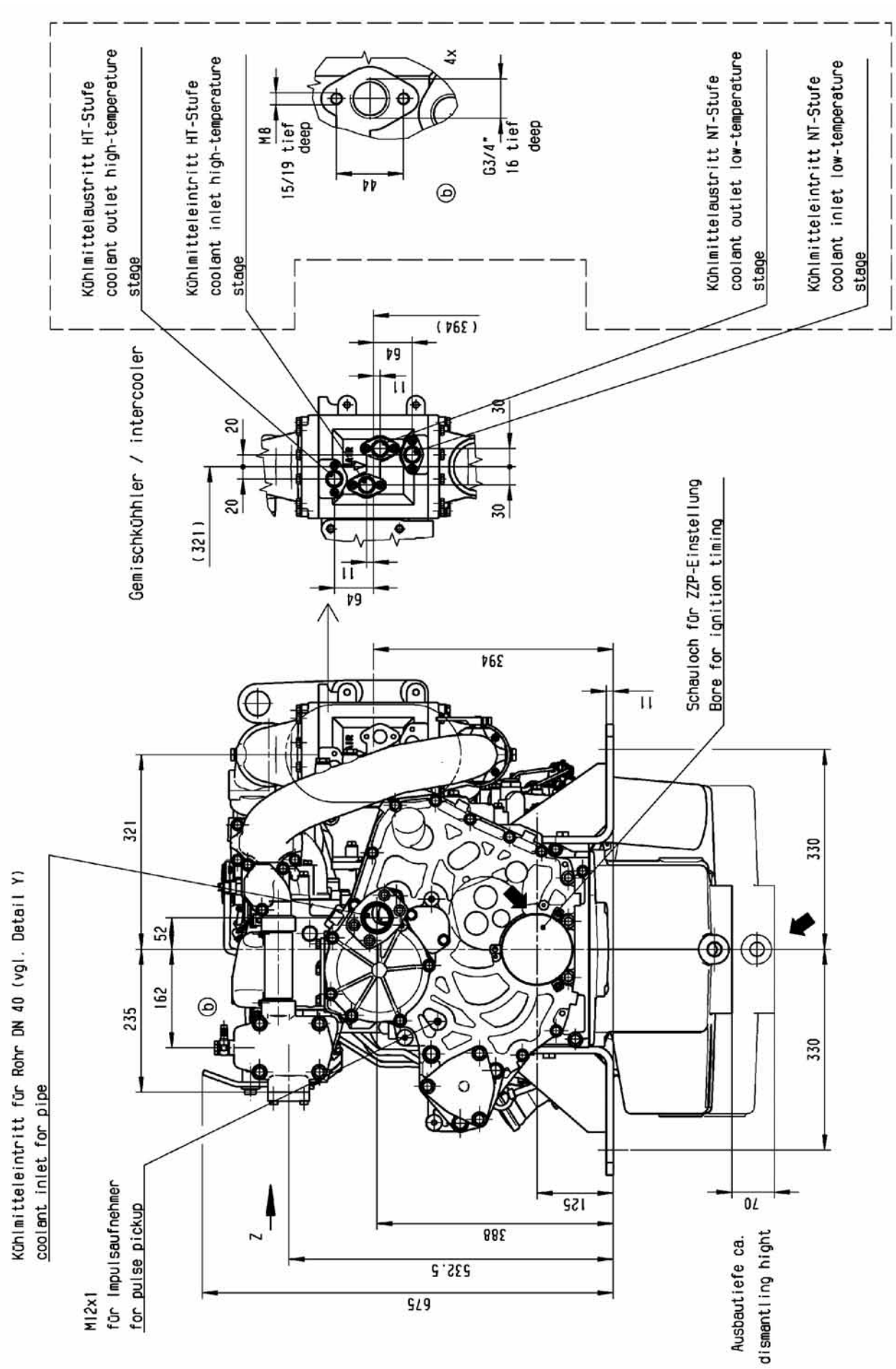
Installation Drawings of the Engine E0834 LE302



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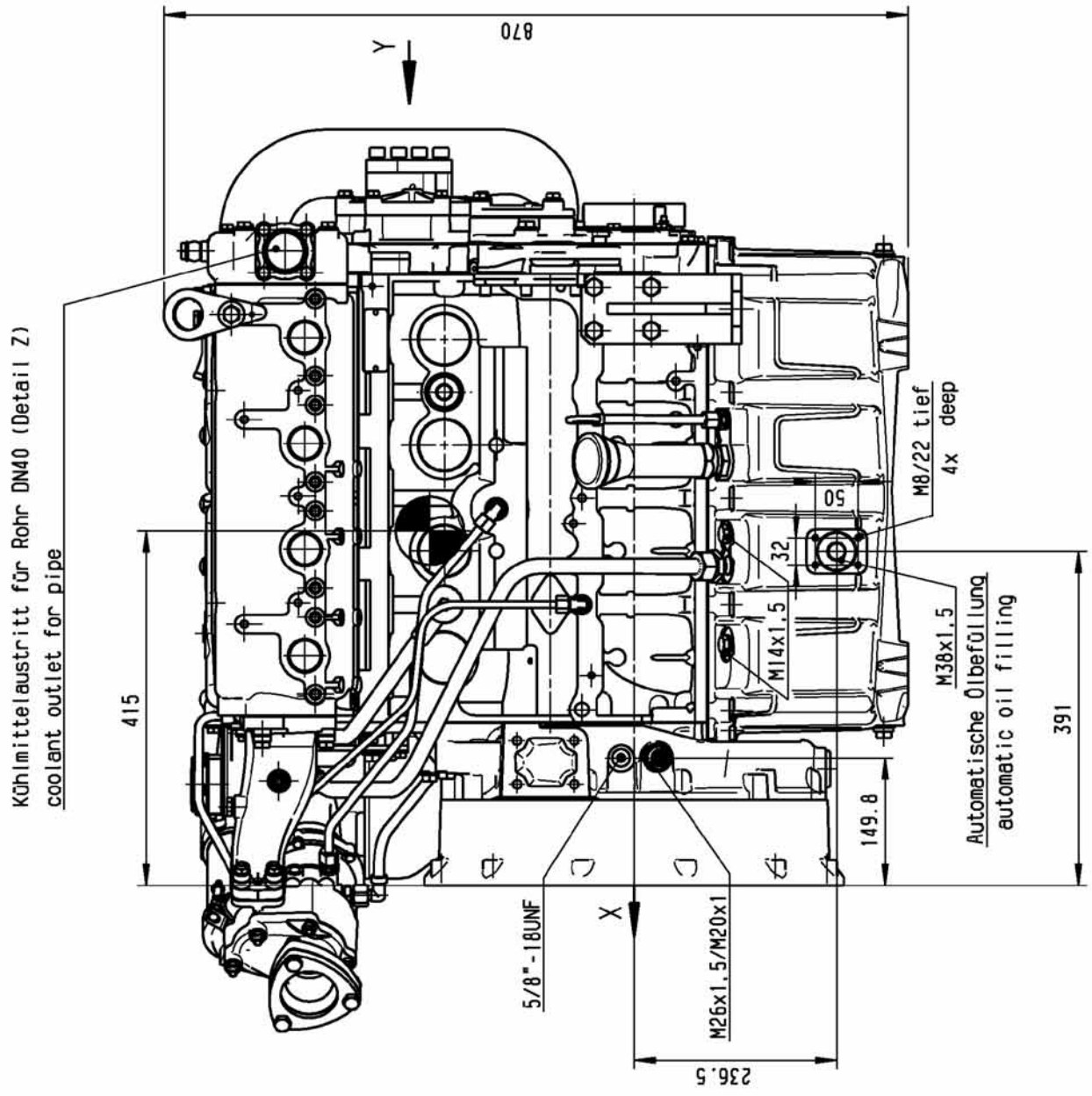

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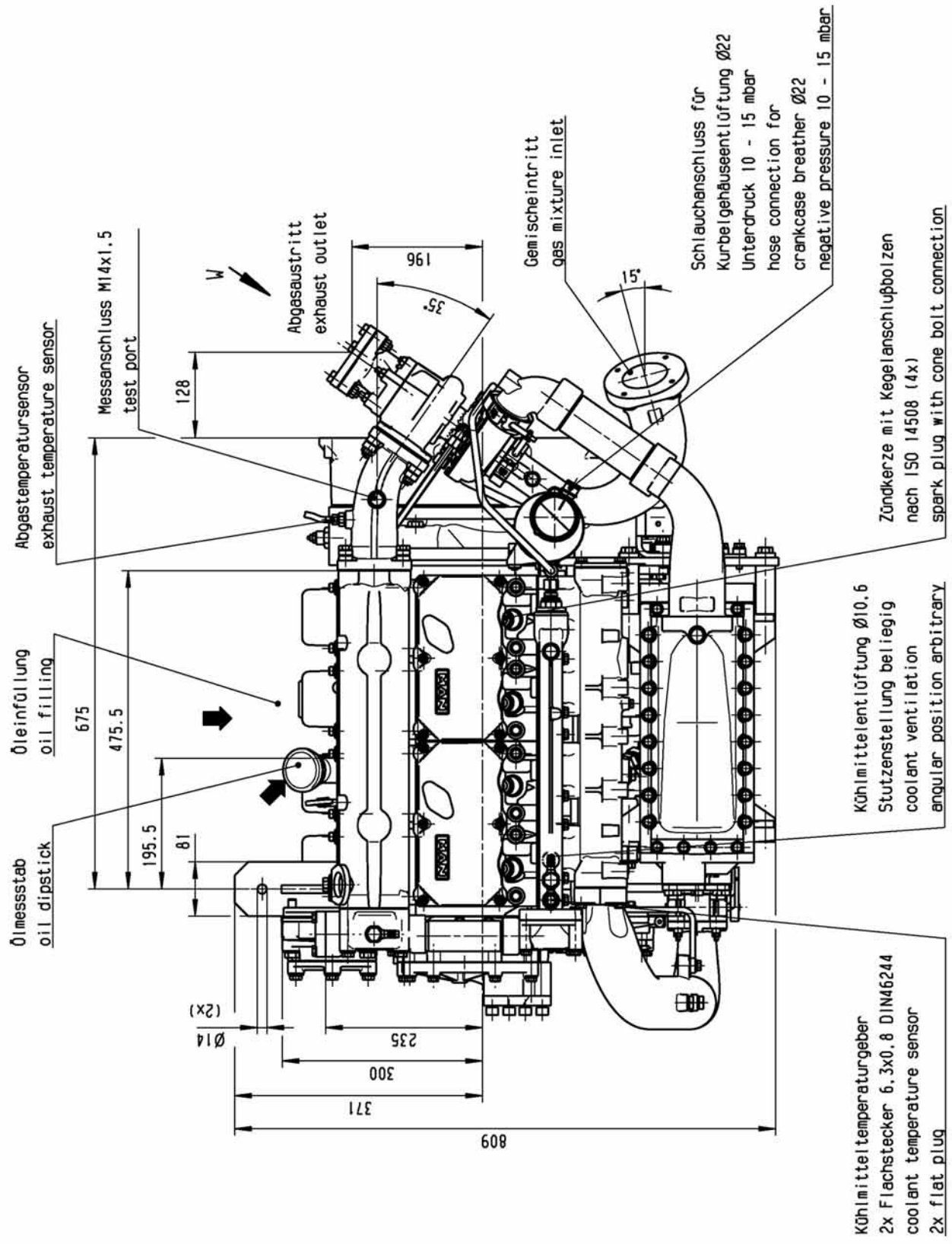

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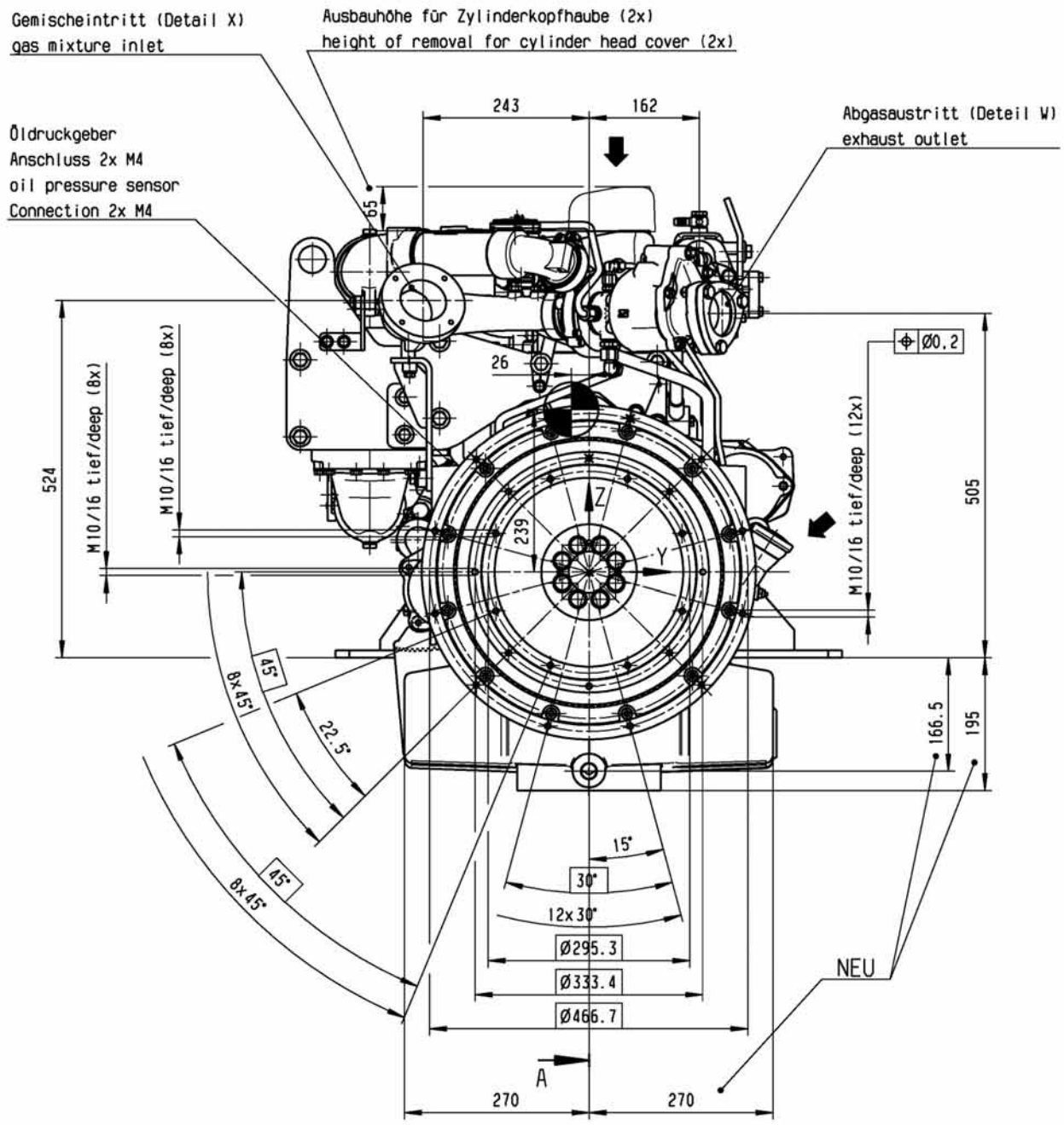

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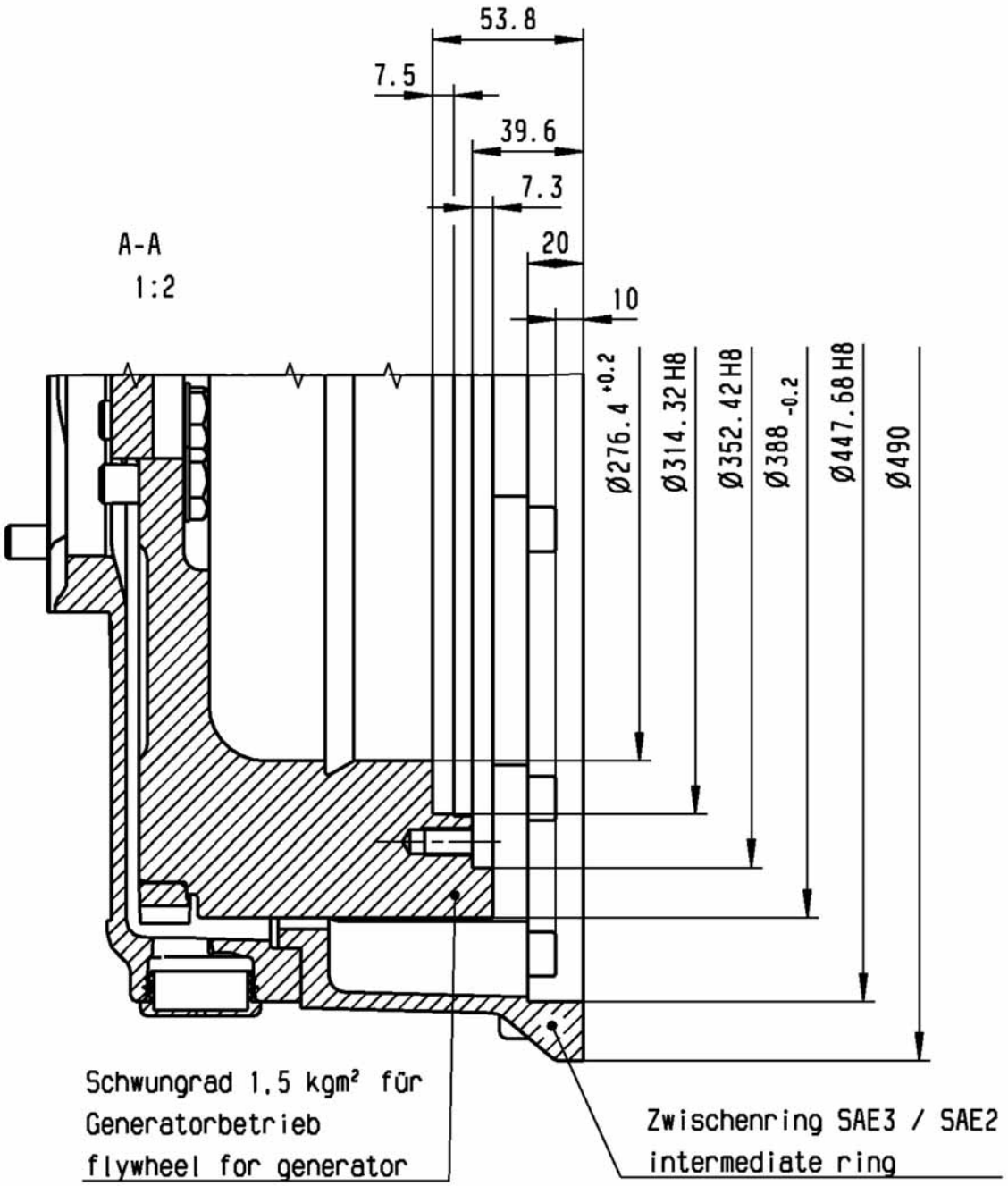

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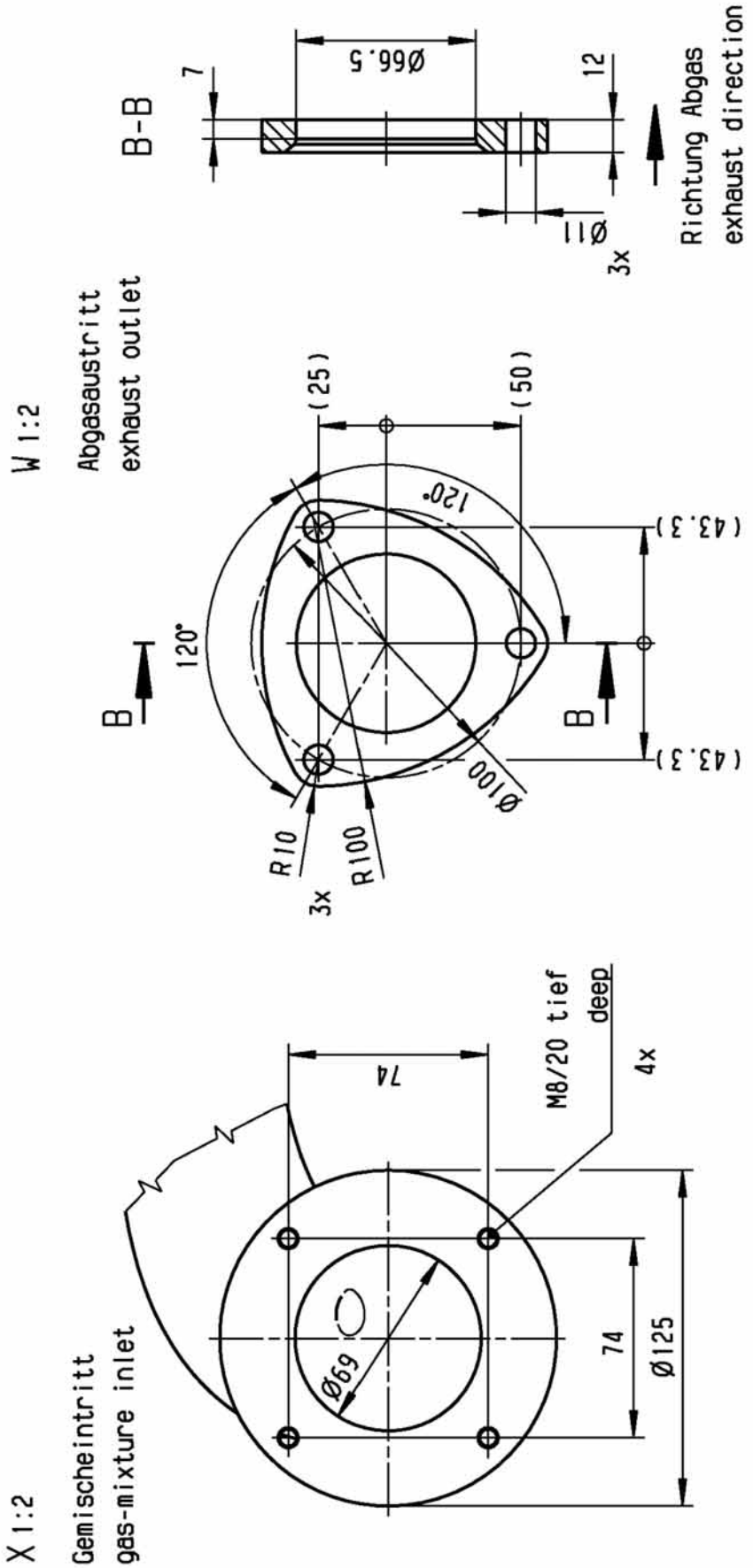

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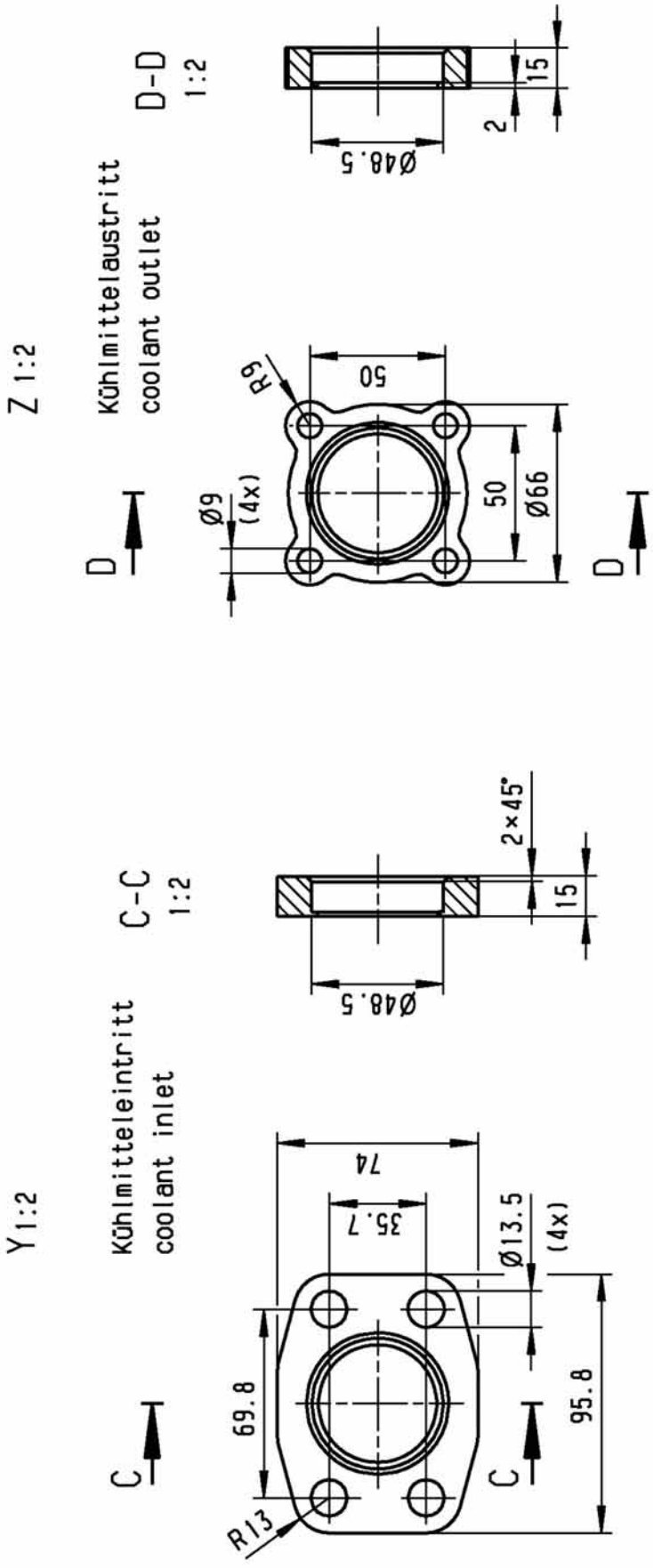

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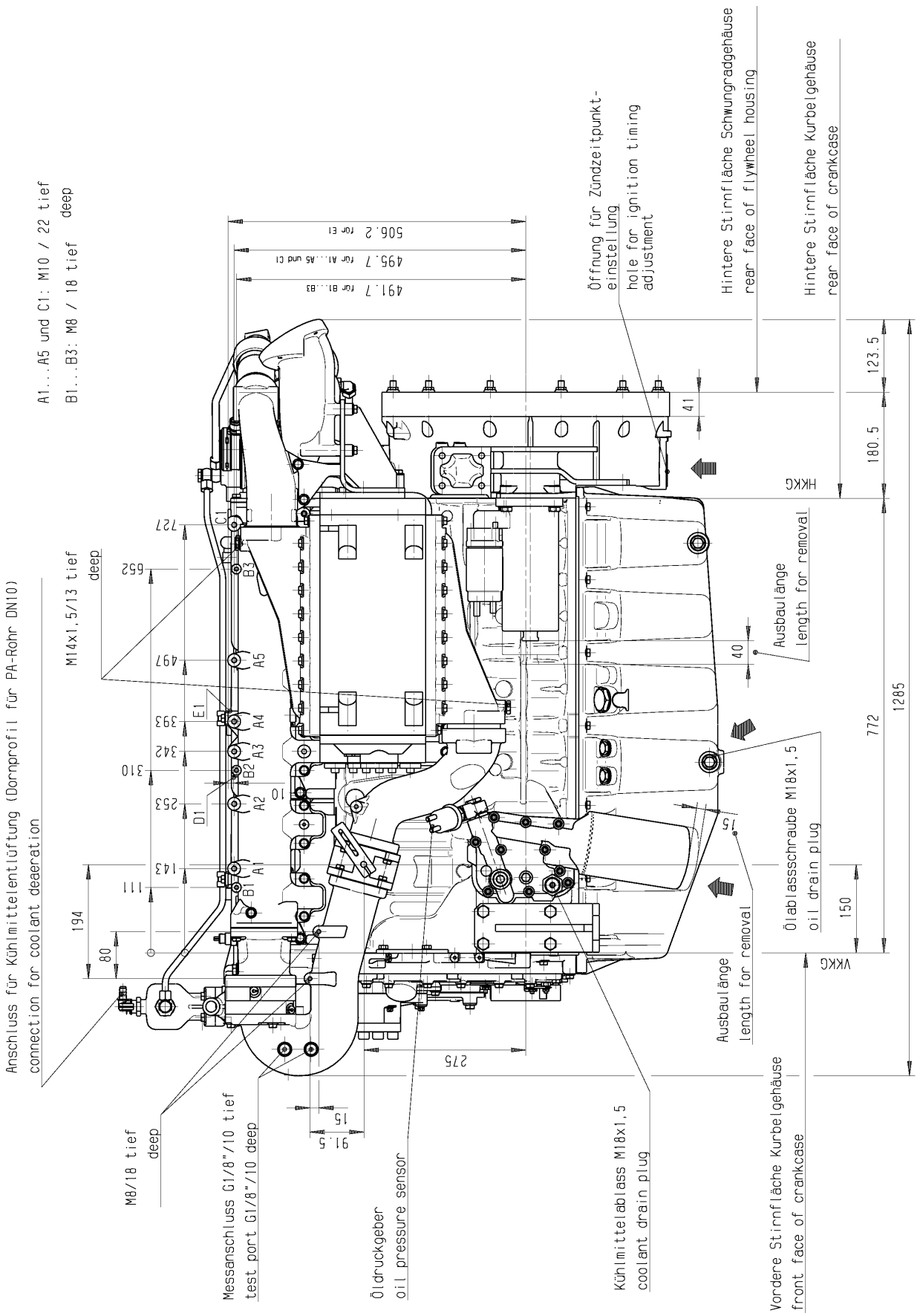

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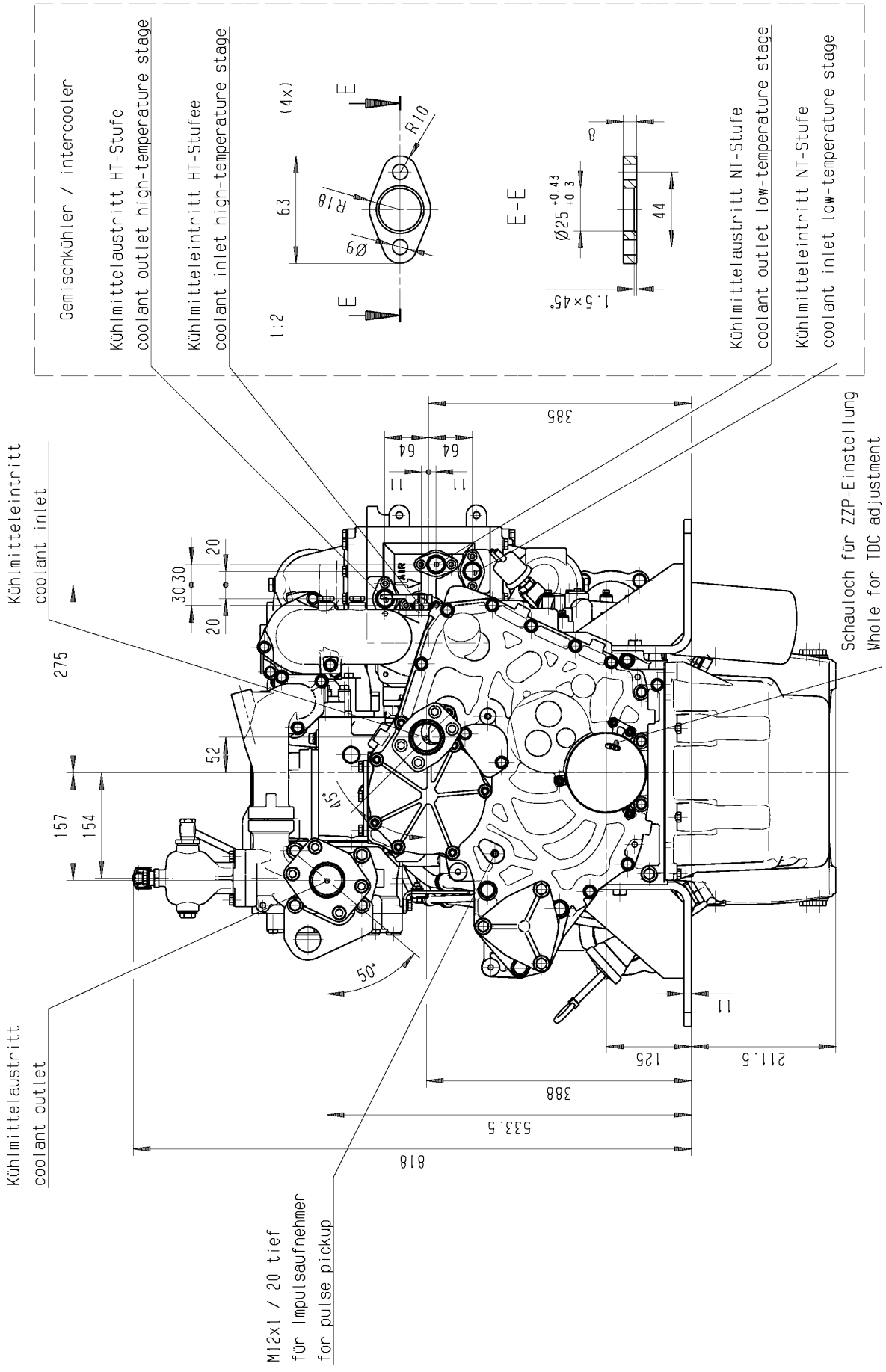
Installation Drawings of the Engine E0836 LE202



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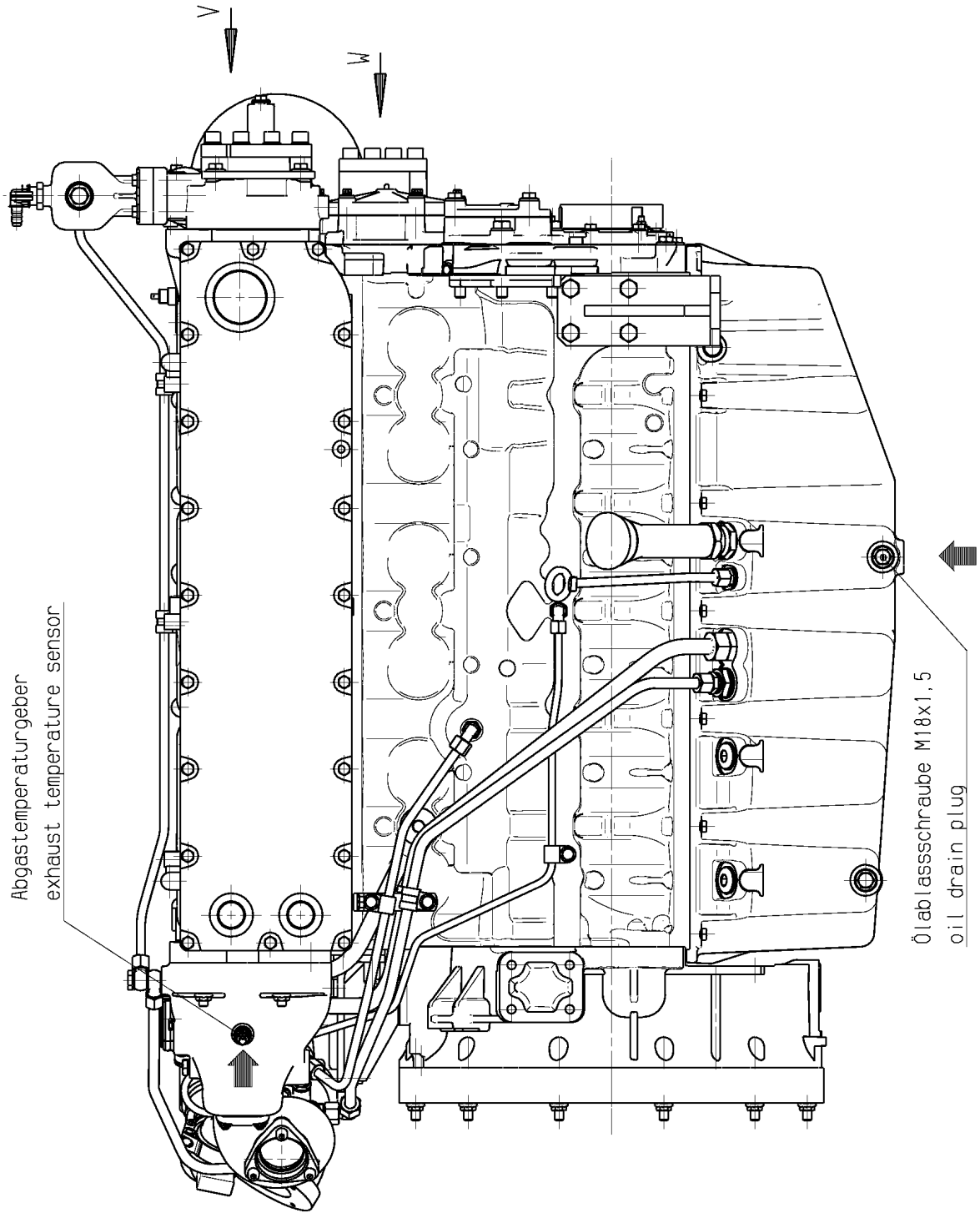

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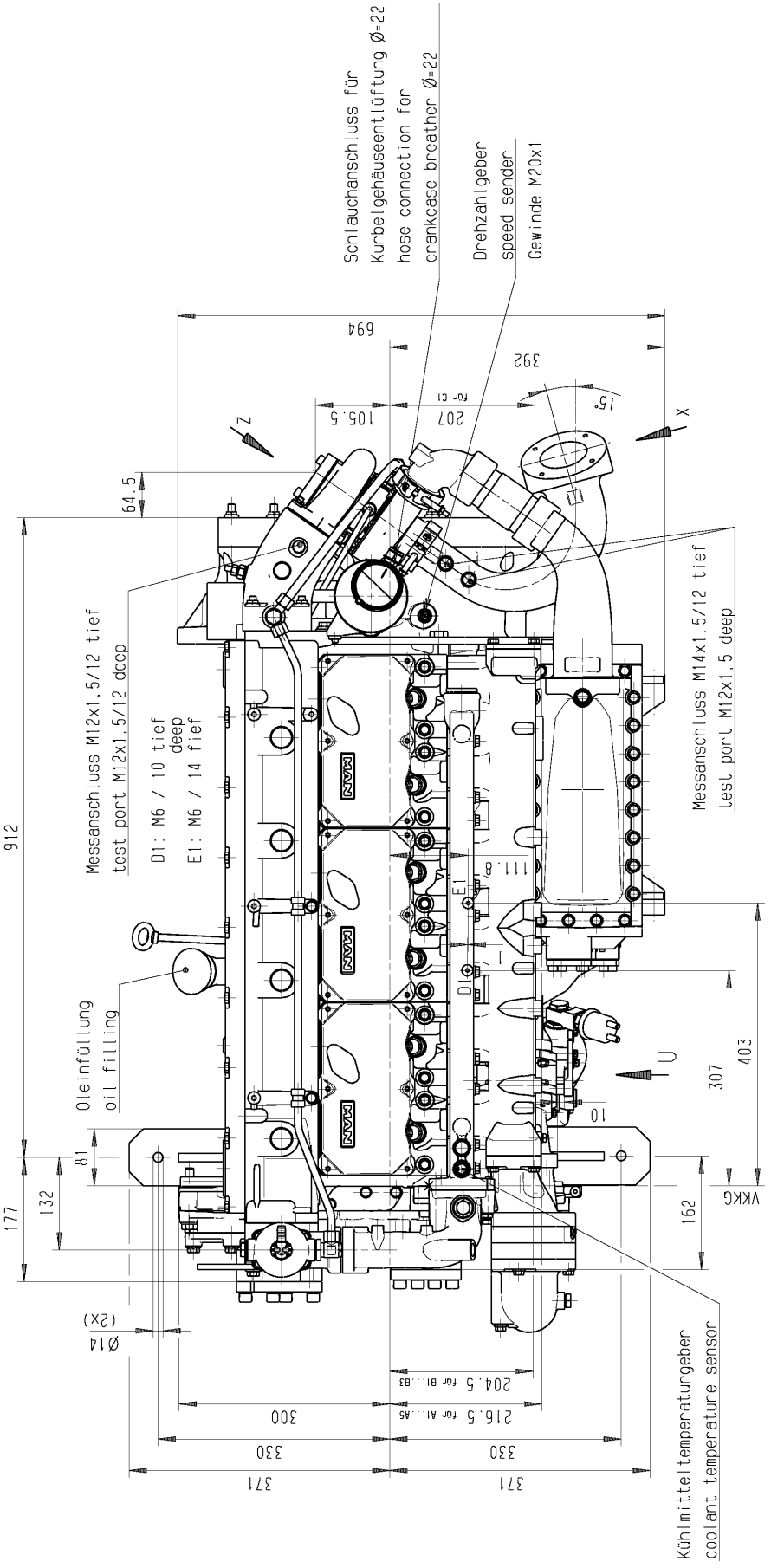
Installation Drawings of the Engine E0836 LE202



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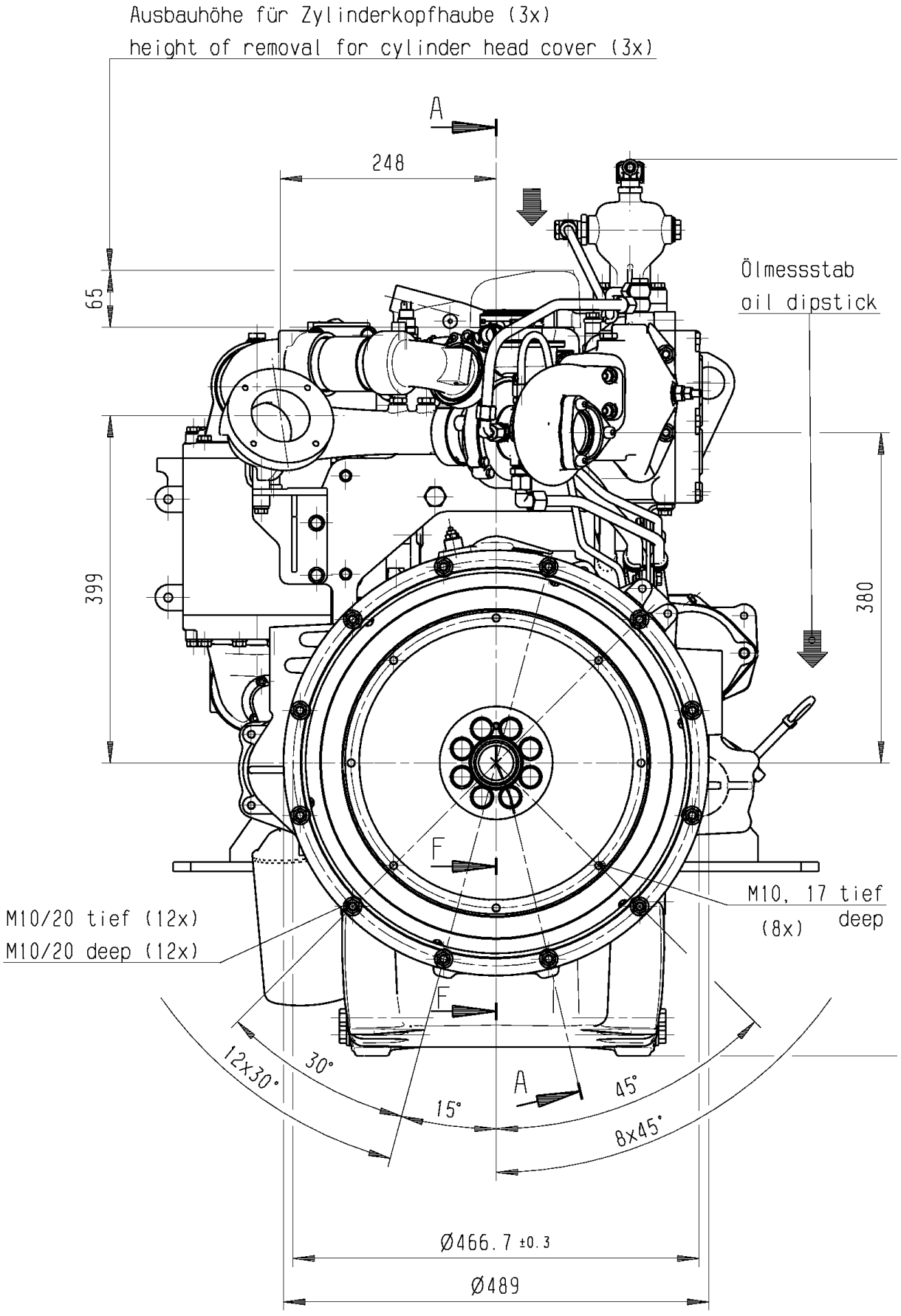

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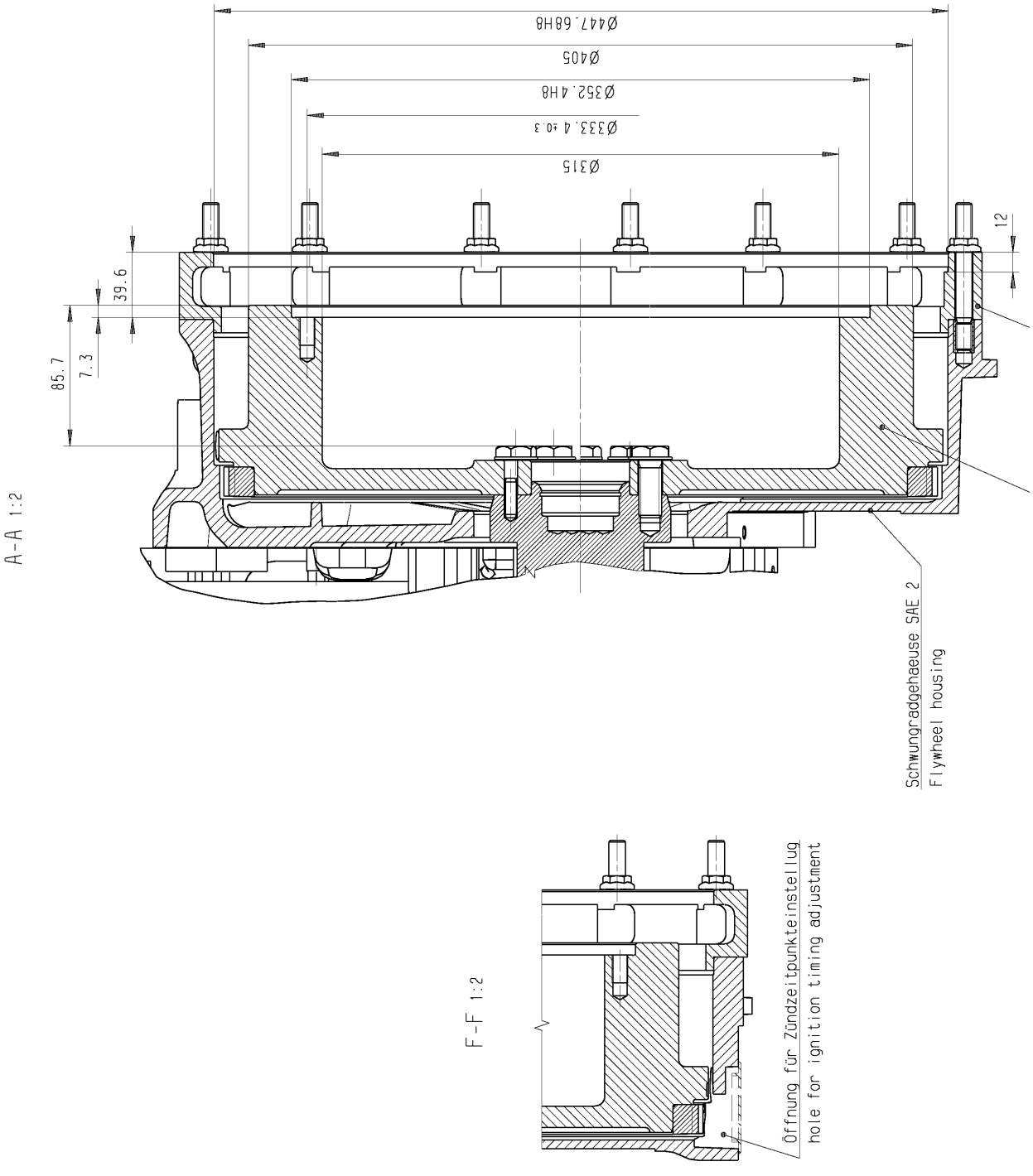
Installation Drawings of the Engine E0836 LE202



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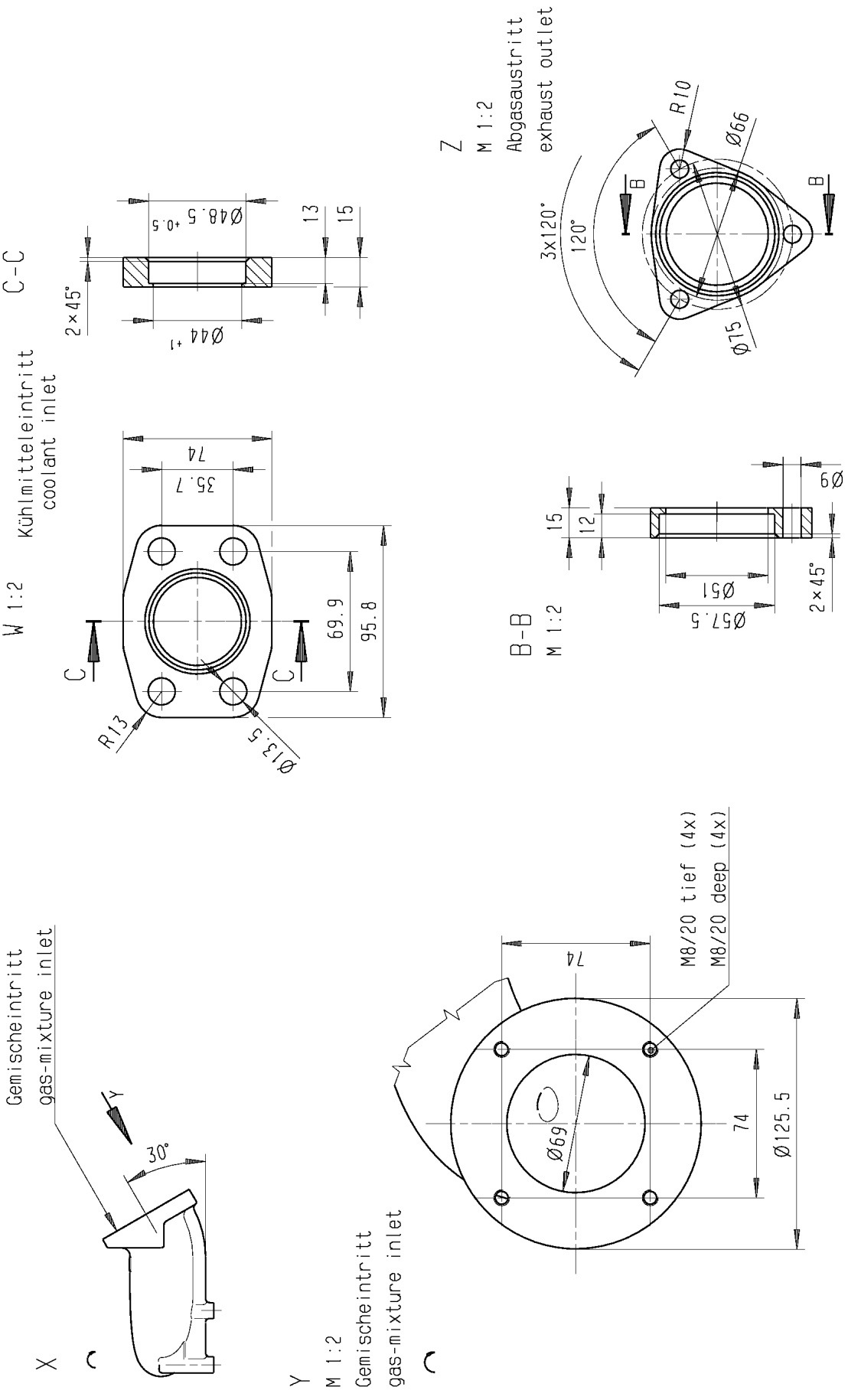

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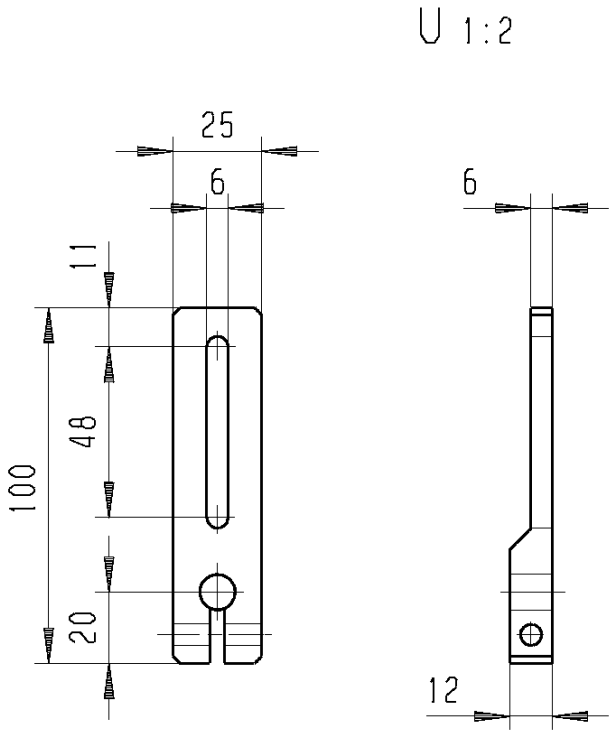

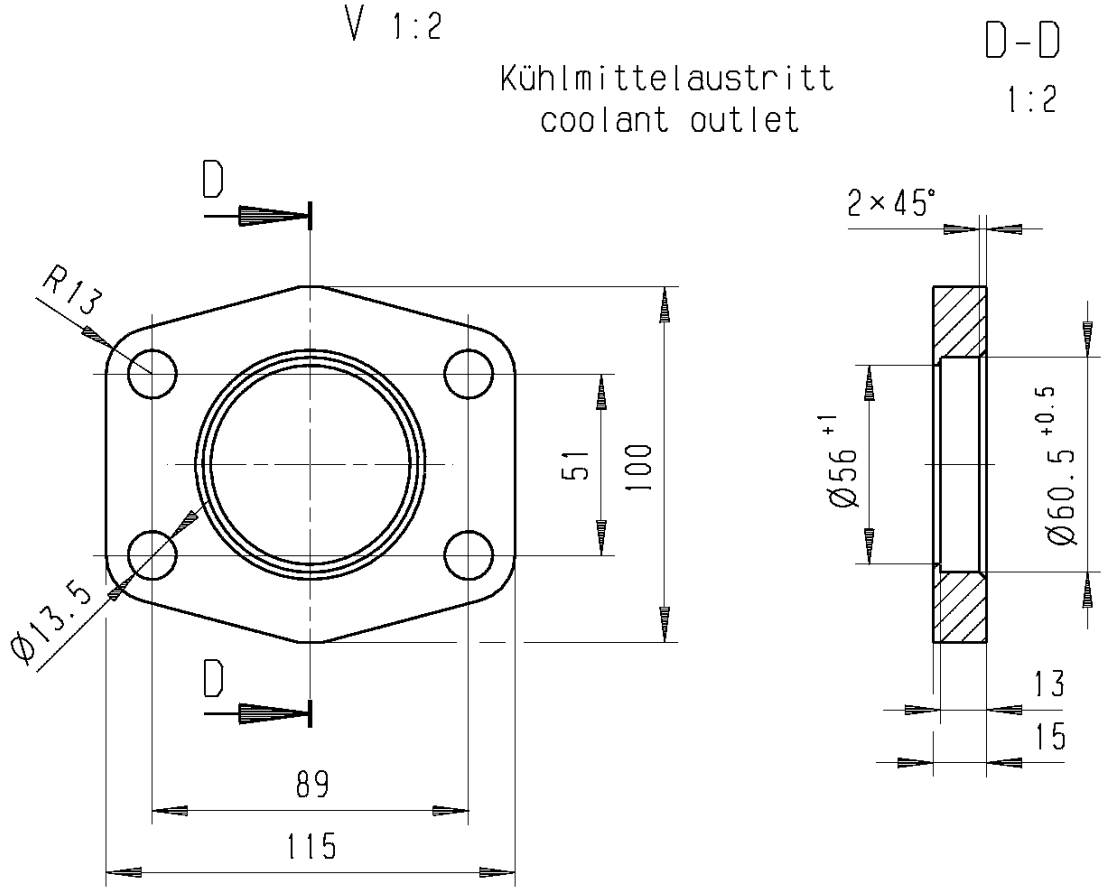

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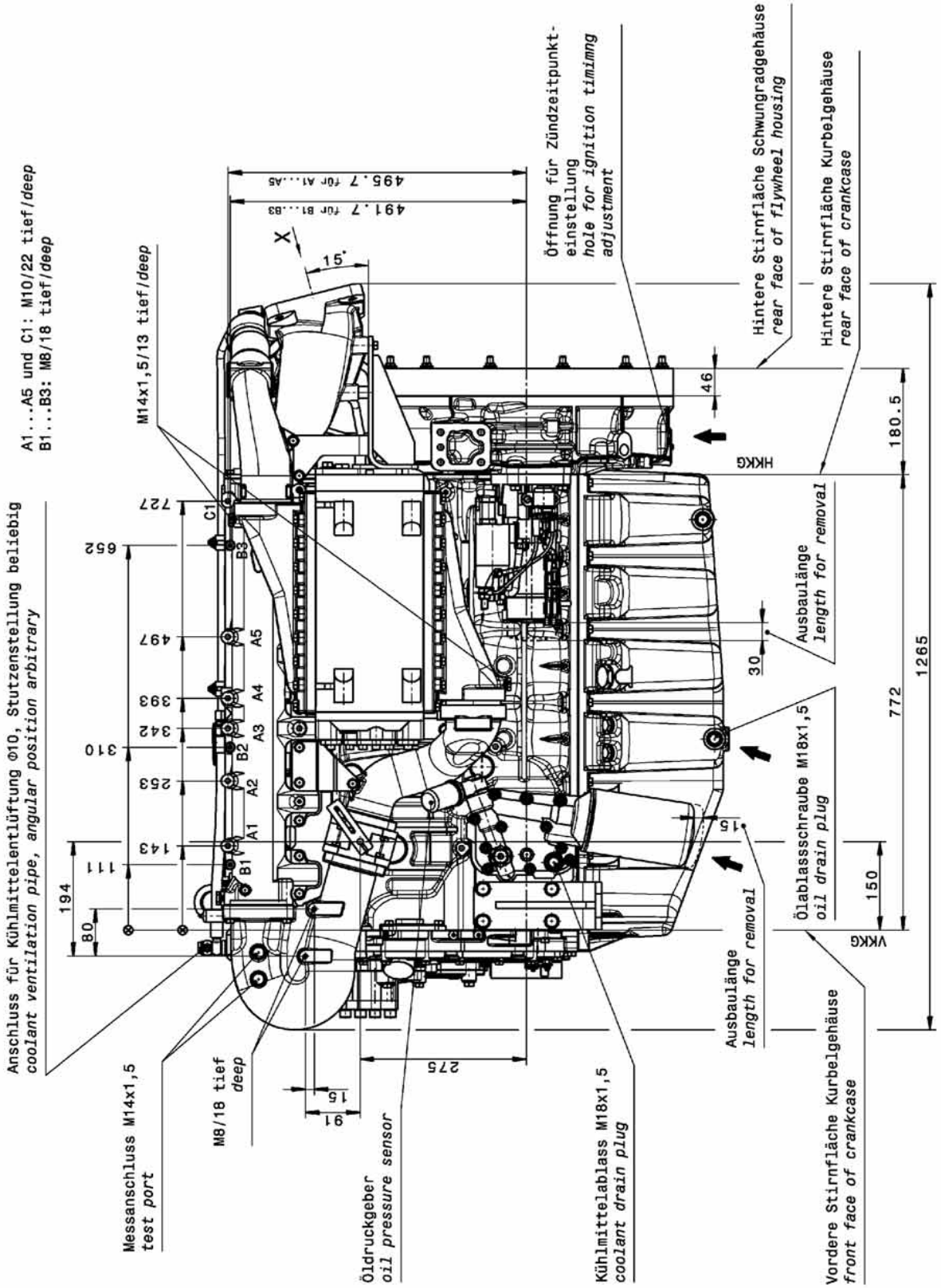

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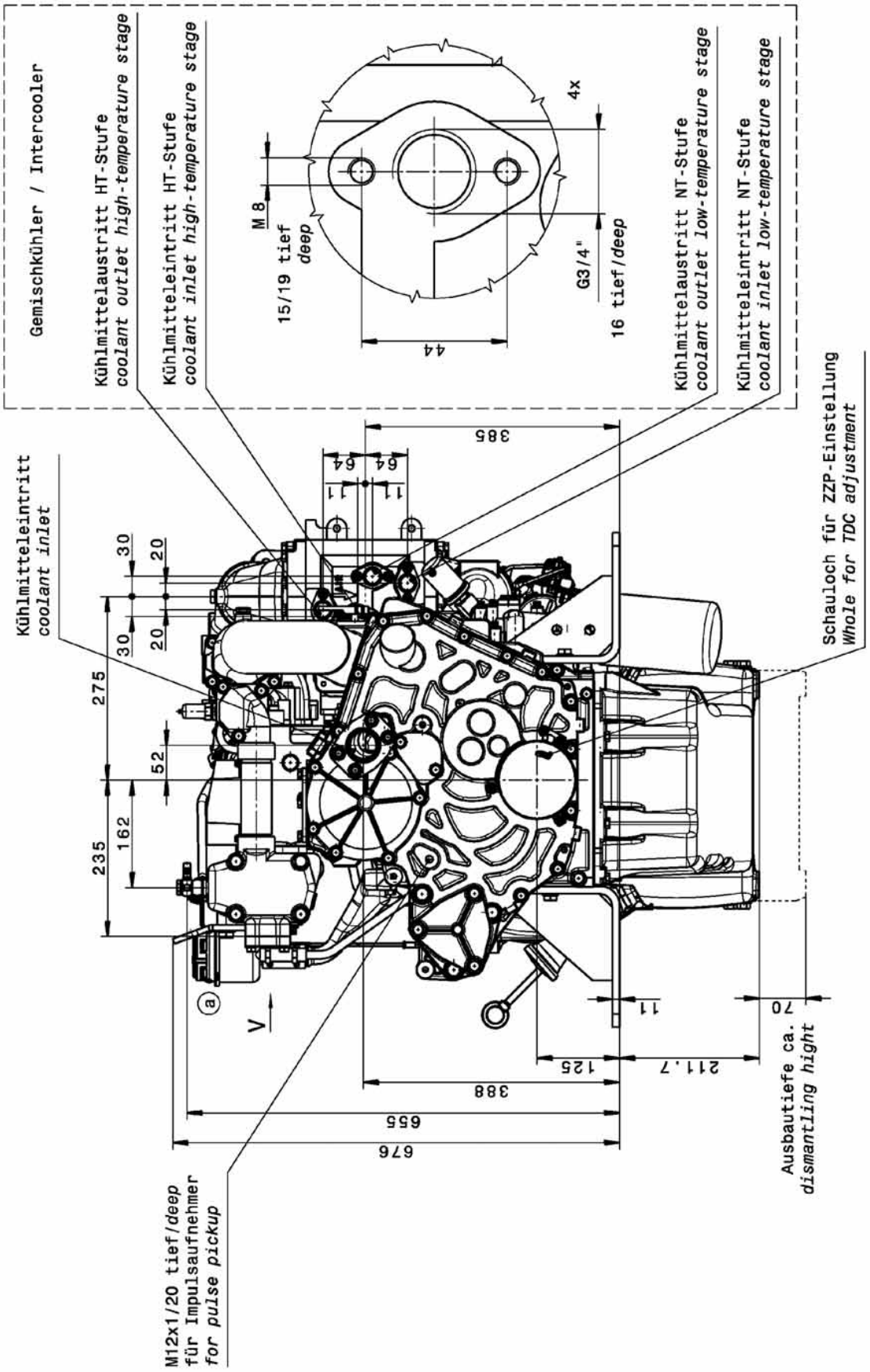
Installation Drawings of the Engine E0836 LE302



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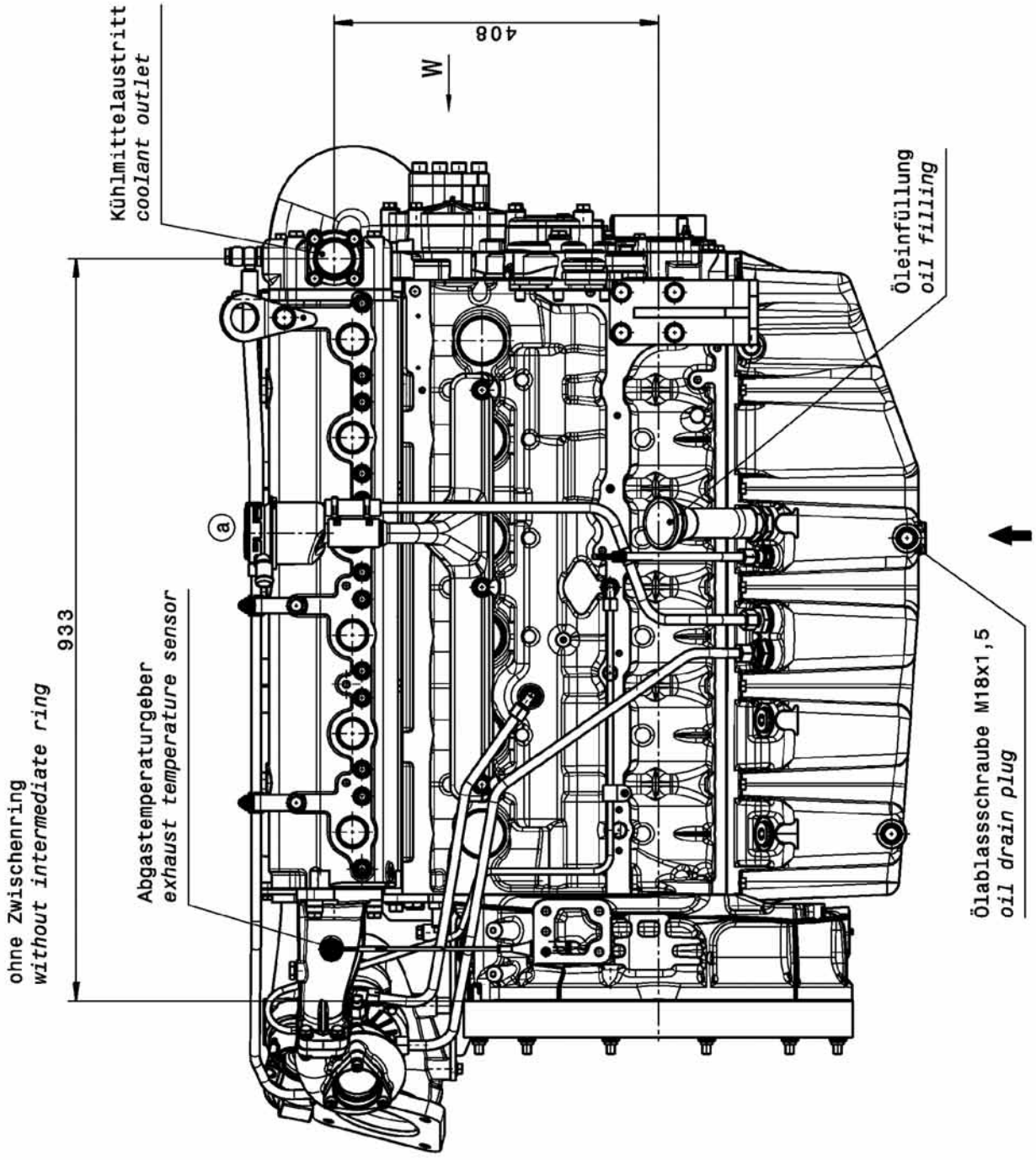

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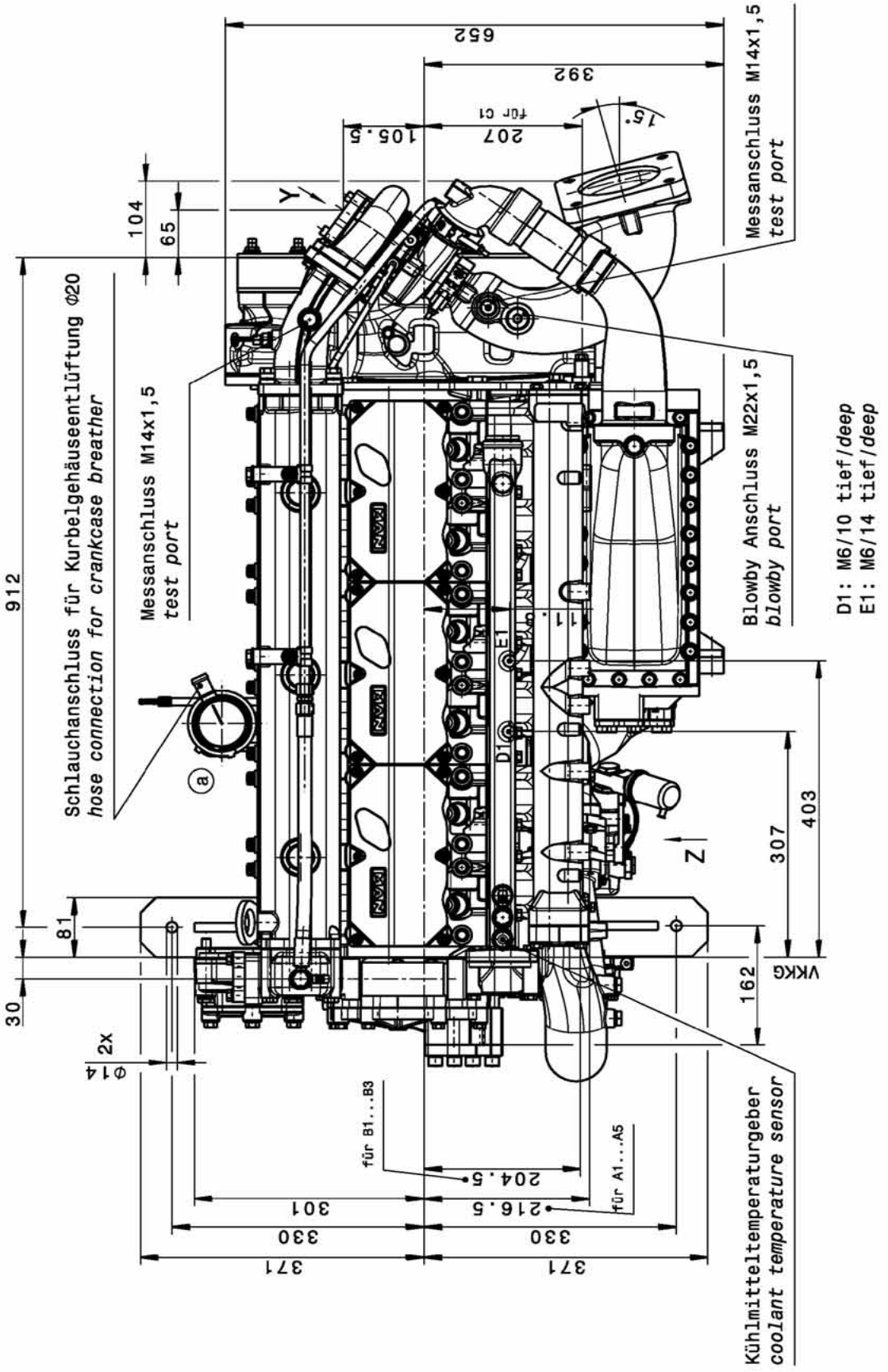

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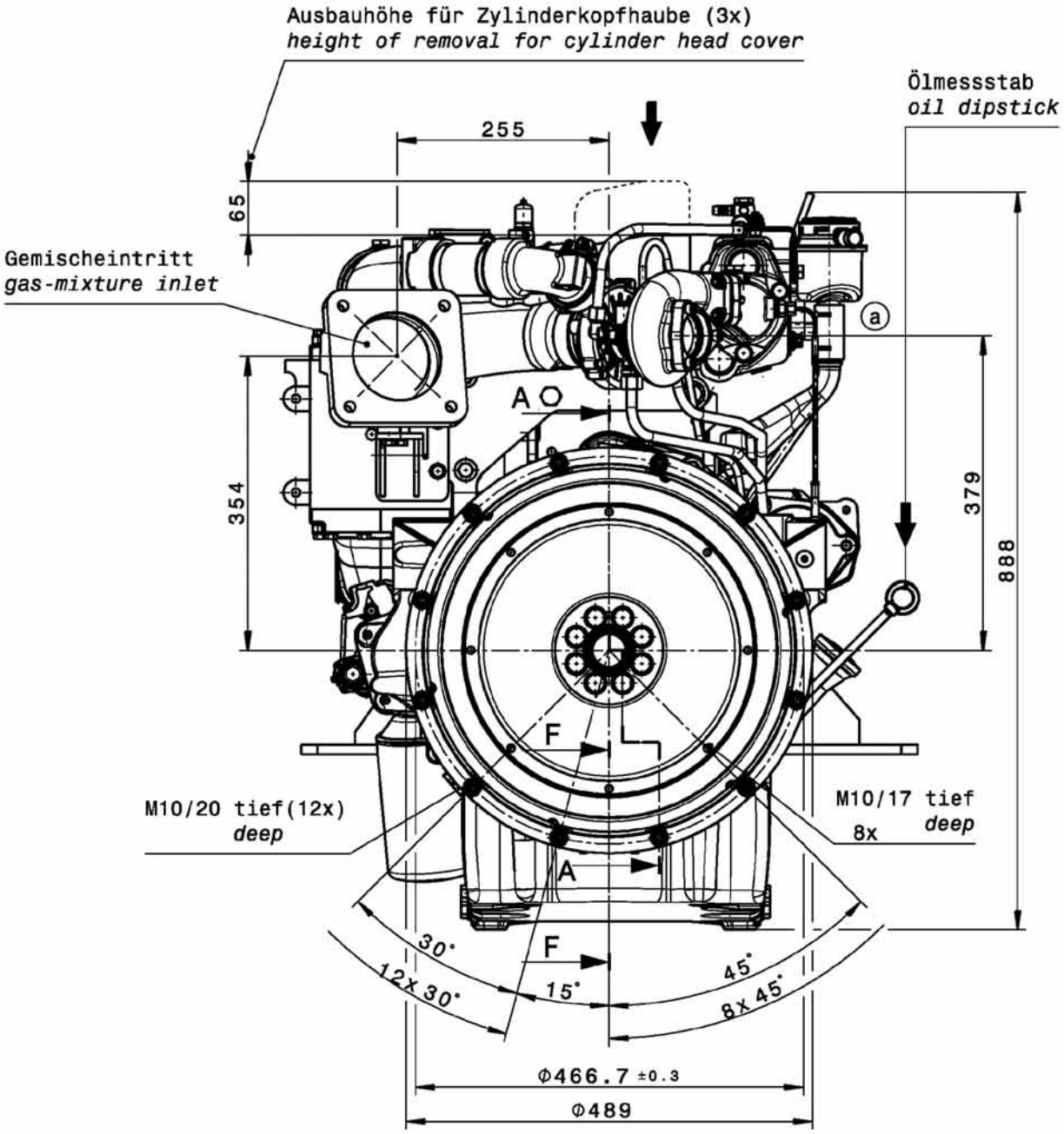

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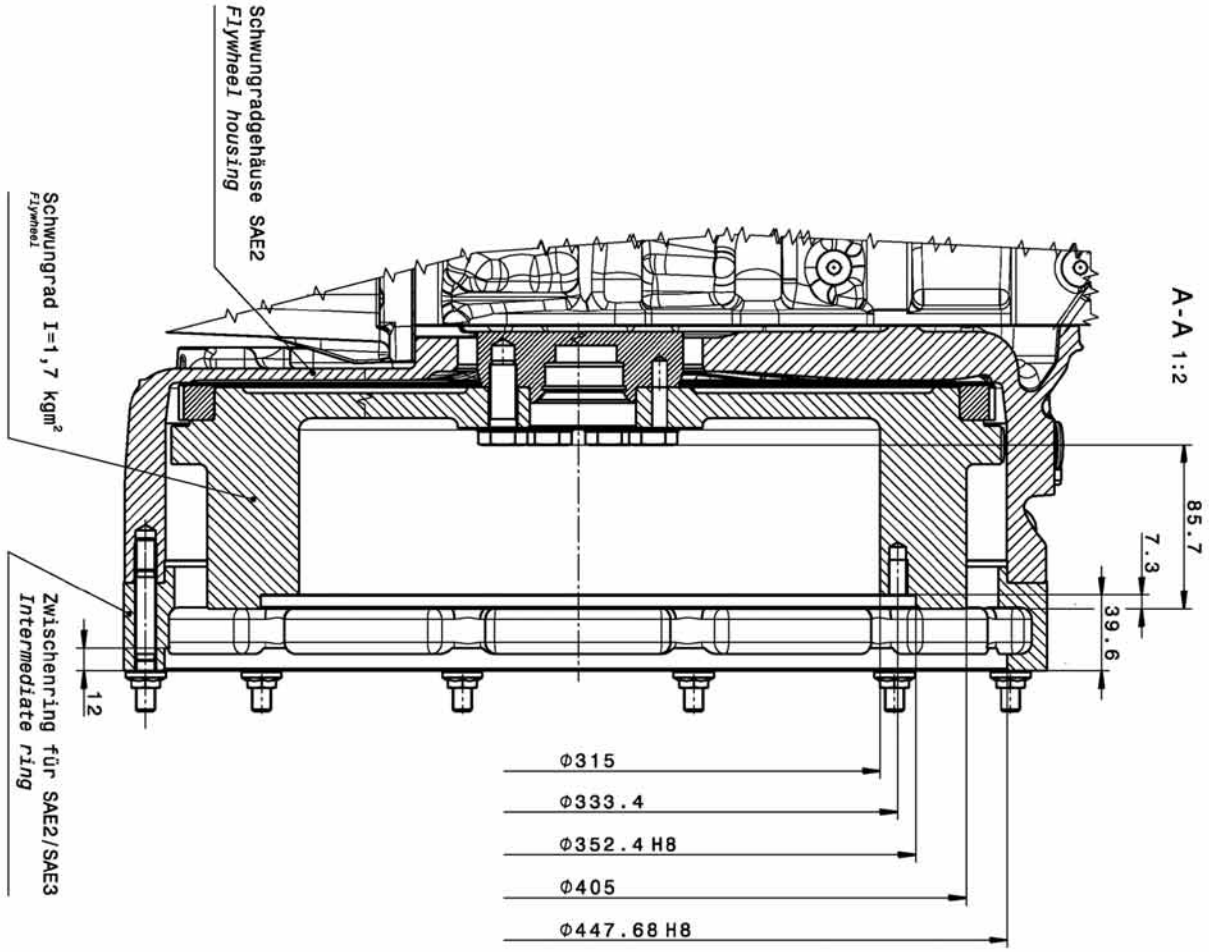
Installation Drawings of the Engine E0836 LE302



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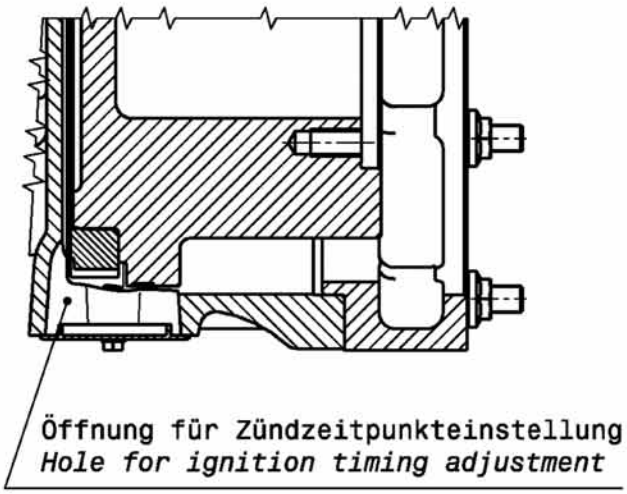

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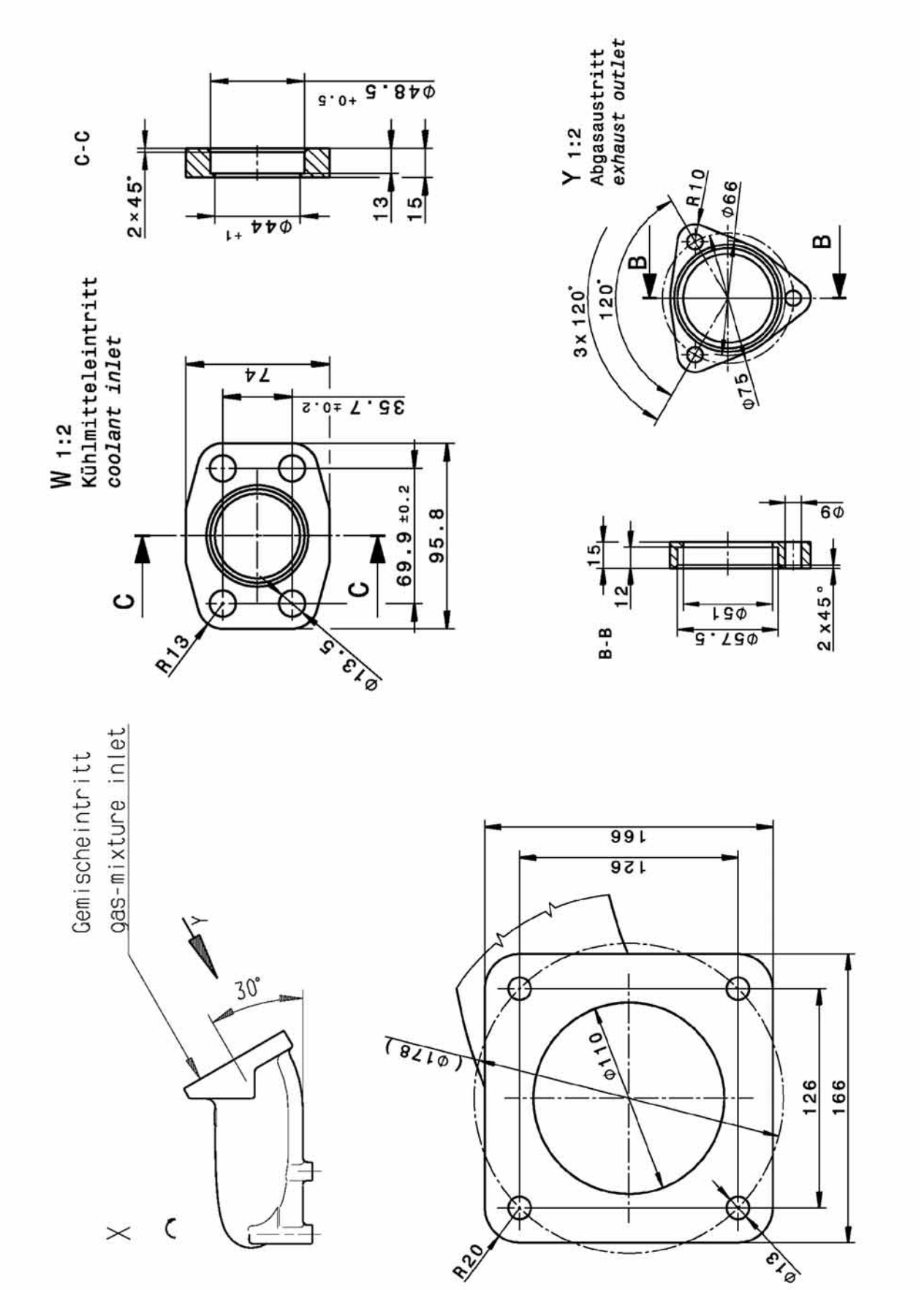

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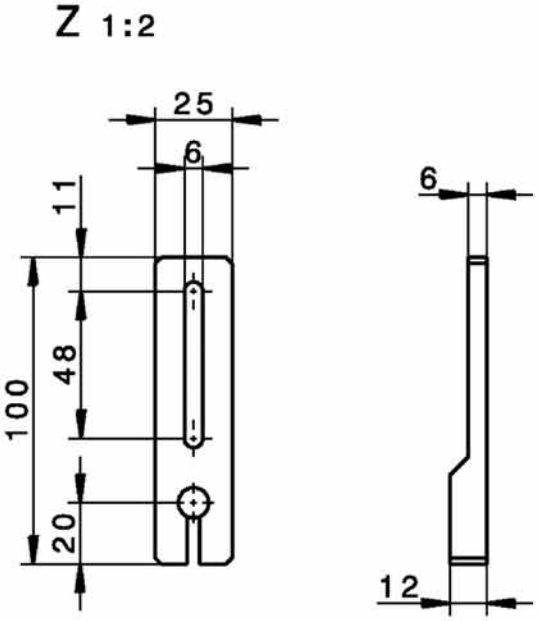

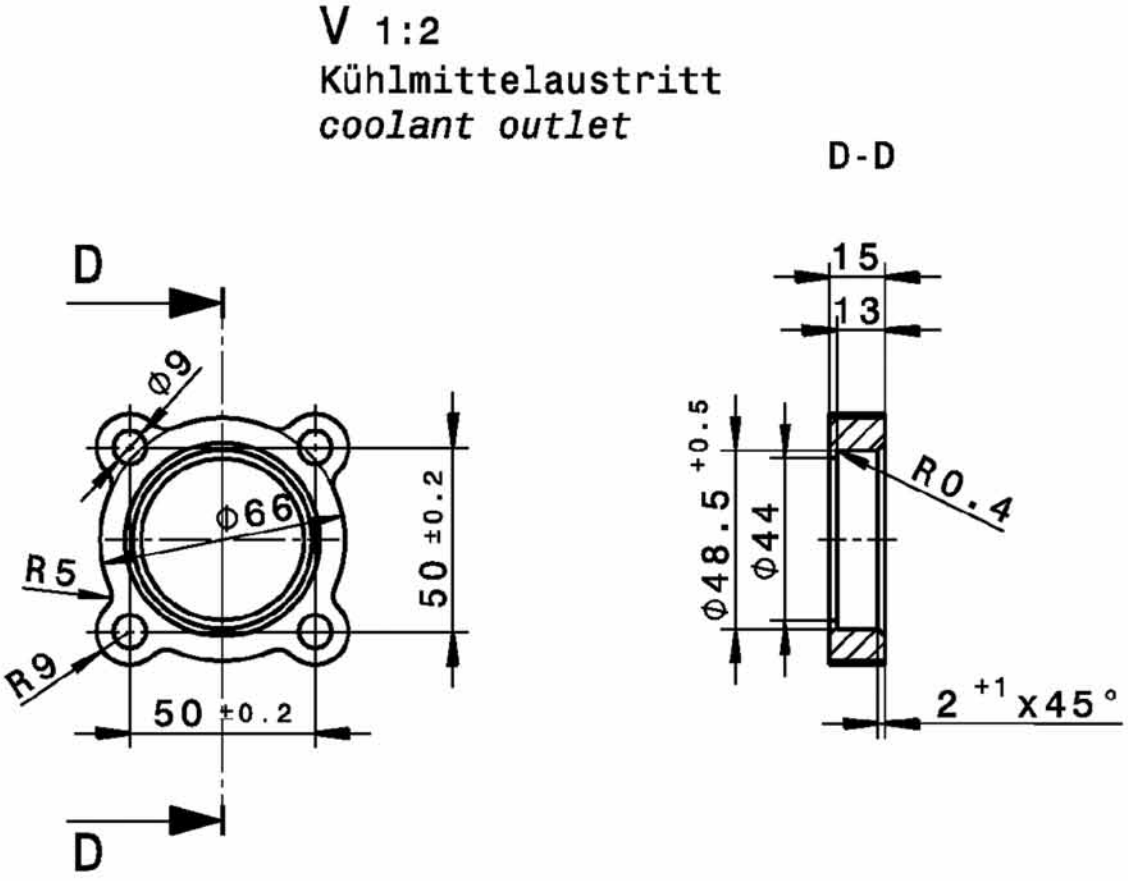

Identification no. of installation drawing: 51.00506-7817 “B”,
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