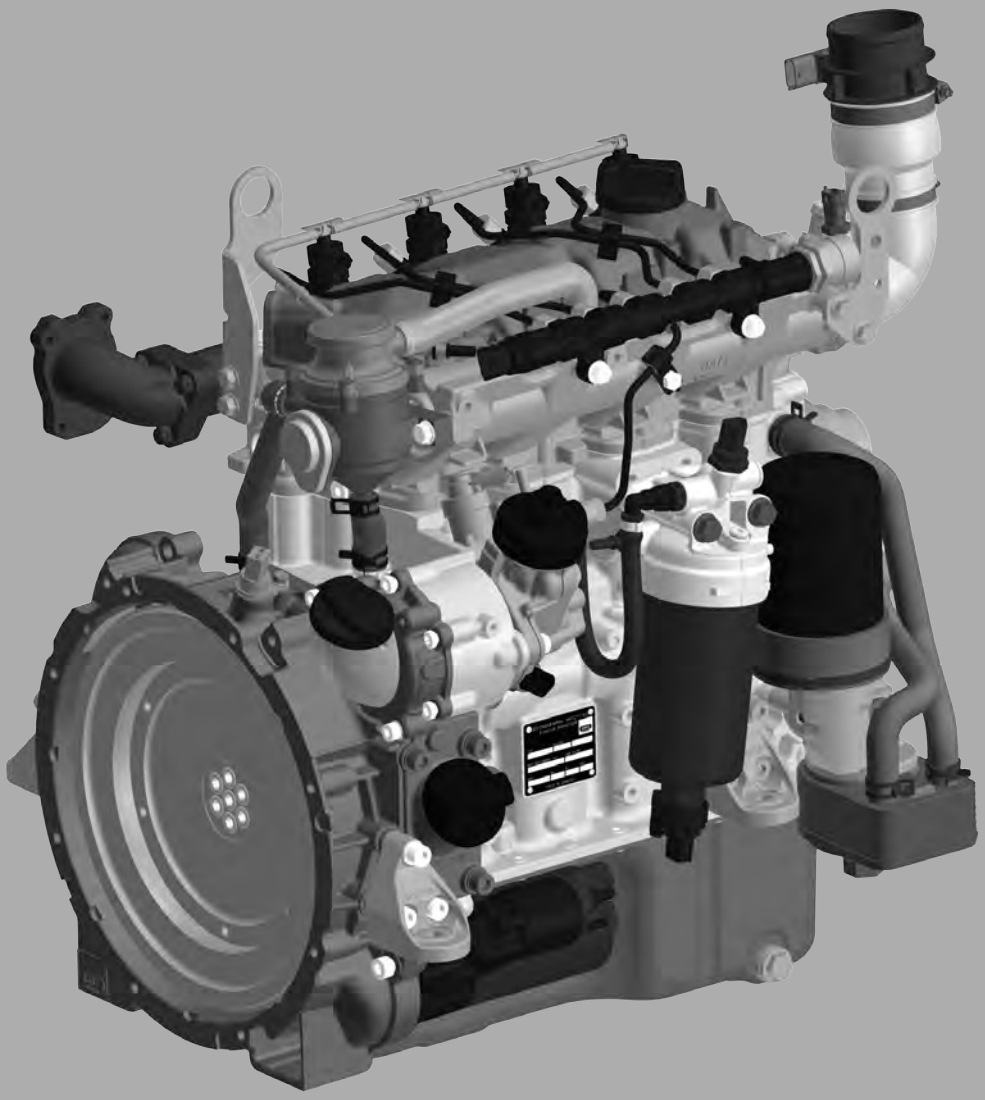
CREATING
POWER
SOLUTIONS

HATZ



4H50N | 4H50NO

ASSEMBLY INSTRUCTIONS
Diesel engine

Hatz

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1 Legal notices

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Original manual

This manual has been translated into multiple languages.

The German version is the **original manual**. All other language versions are **translations** of the **original manual**.

Revision

Version	Date	Name
Ver. 00	11/29/2023	GMT-CI / bw
Ver. 01	07/17/2024	GMT-CI / bw
Ver. 02	03/19/2025	GMT-CI / bw

2 General information

Information on the document

Our engines are state of the art and meet the basic safety and health requirements specified in the EC - Machinery Directive (2006/42/EC). These Assembly Instructions contain important instructions on how to safely assemble the engine. In addition, the rules and regulations for accident preventions applicable for the place of use must be heeded.

The engine provides a high degree of operational safety and a high quality standard which is ensured by a certified quality management system (EN ISO 9001). Proper functioning of all engines is checked prior to leaving the factory.

HATZ diesel engines are efficient, robust, and have a long service life. Therefore, they are usually installed in machines that are used for commercial purposes.

You must read the manual for diesel engine before starting the first time. It will help you avoid accidents, operate and maintain the engine correctly and, hence, ensure a long service life.

Give the manual for diesel engine to any further users or subsequent owner of the engine.

Machine

This manual describes the following machine.

Machine name	HATZ diesel engine
Type number	4H50N, 4H50NO

Customer service

Have service work performed by qualified technicians only. We recommend that you work with one of the over 500 **HATZ service stations**. Trained specialists there will repair your machine with **Hatz original spare parts** and with **HATZ tools**. The global HATZ service network is at your disposal to advise you and supply you with spare parts. For the address of the **Hatz service station** nearest you, please see the enclosed spare parts list or visit us in the Internet at: **www.hatz-diesel.com**

Installation of unsuitable spare parts can lead to problems. We cannot accept liability for direct damage or secondary damage that results from this.

We therefore recommend the use of **genuine Hatz spare parts**. These parts are manufactured according to strict Hatz specifications and achieve maximum operational reliability through their perfect fit and functionality. The order number can be found in the Internet at: **www.hatz.com**

Exclusion of liability

The manufacturer cannot be held liable for personal injury, damage to property or damage to the machine itself caused by improper use, foreseeable misuse, or failure to follow or adequately follow the safety measures and procedures described in this manual. This also applies to changes made to the machine and the use of unsuitable spare parts.

Modifications, which serve the technical improvements, are reserved.

Depending on the use and installation of the engine, it may be necessary for the machine manufacturer and machine user to install safety equipment to prevent inappropriate use, such as:

- Parts of the exhaust gas system and the engine surface naturally become hot and must not be touched during operation or until they cool down after the engine is switched off. Suitable precautions must be taken for this
- Incorrect cable connections and incorrect operation of the electrical equipment can lead to sparking and must be avoided.
- After the engine is installed in the machine, rotating parts must be protected against contact.
- It is essential to heed the starting instructions in the **manual for diesel engine** prior to commissioning the engine.
- Prior to starting, ensure that all safety devices provided are attached and functional.
- The engine must only be operated, maintained and repaired by persons who are trained in this work.
- Protect the starting key from unauthorized access.

- Never run the engine in closed or poorly ventilated rooms. Do not breathe in the exhaust gases - danger of poisoning.
- Fuels, lubricants, coolants and cleaning agents can contain toxic elements. Heed the instructions (safety datasheets) of the manufacturer in this regard.
- Only carry out maintenance and repair work when the engine is switched off (disconnect the negative terminal of the battery).
- Only refuel when the engine is switched off. Never smoke in the vicinity of open flames or sparks that can cause ignition.
- Keep explosives and flammable materials away from the engine because the engine surface – and especially the exhaust gas system – becomes very hot during operation.
- Only wear close fitting working clothes when working on a running engine. Do not wear necklaces, bracelets or other items that could get caught.
- Comply with all notices and warning labels on the engine and keep them in a legible condition. If a label should become detached or difficult to read, it must be replaced promptly. For this purpose, contact your nearest **Hatz service station**.
- Any improper modification of the engine will result in a loss of liability coverage for resulting damage. Only regular maintenance, as specified in the manual for diesel engine, will maintain the operating readiness of the engine.

If you have any questions, please contact your nearest **Hatz service station** before commissioning the engine.

3 Safety

3.1 General information

Introduction

This chapter contains the information you need to work safely with this machine.

To prevent accidents and damage to the machine, it is imperative that these safety instructions be followed.

Read this chapter carefully before beginning work.

3.1.1 Intended use

Intended use

The machine described in this manual fulfills the following functions:

- Diesel engine intended for installation in a machine or for assembly with other machines to form a machine. See chapter *17 Declaration of incorporation, page 119*.

This engine is intended exclusively for the purpose specified and tested by the manufacturer of the machine in which the engine is installed.

Any other use is not intended and therefore not permitted. Violations compromise the safety of the personnel working with the machine. Motorenfabrik HATZ does not accept any liability for damage resulting from this.

The operational safety of the machine is only guaranteed if it is used as intended.

Use according to the intended purpose also includes observance of the instructions in this Operator's Manual and the Diesel Engine Manual

Foreseeable misuse

The following is considered to be foreseeable misuse:

- Any use that varies from or extends beyond the uses specified above.
- Failure to comply with the instructions given in this manual.
- Failure to comply with the safety instructions.
- Failure to immediately eliminate malfunctions that impact safety before continuing work with the machine (working with the machine when it is not in perfect condition, either functionally or in terms of safety).
- Failure to perform the necessary inspection and maintenance work.
- Any unauthorized modification of or removal of safety equipment.
- Use of spare parts and accessories that are unsuitable or have not been approved by HATZ.
- Fuel other than specified in the instructions.
- Operation in flammable or hazardous environments.
- Operation in closed-off or poorly ventilated rooms.
- Operation in an aggressive atmosphere (e.g., high salt content) without further measures for corrosion protection.
- Improper operation at variance with DIN ISO 3046 -1 and DIN ISO 8528 (climate, load, safety).

Residual risks

Residual risks result during daily use and in association with maintenance work.

These residual risks will be pointed out in chapter *3.3.2 Machine-specific safety instructions for operation, page 15* and in chapter *3.3.3 Machine-specific safety instructions for maintenance work, page 16* as well as in the further contents of the manual, directly in front of the descriptions or operating instructions concerned.

3.1.2 Machine user or machine manufacturer obligations

Machine manufacturer obligations

These assembly instructions contain important information on how to safely assemble the engine including the equipment delivered by HATZ.

It is prohibited to start the engine before it is fully installed.

It is prohibited to start up the machine before it has been ensured that the machine meets all safety-related measures and legal regulations.

Before placing the machine on the market, the device manufacturer is responsible for ensuring that all legal regulations and the locally applicable requirements for the machine have been fulfilled.

User obligations

The operator is obliged to only operate the machine when it is in perfect condition. The operator must check the condition of the machine before use and ensure that any defects are eliminated before it is taken into service. Running the machine while identified defects exist is not permitted. The operator must also ensure that all persons who work on the machine are familiar with the contents of this manual, and the Diesel Engine Manual.

Obligations of the operating and maintenance personnel

Personnel assigned with operating and maintaining the machine must have read and understood this **manual for the diesel engine** or must possess the qualifications necessary for working with this equipment, acquired in training/instructional courses. No one may work with the machine without the necessary qualifications, even if for just a brief period. The operating and maintenance personnel must not be under the influence of drugs, medication or alcohol.

3.1.3 Representation of safety notes

Overview

This machine has been designed and built according to state-of-the-art technology and the recognized safety standards. Despite these precautions, risks exist when commissioning or operating the machine and during maintenance work. The risks are identified in this manual by means of safety notes. The safety notes precede the relevant description or operating step.

Structure of the safety notes

The safety notes consist of:

- Danger symbol
- Signal word
- Description of the danger
- Possible consequences
- Preventative measures

General danger symbol

The general danger symbol is used to identify the danger of personal injury.

Signal words

Signal words identify the magnitude of the risk and the seriousness of possible injury:

Danger symbol/ signal word	Meaning
DANGER	This signal word is used to indicate imminently dangerous situations which, if not avoided, will lead to serious injury or death.
WARNING	This signal word is used to indicate potentially dangerous situations which, if not avoided, may lead to serious injury or death.
CAUTION	This signal word is used to indicate potentially dangerous situations which, if not avoided, may lead to minor or moderate injury.
CAUTION	This signal word, without a danger symbol, is used to indicate the risk of property damage.
NOTICE	This signal word indicates additional useful information, such as operating tips and cross references.

3.2 Meaning of safety symbols

3.2.1 Explanation of symbols

The following table describes the meanings of the safety symbols used in this manual.

Symbol	Meaning
	Smoking, fire, and open flames are prohibited!
	Warning of personal injury!
	Warning of hot surfaces!
	Warning of flammable substances!
	Warning of explosive substances!
	Warning of toxic engine exhaust!
	Warning of corrosive substances!
	Warning of heavy loads!
	Warning of environmental damage!
	Comply with this manual or additional documentation from other manufacturers or the operator.
	Important note!
	Additional information that is useful to the reader.

3.3 Safety notes

3.3.1 Operational safety

Introduction

This chapter contains all of the important safety instructions for personal protection and for safe and reliable operation. Additional, task-related safety instructions can be found at the beginning of each chapter.

DANGER	
	**Danger to life, danger of injury or danger of property damage due to failure to comply with this manual and the safety instructions contained therein.** ▪ As the operator of the machine, you must ensure that all people working on the machine are familiar with the content of this manual. ▪ Before working on the machine, read this manual carefully, paying special attention to the safety notes in Diesel Engine Manual.. ▪ Fulfill all required safety conditions before working on the machine. ▪ Follow all general safety instructions as well as the specific task-related safety instructions contained in the individual chapters.

Using the machine

- Only operate the machine for the purposes described in chapter *3.1.1 Intended use, page 9*.

Compliance with other regulations

- Adhere to the applicable accident prevention regulations of the trade associations.
- Comply with the regulations concerning the minimum safety and health requirements for the use of work equipment by workers at work.
- In addition, local safety, accident prevention and environmental regulations also apply when operating the machine.

Personal protective equipment

During operation and maintenance of the machine, personal protective equipment must be available and must be used if necessary. The use of personal protective equipment is specified in the description of the operating steps.

Personal protective equipment	Pictogram	Function
Safety shoes		Safety shoes offer protection against: ▪ Slipping ▪ Falling objects
Hearing protection		Hearing protection offers protection against ear injuries due to excessive and constant noise.
Safety gloves		Safety gloves protect the hands against injury, e.g., from battery acid.
Safety goggles (with side protection)		Safety goggles protect the eyes from flying objects (e.g., dust particles, spraying liquids, spraying acid).
Fine dust mask		A fine dust mask protects the wearer against particulate pollutants.

Personal protective equipment	Pictogram	Function
Working clothes		Wear close-fitting clothing. It must not restrict the wearer's freedom of movement, however.

Warning labels and information signs on the machine

The warning and notice labels on the machine must be followed (see **"Diesel Engine Manual"**). Comply with all warning labels and notices on the engine and keep them in a legible condition, and replace if necessary. If an adhesive label should become detached or become difficult to read, it must be replaced promptly. For this purpose, contact your nearest **HATZ service station**.

Maintenance work

Maintenance work that goes beyond the scope of the work described in the **diesel engine manual** must only be performed by qualified technicians (see chapter *2 General information, page 7*).

Independent maintenance work and constructional changes to the machine, especially to the safety equipment, are not permitted.

Safety equipment

Safety equipment must not be modified and must not be rendered ineffective during normal operation.

General safety instructions

DANGER

Danger to life and danger of injury due to failure to follow the warnings on the machine and in this manual.

- Heed the warnings on the machine and in this manual.

WARNING

Danger of injury and danger of incorrect operation due to inadequate personnel qualifications.

- The personnel must have read and understood this manual or must possess the qualifications necessary for working with this equipment, acquired in training/instructional courses.
- Only qualified personnel is permitted to operate, maintain and service this machine.
- Failure to comply will cause the warranty to become void.

WARNING

Danger of injury from failure to follow the Operating Instructions and from performing unauthorized tasks on the machine.

- Follow all instructions.
- Do not perform activities for which no qualification is available. Contact properly trained personnel if necessary.

CAUTION

Danger of injury from overloading the body.

Lifting the machine to transport it or to move it to another location can lead to injuries (of the back, for example).

- Only lift the machine with a hoist (see chapter *7.1 Transport, page 30*).

3.3.2 Machine-specific safety instructions for operation

Introduction

The machine can pose residual risks during operation. To eliminate these risks, all persons working on the machine must follow the general and machine-specific safety instructions.

If you have an engine that is not yet installed in a machine, it is imperative that you follow the **Assembly Instructions for HATZ Diesel Engines** before installing the engine.

These Assembly Instructions contain important information on safe installation.

If the engine is installed in a machine or assembled with other machines to form a machine, it is prohibited to start the engine before it has been determined that the newly created machine fulfills all safety-related requirements and applicable legal regulations.

Safe operation

- Before switching on the machine, ensure that no one can be injured when the machine is started up.
- During machine operation, ensure that unauthorized persons do not have access to the area in which the machine has an impact.
- Parts of the exhaust gas system and the surface of the engine become hot during operation. Risk of injury from touching hot parts! Let the engine cool before maintenance.
- Do not refuel during operation if this would result in a potential danger, e.g., if the engine would be operated close to the tank.

Faults

- Immediately eliminate faults that compromise safety.
- Switch off the machine and do not take into service again until all faults have been eliminated.

Safety instructions for operation

DANGER

Danger to life from inhaling exhaust gases.

Toxic engine exhaust gases can lead to loss of consciousness, and even death, in closed-off and poorly ventilated rooms.

- Never operate the machine in closed-off or poorly ventilated rooms.
- Do not breathe in the exhaust gases.

DANGER

Danger of fire from hot exhaust gas system.

If inflammable materials come into contact with the exhaust gas flow or the hot exhaust gas system, these materials can ignite.

- Keep inflammable materials away from the exhaust gas system.
- Do not operate the engine (exhaust flow or hot exhaust gas system) in the direct vicinity of combustible materials.

DANGER

Fire hazard from fuel.

Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries.

- Only refuel when the engine is switched off and has cooled down.
- Never refuel in the vicinity of open flames or sparks that can cause ignition.
- Do not smoke.
- Do not spill fuel.

3.3.3 Machine-specific safety instructions for maintenance work

Introduction

The machine can pose residual risks during maintenance. To eliminate these risks, all persons working on the machine must follow the general and machine-specific safety instructions.

Maintenance intervals

- Strictly adhere to the maintenance intervals.
- Check the safety equipment regularly to ensure it is in good condition and functioning properly.
- Check connections, cables and fasteners regularly to ensure they are in good condition.

Maintenance work

Maintenance work that goes beyond the scope described in the manual for diesel engine must only be performed by qualified technicians. We recommend that you work with one of the over 500 **HATZ service stations**.

Replacing parts

- When replacing defective components, we recommend that you use **genuine Hatz spare parts** (see chapter Intended use).
- When disposing of parts that can no longer be used, do so in accordance with local environmental regulations or send them to a recycling center.

Measures following maintenance and troubleshooting

- Securely reconnect loose electrical connections; check that the electrical components and equipment are functioning properly.
- Check the entire machine for foreign bodies; remove any foreign bodies.

Safety instructions for maintenance work

DANGER

Danger of explosion from flammable cleaning agents.

Cleaning with benzene is an explosion hazard. It is highly flammable, can become electrostatically charged, and can generate an explosive gas/air mixture.

- Use halogen-free, cold cleaners with a high flash point for cleaning.
- Comply with manufacturer's instructions.

DANGER

Fire hazard from spontaneous combustion.

Cleaning materials soaked with cold cleaner may produce heat together with atmospheric oxygen and combust spontaneously.

- Collect cleaning materials soaked with cold cleaner only in fire-proof, tightly sealed containers.
- Do not dispose of cold cleaner residues and used cleaning materials with domestic waste, rather only in accordance with manufacturer instructions.
- Comply with the instructions for preventing fire on the safety data sheet for the cold cleaner.

WARNING

Danger of injury from compressed air and dust particles.

Eye injuries can occur when cleaning with compressed air.

- Wear safety goggles.

CAUTION

Danger of injury from ignoring the maintenance instructions.

- Only perform maintenance work when the engine is switched off.
- For engines with an electric starter:
  Disconnect the negative battery terminal.
  Protect the starting key from unauthorized access.

CAUTION

Danger of burns.

There is a danger of burns when working on a hot engine.

- Let the engine cool before maintenance.

3.3.4 Electrical equipment

Safety notes

DANGER

Danger to life, danger of injury or danger of property damage due to incorrect use of batteries.

- Do not place tools or other metal objects on the battery.
- Before performing work on the electrical equipment, always disconnect the negative battery terminal.
- Never swap the positive (+) and negative (–) battery terminals.
- When installing the battery, first connect the **positive cable** and then the **negative cable**.
- When removing the battery, first disconnect the **negative cable** and then the **positive cable**.
- It is imperative to prevent short circuits and mass contact of current carrying cables.
- If faults occur, check the cable connections for good contact.

DANGER

Danger of explosion from flammable substances.

There is a danger of explosion from flammable gases.

- Keep batteries away from open flames and incendiary sparks.
- Do not smoke when working with batteries.

CAUTION

Danger of damage to the machine from incorrect engine cleaning.

- Let the engine fully cool down before cleaning.
- Do not use gasoline or acid-based cleaning agents.
- Do not spray electrical and electronic components with a water jet or high pressure jet during cleaning.
- Never aim the water jet into the intake opening for combustion air or into the exhaust pipe.

CAUTION

Danger of chemical burns

Chemical burns can occur when using batteries for the electrical operation.

- Protect your eyes, skin, and clothing from corrosive battery acid.
- Immediately rinse areas affected by splashed acid with clear water and consult a physician if necessary.

- Promptly replace faulty indicator lamps.
- Do not disconnect the battery while the machine is running. Resulting voltage peaks could destroy the electronic components.
- When performing welding work on the machine, disconnect the battery and place the ground clamp of the welding equipment as close as possible to the welding area. Disconnect the plug connectors to the engine control unit and to the voltage regulator of the three phase alternator.

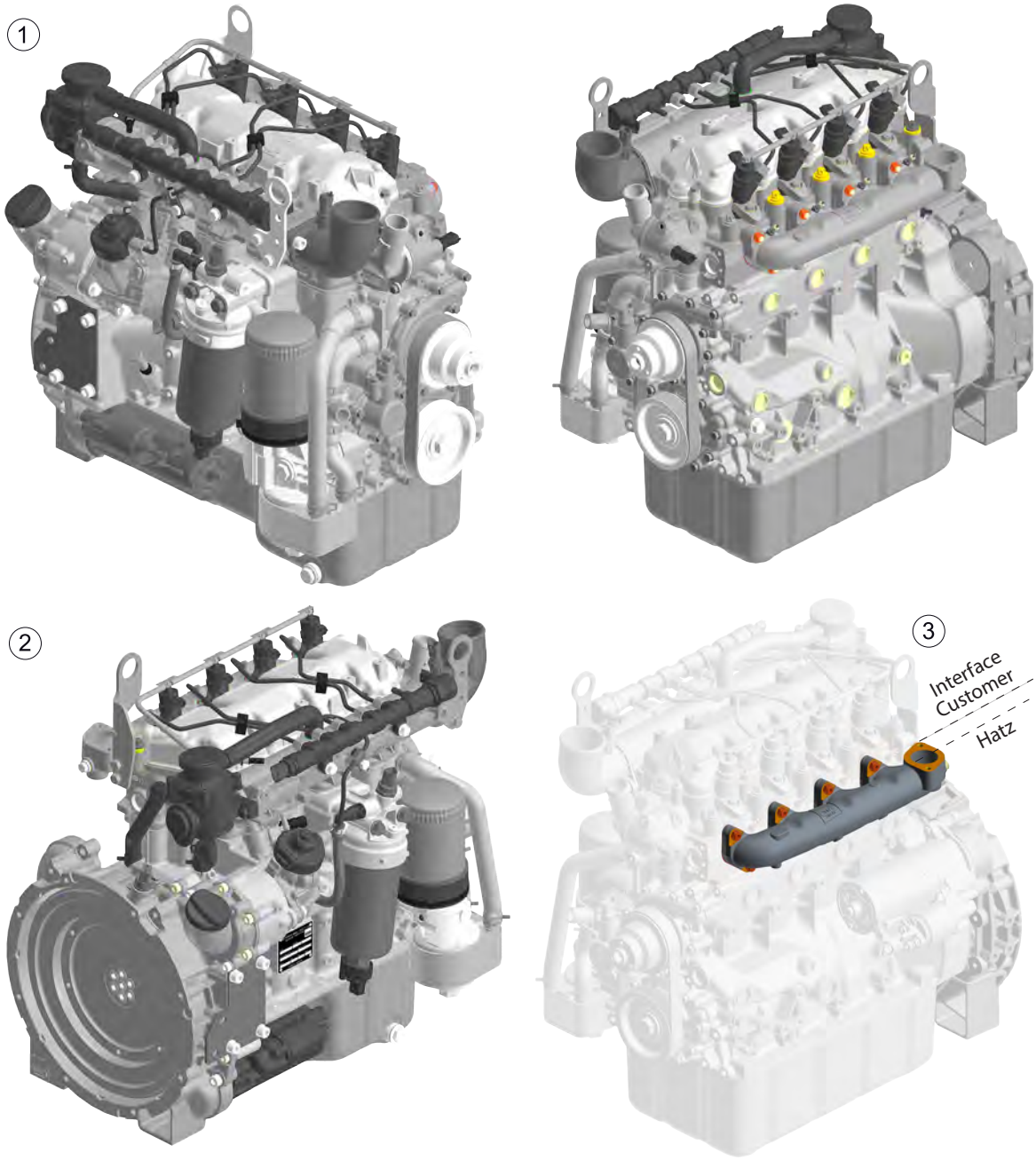
NOTICE	
	▪ **Connection and wiring plans** can be viewed at www.hatz.com/docu after entering the engine serial number located on the type plate directly on the engine. ▪ Liability cannot be accepted **for electrical equipment** that is not designed according to HATZ wiring diagrams.

3.3.5 Labels

Warning labels and information signs on the engine

sign	Meaning
WARNING: Breathing diesel engine exhaust exposes you to chemicals known to the State of California to cause cancer and birth defects or other reproductive harm. • Always start and operate the engine in a well-ventilated area. • If in an enclosed area, vent the exhaust to the outside. • Do not modify or tamper with the exhaust system. • Do not idle the engine except as necessary. For more information go to www.P65warnings.ca.gov/diesel 043 550 00	CALIFORNIA Proposition 65 Warning. For more information, see www.P65warnings.ca.gov/diesel (The warning label must be attached in a location where it is clearly visible on the machine. If necessary, Hatz can deliver the adhesive label unattached.)
	Cleaning with a high pressure cleaner is prohibited!

4 General information about the engine



1	Top view
2	Maintenance side (operating side)
3	Exhaust side [1)]

[1)] For engine model 4H50NO, the diesel oxidation catalytic converter (DOC) along with the exhaust piping, compensator, etc., are installed by the customer. See chapter *8.5 Exhaust system, page 57*.

5 Technical data

5.1 Engine information and filling quantities

type		**4H50N / 4H50NO**
Type		Liquid-cooled four stroke diesel engine
Combustion system		Direct injection
Number of cylinders		4
Bore/Stroke	mm	84 / 88
Displacement	cm^3	1.951
Engine oil capacity	Approx. ltr.	9.0 [1)]
Difference between "max" and "min" marking	Approx. ltr.	1.0 [1)]
Engine oil consumption (after running-in period)	Max.	0.5 % of fuel consumption, pertaining to full load
Engine oil pressure		2.5 bar to 4.5 bar
Coolant-filling amount [2)]	Liter	2.7
Coolant-filling amount [5)]	Liter	9
Sense of rotation		Left (view toward flywheel)
Tappet clearance		Automatic hydraulic valve adjustment (maintenance-free)
Max. permissible permanent slope [3)]		HATZ radiator with **integrated expansion tank** radiator low: 20°, other parts: 30°
		HATZ radiator with **external expansion tank**
		30°
		35° [4)]
Battery capacity	Max.	12 V – 110 Ah / 760 A (EN) / 800 A (SAE) 24 V – 66 Ah / 510 A (EN) / 540 A (SAE)

[1)] These values are approximations only. The max. mark on the dipstick is decisive in any case.

[2)] Engine without cooler and without cooler hoses

[3)] **Exceeding these limit values causes engine damage.**

[4)] Permissible sloping position for a maximum of 7 hours. After this period, return the engine from the sloping position to the horizontal position and switch it off for at least 5 minutes. Merely a reduction in the sloping position is not sufficient.

[5)] Cooler with integrated expansion tank

Weights

*Weights without cooler

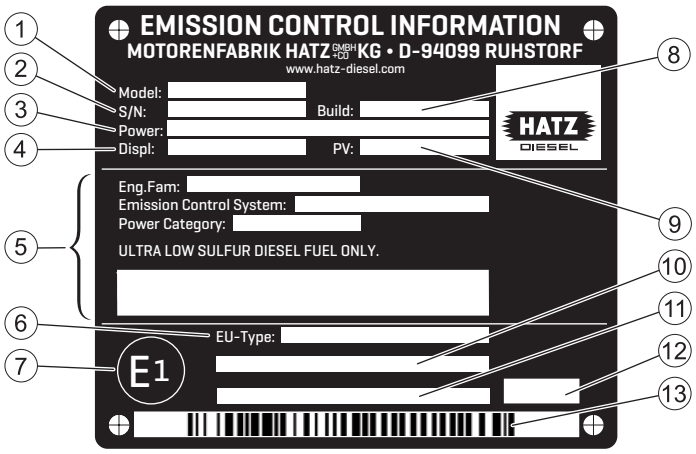
Engine specifications

Model	Description
N	Naturally aspirated engine
NO	Naturally aspirated engine with diesel oxidation catalyst (DOC)

Screw tightening torque

Designation	Nm
Oil drain screw	58
Drain screw on engine cooler	50
Screws for the breather cap of the crankcase ventilation	4
Screw cap on main fuel filter	25

5.2 Engine type plate



The engine type plate is affixed to the crankcase and includes the following engine information:

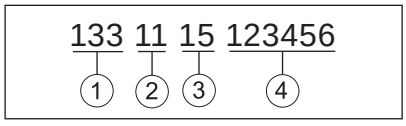
1	Model designation of the engine
2	Engine serial number
3	Engine power (kW) at rated speed (rpm)
4	Displacement (liters)
5	Information for US emission certification (EPA/CARB)
6	EU type approval number
7	EU country of origin (Germany)
8	Model year (month/year)
9	Test specification for special settings
10	Engine family designation or exemption code (EM) or transition code (TM) according to regulation (EU) 2016/1628
11	Additional specifications according to Regulation 2017/656 (exceptions) or "Separate shipment information"
12	Code for type plate variant
13	Barcode (engine serial number)

The following data must always be specified in case of queries and for spare parts orders:

1	Model designation
2	Engine serial number

5.3 Engine serial number

Breakdown of the engine serial number



1	Engine type number

2	Engine serial number
3	Model year
4	Fabrication number (consecutive)

Engine type number

The engine type number makes it possible to see if the engine is equipped with a diesel oxidation catalytic converter (DOC). Engines with DOC have more stringent requirements on engine oil and fuel quality. The following table shows which engine types are equipped with DOC.

Engine type number	Type number	DOC
192	4H50NO	X
193	4H50N	

5.4 Rotational speed application

Speed (rpm)	4H50N – EPA / EU Stage V <19 kW
2000	Variable speed

Speed (rpm)	4H50N – EU Stage V <19 kW
1500	Constant speed

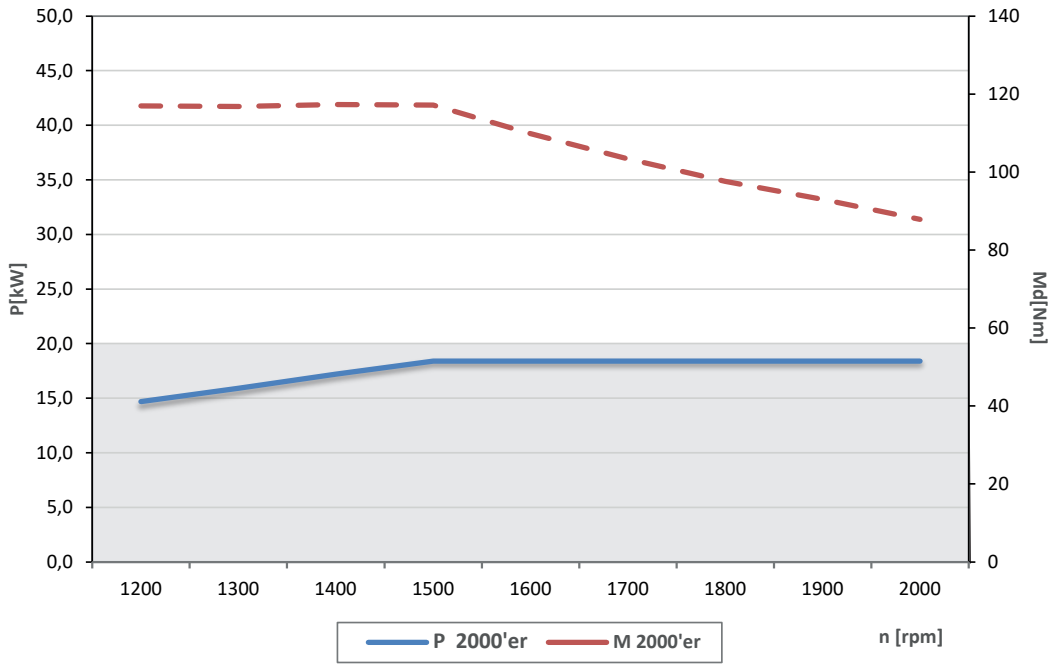
Speed (rpm)	4H50N – EPA / CARB <19 kW
1800	Constant speed

Speed (rpm)	4H50NO – EPA / CARB-TRU <19 kW
2000	Variable speed

5.5 Performance data

4H50N/NO – EPA / CARB-TRU / EU Stage V		
Speed n [1/min]	IFN - variable [kW]	Torque Md [Nm]
2000	18.4	88
1900	18.4	93
1800	18.4	98
1700	18.4	103
1600	18.4	110
1500	18.4	117
1400	17.2	117
1300	15.9	117
1200	14.7	117

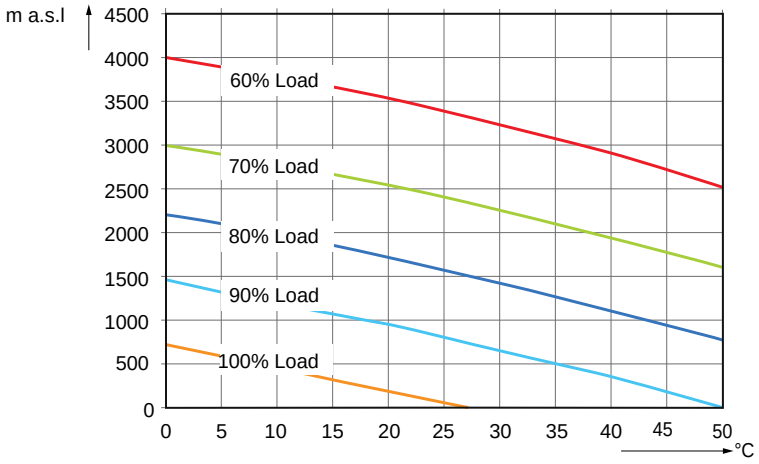
4H50N – EU Stage V		
Speed n [1/min]	IFN - variable [kW]	Torque Md [Nm]
2000	18.9	90
1900	18.9	95
1800	18.9	100
1700	18.9	106
1600	18.9	113
1500	18.9	117
1400	17.2	117
1300	15.9	117
1200	14.7	117



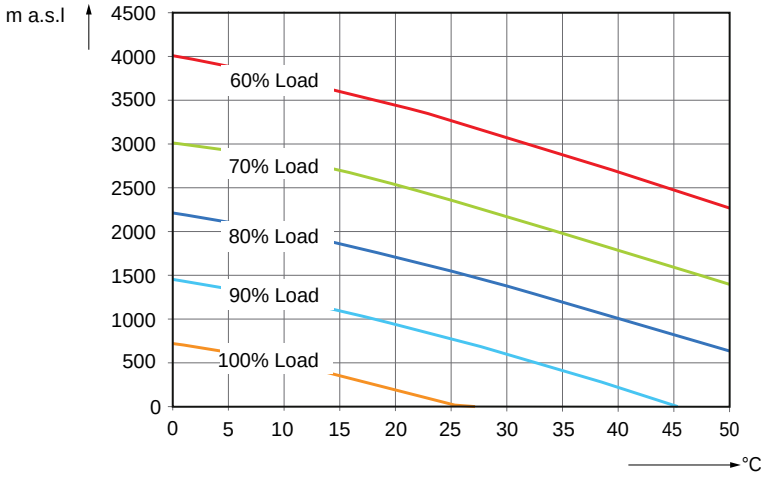
5.6 Power reduction as a function of elevation, temperature and humidity as per ISO 3046

It is recommended to keep the intake air temperature relatively low, ideally not more than 5 °C above the ambient temperature.

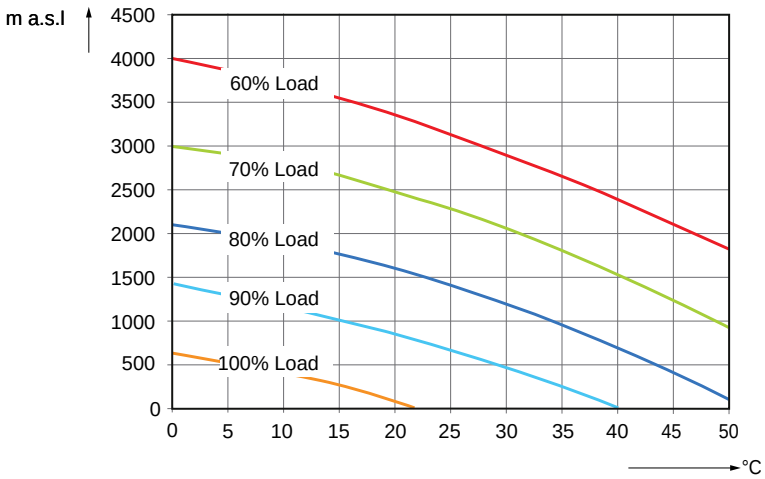
Power reduction at 40 % humidity:



Power reduction at 60 % humidity:



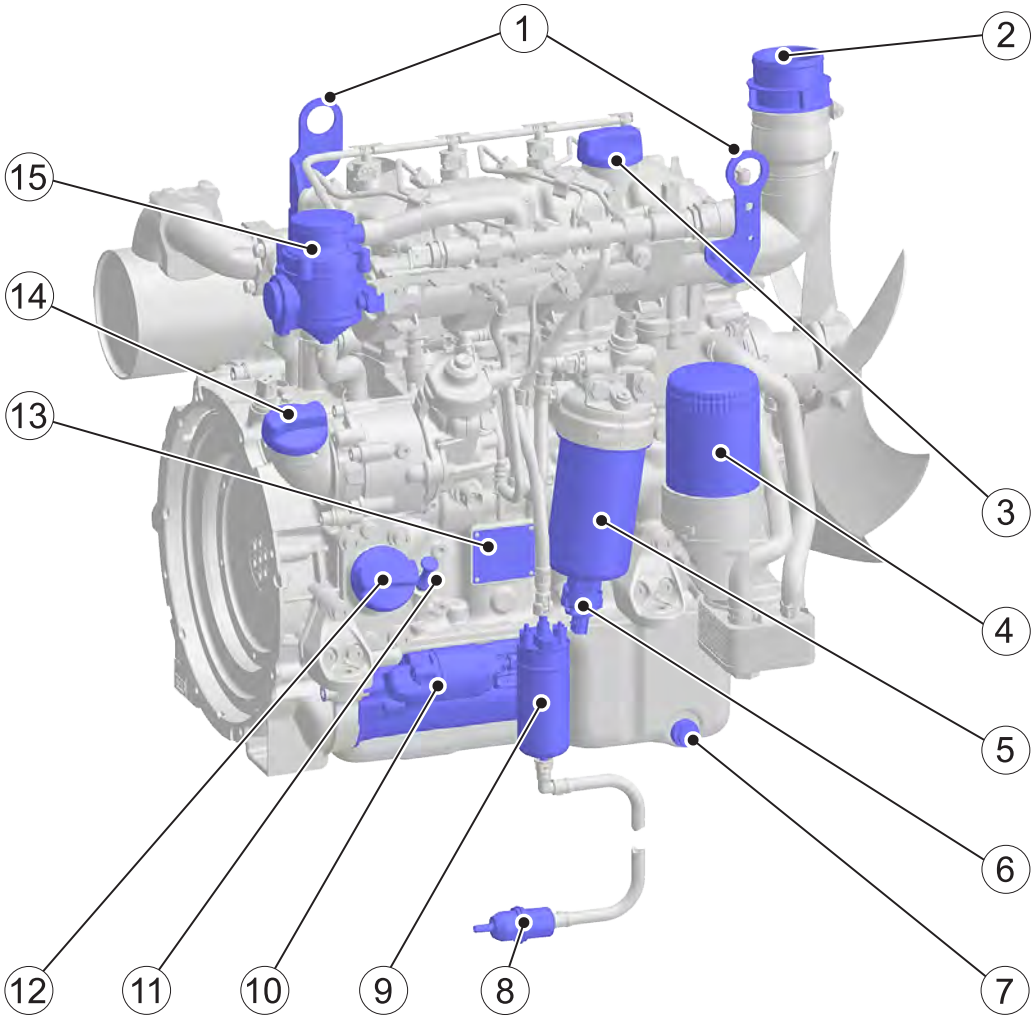
Power reduction at 100 % humidity:



6 Engine overview

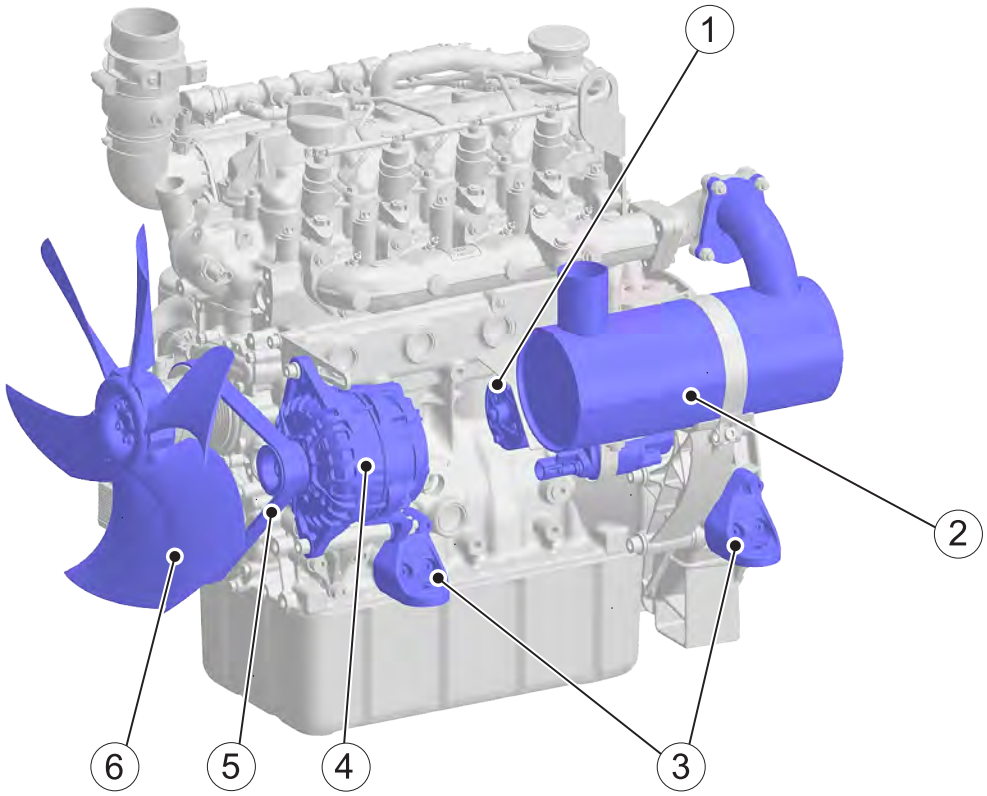
6.1 Designation of components

Version – N / NO
Intake side



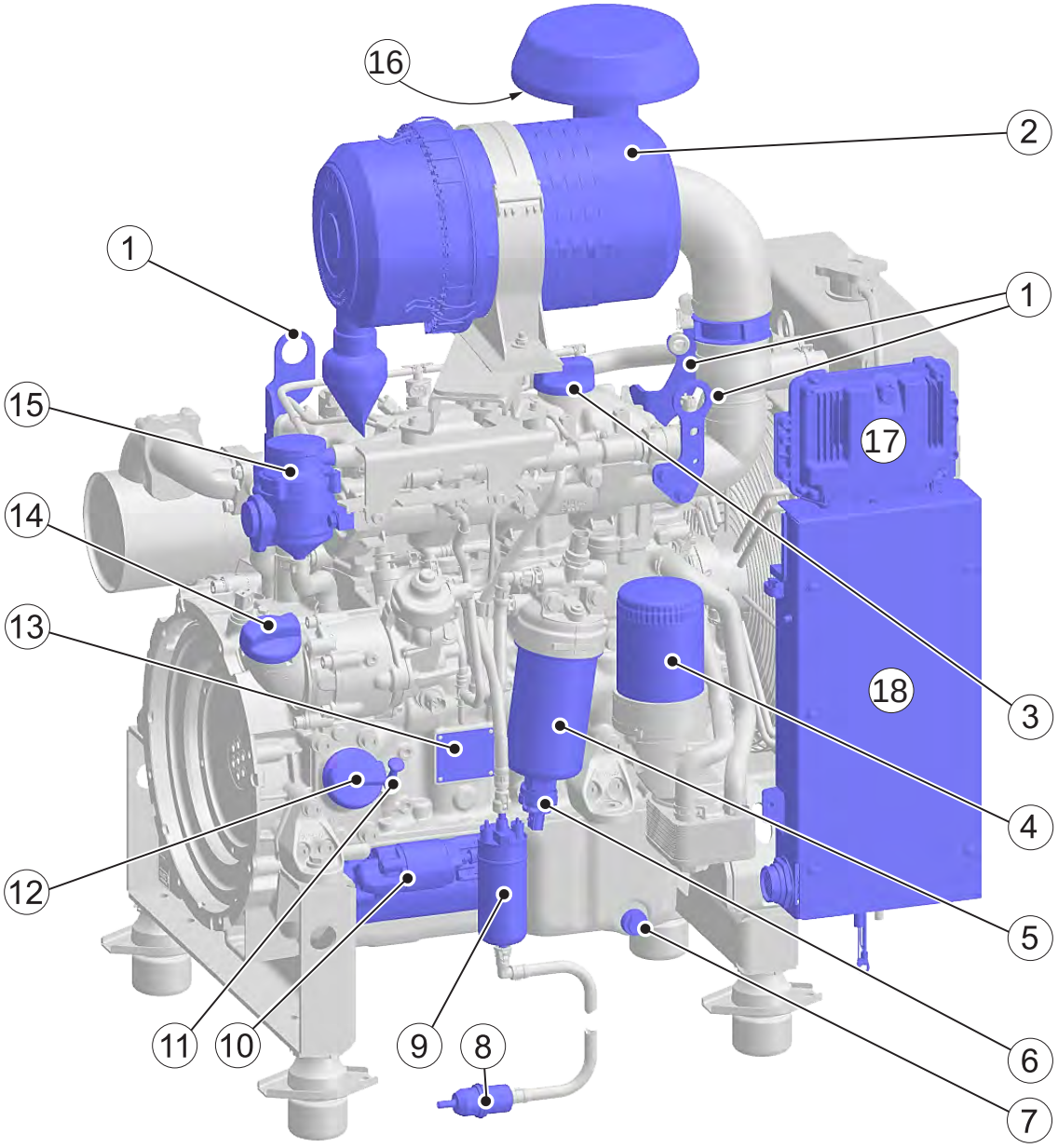
1	Lifting eyes
2	Intake opening for combustion air (engine model - N)
3	Oil filler plug, top (option)
4	Oil filter, vertical fitting (option)
5	Main fuel filter
6	Drain screw with integrated water in fuel sensor
7	Side oil drain screw
8	Fuel prefilter
9	Electric fuel pump
10	Starter (low mounting position)
11	Dipstick
12	Oil filler plug, bottom (option)
13	Engine type plate
14	Oil filler plug, middle
15	Crankcase ventilation

Version – N / NO
Outlet side



1	Starter (high mounting position)
2	Silencer (engine model - N) or Diesel oxidation catalytic converter DOC (engine model - NO)
3	Engine brackets
4	Three phase alternator
5	Poly v belt
6	Fan

Model OPU – N / NO
Intake side

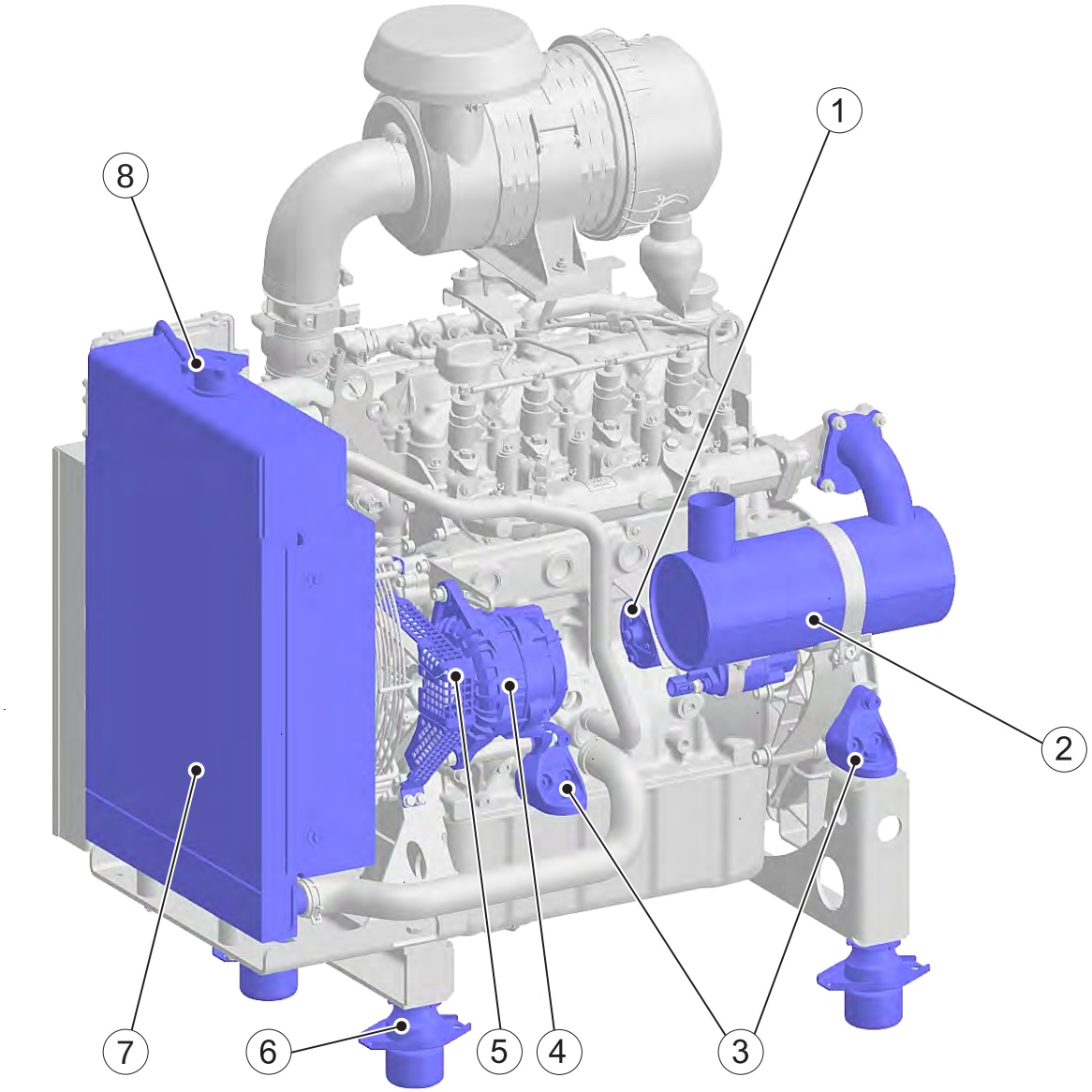


NOTICE
The Open Power Unit (OPU) is a complete system which, in addition to the engine, also includes all of the components required for cooling.

1	Lifting eyes
2	Air filter (engine model N)
3	Oil filler plug, top (option)
4	Oil filter, vertical fitting (option)
5	Main fuel filter
6	Drain screw with integrated water in fuel sensor
7	Side oil drain screw
8	Fuel prefilter
9	Electric fuel pump

10	Starter (low mounting position)
11	Dipstick
12	Oil filler plug, bottom (option)
13	Engine type plate
14	Oil filler plug, middle
15	Crankcase ventilation
16	Rain cap (intake opening for combustion air)
17	Engine control unit
18	Plug retaining plate with integrated relay

Model OPU – N / NO
Exhaust side



1	Starter (high mounting position)
2	Silencer (engine model - N) or Diesel oxidation catalytic converter DOC (engine model - NO)
3	Engine brackets
4	Three phase alternator
5	Belt guard (option)
6	vibration damper
7	Cooler
8	Sealing cap for coolant

7 Transport and packaging

7.1 Transport

Safety notes

⚠ WARNING

Danger of injury from improper lifting and transport.

Danger of crushing from the engine falling or tipping.

- Only use the lifting eye already mounted on the machine for lifting.
- Before lifting the engine, check the lifting eye for damage. Lifting with a damaged lifting eye is not permitted. Replace a damaged lifting eye before using it for lifting.
- Only use a suitable hoist with a sufficient carrying capacity.
- Do not remain under suspended loads.

⚠ CAUTION

Only use the lifting eye for transporting the engine.

Do not use for lifting the entire machine.

⚠ CAUTION

Danger of injury from overloading the body.

Lifting the machine to transport it or to move it to another location can lead to injuries (of the back, for example).

- Only lift the machine with a hoist.

NOTICE

Danger of environmental damage from leaking fluid.

If the machine is tilted, engine oil and fuel can run out.

- Only transport the machine in an upright position.

Transport conditions

Transport conditions

- When transporting the machine, follow the safety instructions.
- When transporting, follow the applicable safety and accident prevention regulations.
- After delivery, check the machine for completeness and transport damage.
- Only transport the machine when it is switched off and has cooled down.
- If you have questions on transporting the machine, please contact your nearest **HATZ service station**. For contact data, see chapter Legal notices or **www.hatz-diesel.com**.

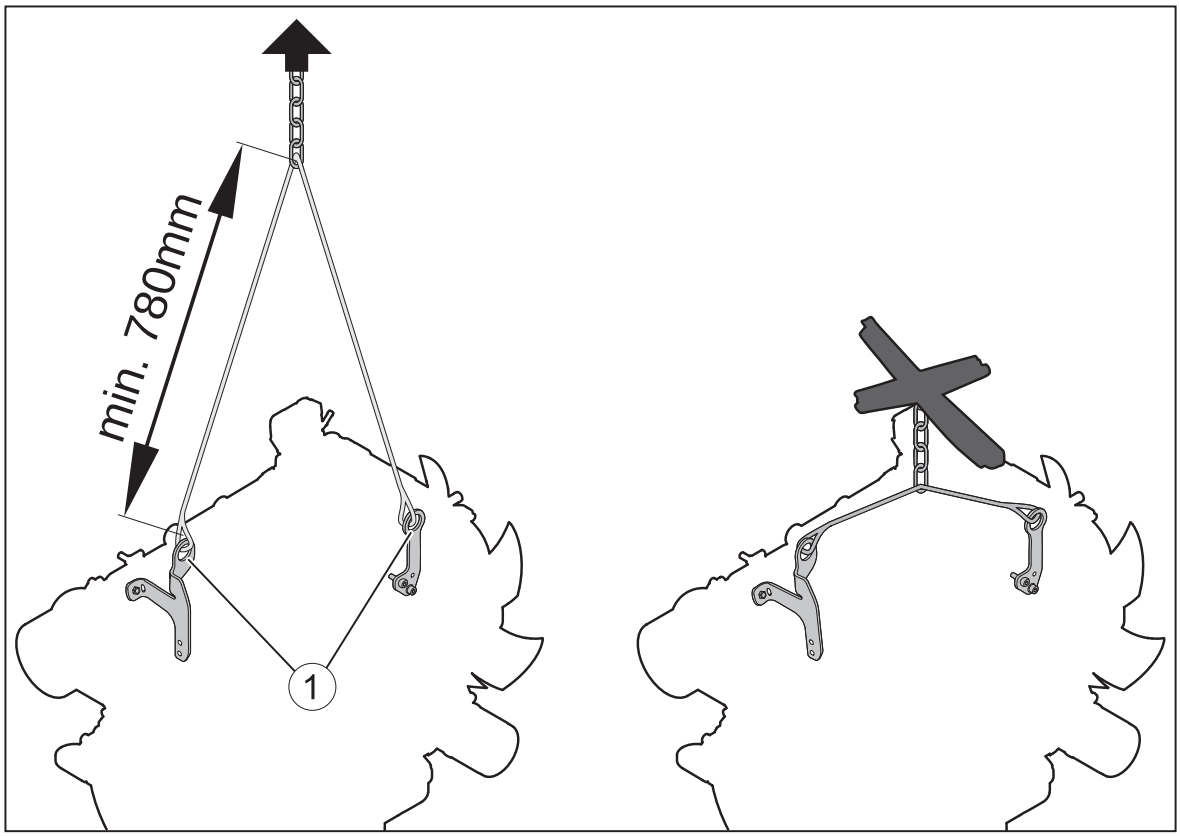
Transport damage

- Inspect the product for transport damage.
- Document any transport damage in the shipping documents, have them countersigned by the shipping agent and immediately inform the manufacturer.

Transport safety

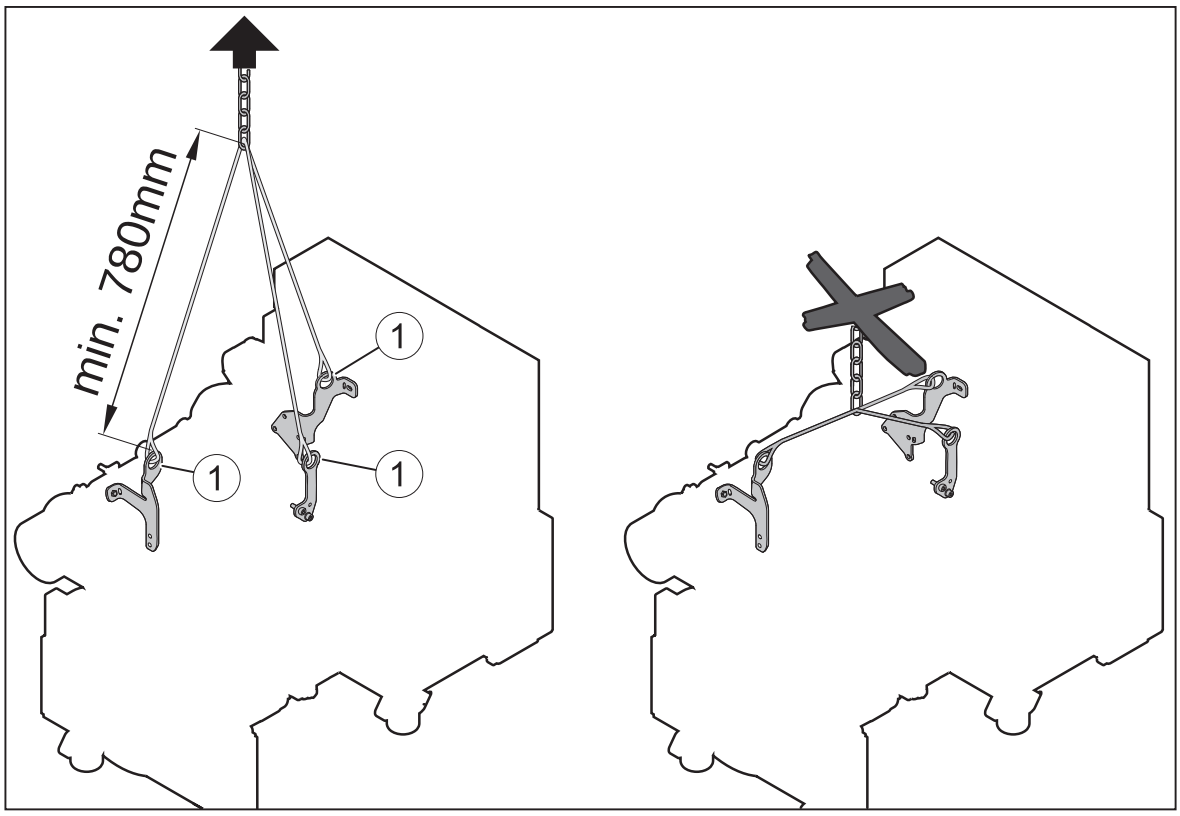
- Select means of transport according to the weight and packaging of the engine (see shipping documents).
- Secure the load properly and transport carefully.
- For transporting the engine by crane, use lifting eyes (see Diesel Engine Manual).

Lifting points (engines with 2 lifting eyes)



1	Lifting points

Lifting points (engines with 3 lifting eyes)



1	Lifting points

7.2 Temporary stoppage

Take the following measures if you intend to take the machine out of service for a lengthy period (3–12 months):

Step	Activity
1	Drain the fuel tank until it is nearly empty and fill with FAME*-free fuel. Operate the engine for a few minutes so that only FAME-free fuel is still in the fuel system. FAME*-free fuel was used during the factory test run.
2	Change the engine oil in accordance with Operator's Manual for the machine.
3	Change the fuel filter.
4	Let the machine cool down.
5	Remove the battery (if present) in accordance with the Operator's Manual for the machine and store at ambient temperature. Comply with the local regulations as well as the regulations of the battery manufacturer for the storage of batteries.
6	Close and seal all engine openings (air intake openings, air outlet openings and the exhaust gas opening) so that no foreign bodies can enter, but a small amount of air can still be exchanged. This avoids condensation.
7	After the machine has cooled down, cover it to protect it against contamination, and store it in a dry and clean place.

*FAME = Fatty Acid Methyl Ester

Ambient conditions during storage

- Max. permissible storage temperature: -25 °C to +60 °C
- Max. permissible humidity: 70%
- Protect the engine from direct sunlight

Step	Activity
1	Remove all covers.
2	Check the cables, hoses and lines for cracks and leak tightness.
3	Check the engine oil level.
4	Check the coolant level.
5	Install the battery in accordance with the Operator's Manual for the machine.

The brand new engine can normally be stored for up to 12 months. The protection lasts up to approx. 6 months at very high humidity and in sea air.

For storage periods of more than 12 months, please contact the nearest **HATZ Service**.

7.3 Packaging

Dispose of packaging materials (cardboard, wood, PET strip etc.) according to local environmental regulations.

8 Installation instructions

8.1 Installation notes – general information

HATZ diesel engines are efficient, robust, and have a long service life. Therefore, they are usually installed in machines that are used for commercial purposes. The machine manufacturer must follow the applicable regulations regarding machine safety.

The engine is a part of a machine – depending on the use and installation of the engine, it may be necessary for the machine manufacturer and machine user to install safety equipment to prevent inappropriate use. Note the following:

- Parts of the exhaust gas system and the engine surface become hot during operation and may not be touched until they cool down after the engine is switched off.
- Incorrect cable connections and incorrect operation of the electrical equipment can lead to sparking and must be avoided.
- After the engine is installed in the machine, rotating parts must be protected against contact. Protective devices from HATZ (e.g., belt protection) are available for this.
- Comply with all notices and warning labels on the engine and keep them in a legible condition. If an adhesive label should become detached or become difficult to read, it must be replaced promptly.
- Any improper modification of the engine will result in a loss of liability coverage for resulting damage.
- If the engine is speed limited via the CAN bus, care must be taken that the maximum machine speed is not exceeded.

The Assembly Instructions contain important information on how to safely assemble the engine.

8.1.1 Torques and screw classification

	NOTICE
	To ensure proper screw connections, the specifications in the list **Torques + classification**056758xx must be adhered to for every installation. For a **category A screw connection,** there are additional requirements that need to be adhered to. The current list can be downloaded at the following link: **www.hatz.com/docu**.

8.2 Engine support/installation

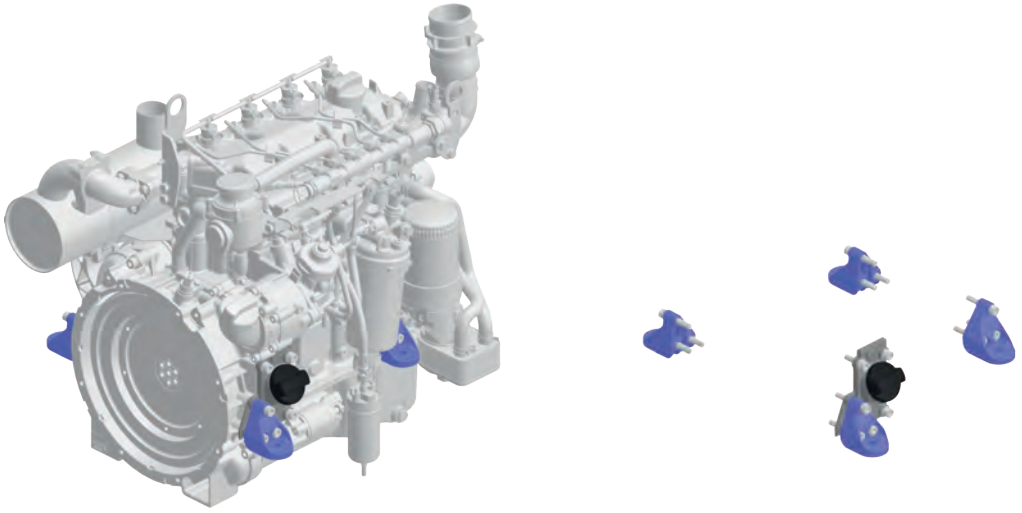
Good operating performance of the machine can be realized neither by the engine nor by the machine to be driven alone, rather the two components must be appropriately and properly matched to each other.

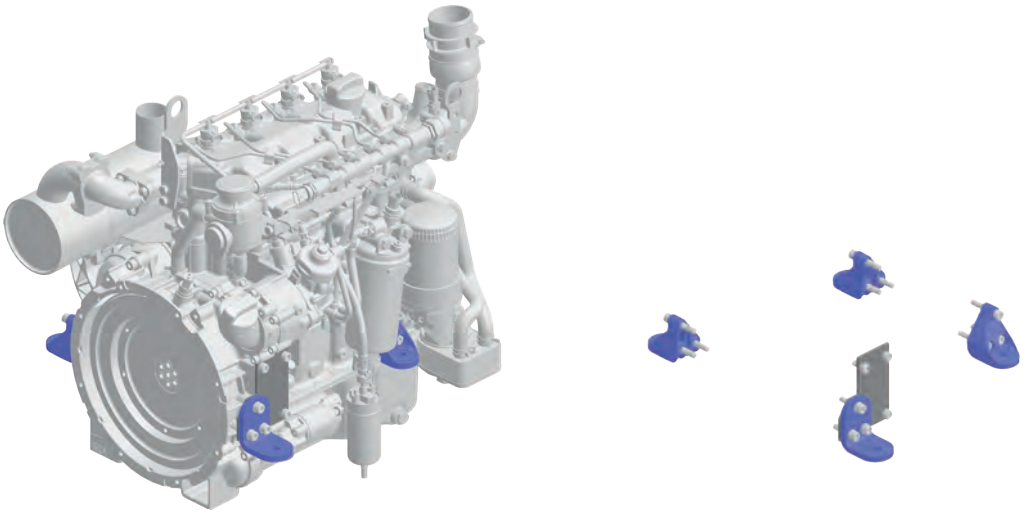
Generally, flexible mounting of the engine should be aimed at. In addition, the engine should be uniformly loaded; see *8.2.7 Uniform bearing load, page 42*.

If there is any doubt, please contact your nearest **Hatz service station**.

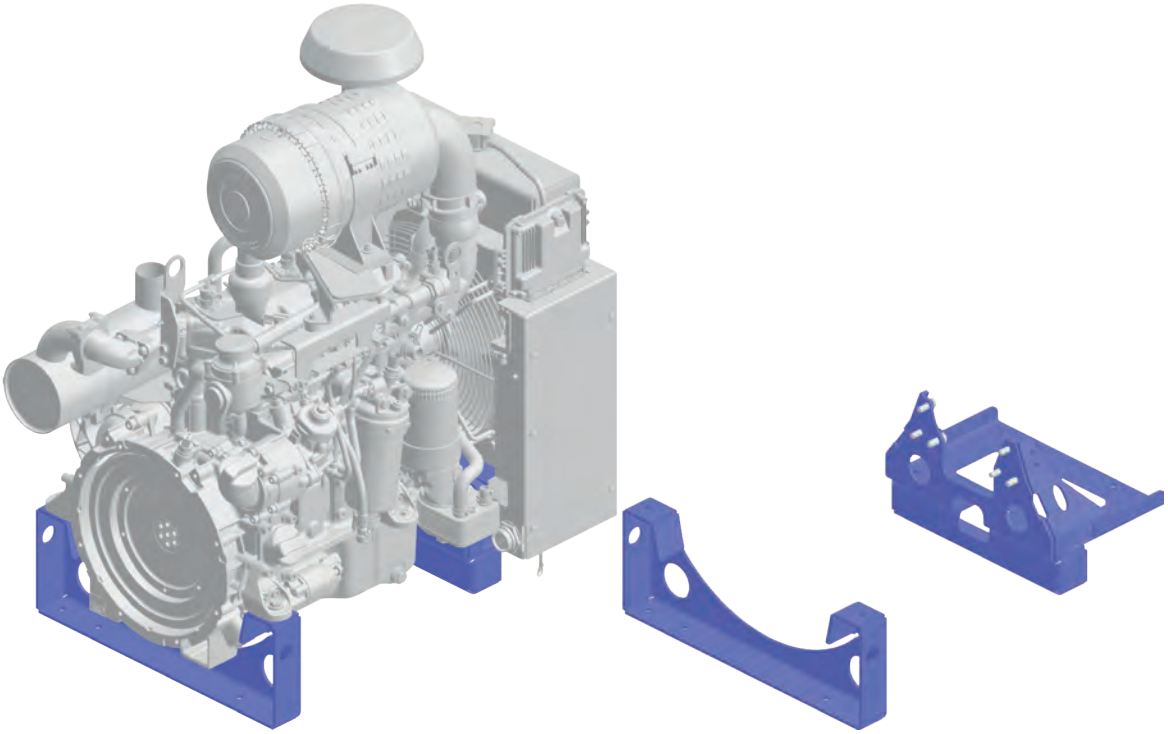
8.2.1 engine brackets

Standard - with or without oil filler at the bottom



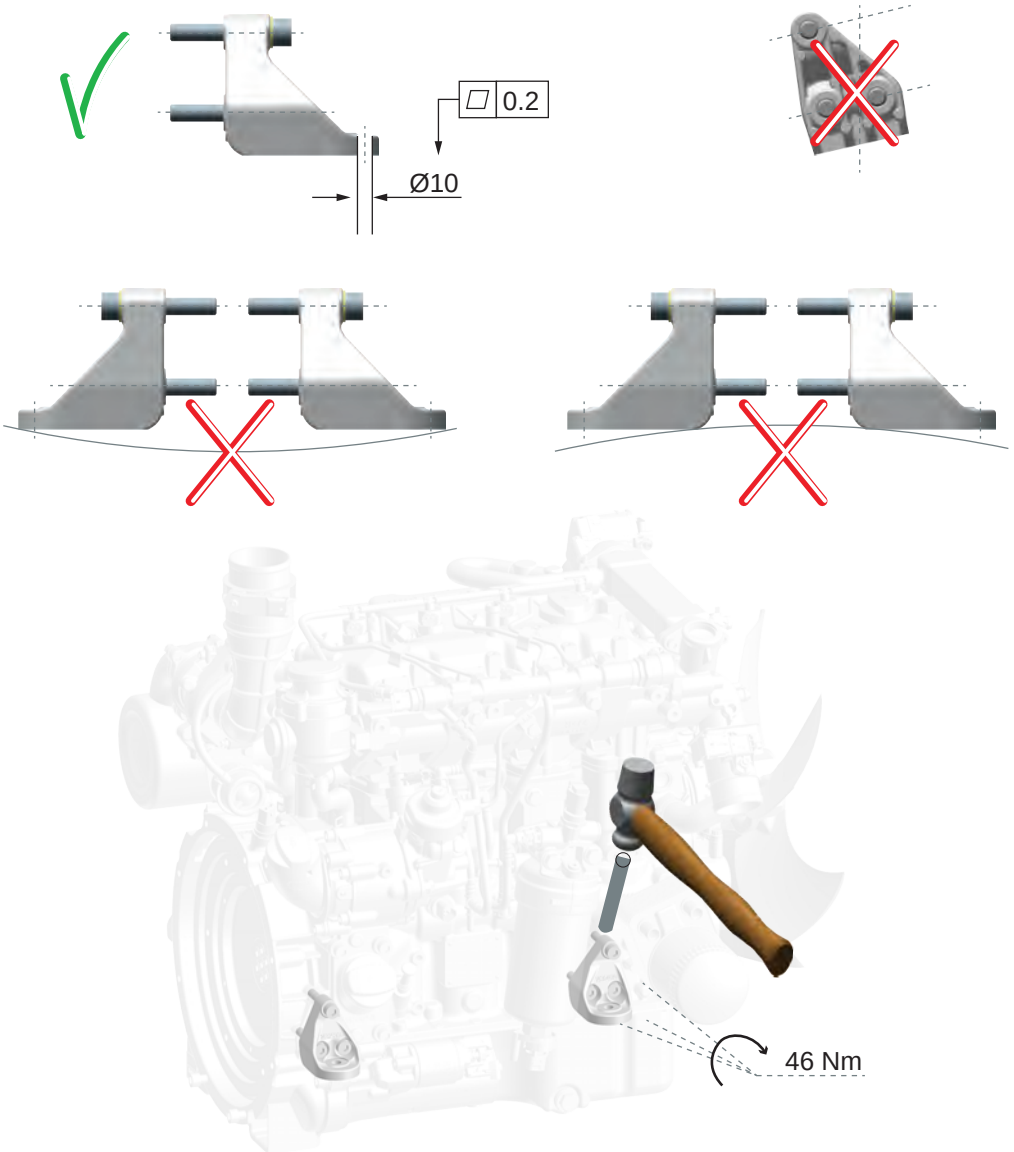


Open Power Unit



8.2.2 Rigid engine suspension

CAUTION	
	Danger of injury and danger of engine damage if the engine is not mounted without stress ▪ If the engine fastening is rigid, the engine brackets with the baseplate must be set up in a stress-free manner (flatness tolerance of the contact surface must be 0.2 mm). ▪ The engine is not permitted to be mounted on painted surfaces. ▪ Non-observance can lead to a risk of injury, breaking of the engine brackets/baseplate, and thus engine damage.



Tightening torque of engine bracket **M10** with **46 Nm**. In order for the engine to also be installed absolutely free of stress, one of the 4 identical engine brackets must be adjusted/aligned to the contact surface.

Rigid mounting can only be allowed up to an engine speed of approx. 1,800 rpm. In addition, the free mass forces are typically so large that a flexible support now makes sense.

The **most important prerequisite for any engine mounting** is that the frame or the mount is rigid and of sufficient size in terms of strength. Parts of the frame that are not rigid act like springs and must be stiffened by braces.

If the **engine speed in a rigid setup should be> 1800 rpm**, Hatz must be consulted to determine if the application can be approved.

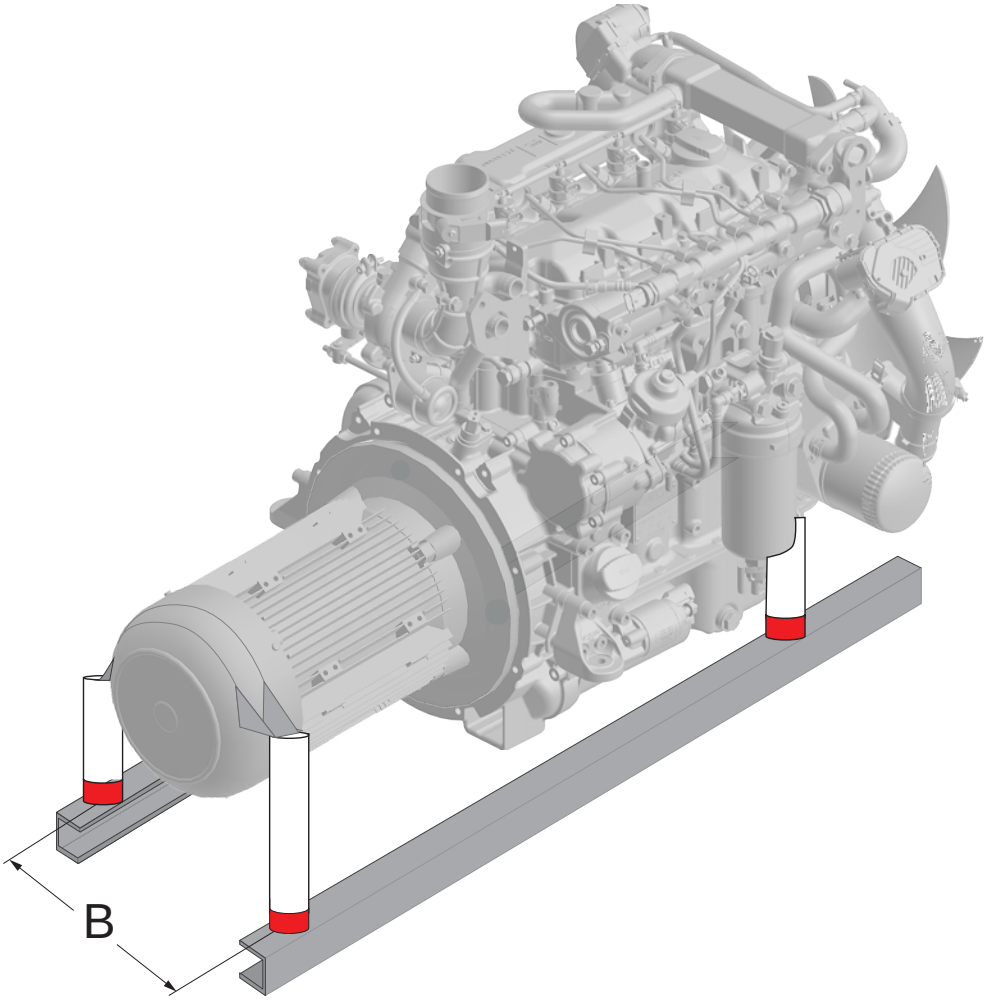
8.2.3 Flexible engine mounting

A flexible engine mount is preferable to a rigid engine mount.

For noise reasons too, flexible mounting can be advantageous because when rubber is used as a bearing element, no structure borne noise is passed on.

The connections for fuel, exhaust gas and exhaust air for flexibly mounted engines must be designed so that the relative movements that occur can be absorbed, i.e. they must be flexible.

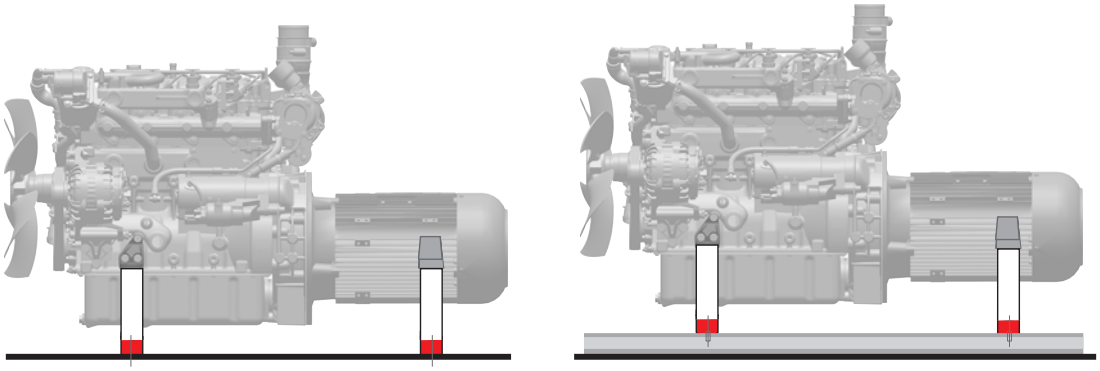
For a flexible mounting, the **base B** must be as wide as possible. This lowers vibration peaks and the forces.



Depending on the type of machine, the flexible mounts are differentiated as follows:

a) Flexible mounting with flange-mounted force sensor

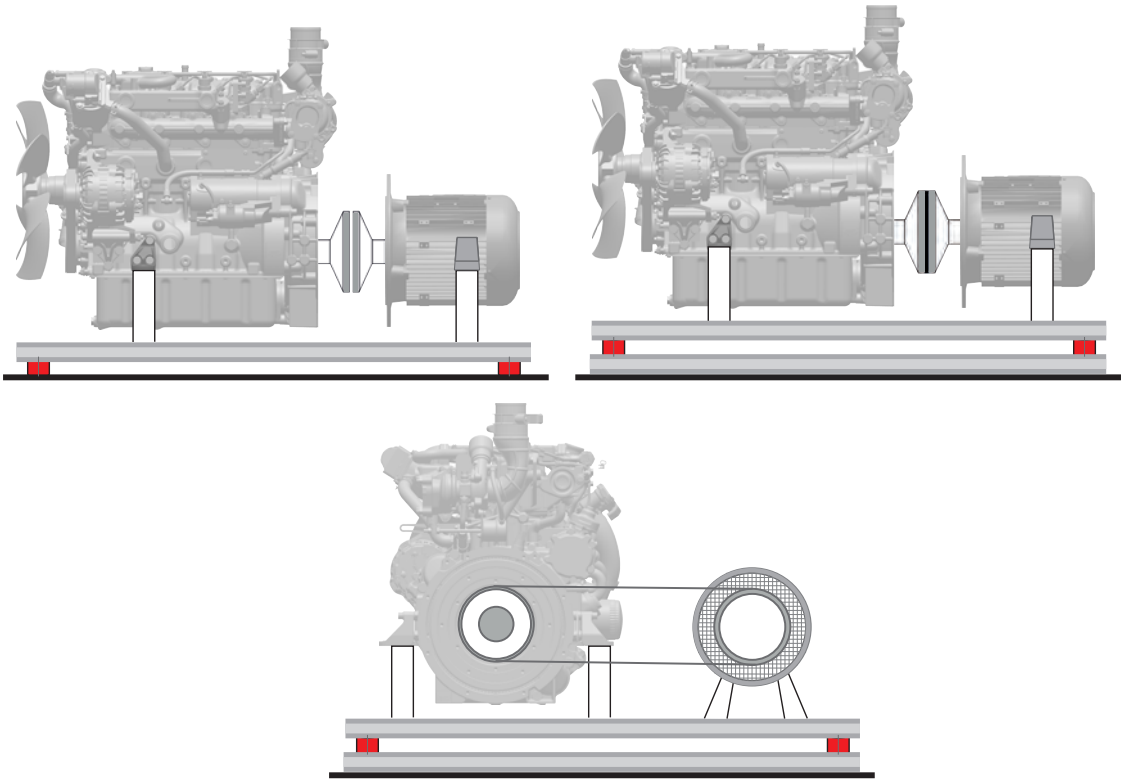
The engine is flange-mounted on the driven force sensors and constitutes a common vibration system. If a corresponding base is available, a frame can be dispensed with because the engine and force sensor already make up a rigid frame.



b) Flexible mounting with non-flange-mounted force sensors

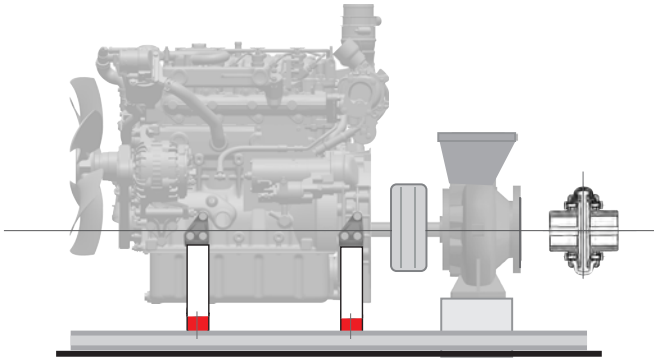
In place of the housing connection to flange-mounted force sensors, there is now a frame onto which the engine and the machine to be driven are rigidly screwed.

Either **flexible couplings or belts** serve as power transmission elements. The frame with rigidly mounted engine and rigidly mounted machine to be driven is now placed on rubber elements or springs, thus constituting a vibration system.

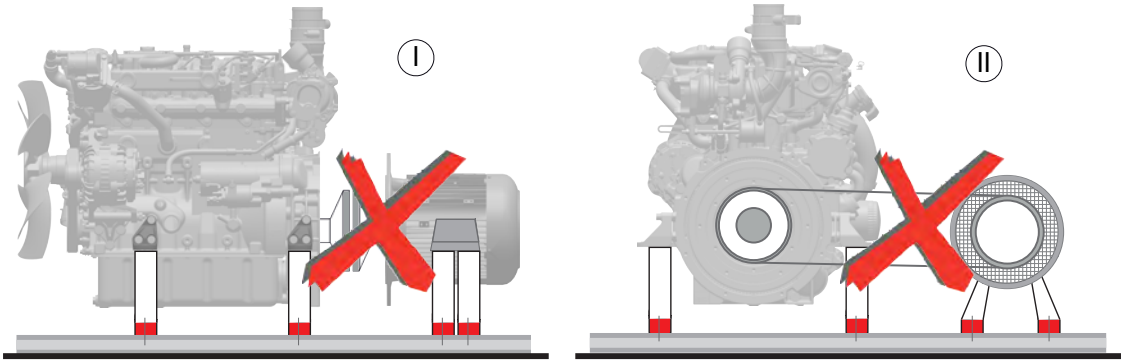


Special case:

Due to the open, non-flange-mounted construction, a **highly elastic coupling** must be used as the shaft connection between the flexibly mounted engine and rigidly mounted pump.



In contrast, variants I and II are not permitted because the engine and machine form separate vibration systems which work against each other and damage the flexible coupling or belt.



8.2.4 vibration damper

The support surface for the fixing of the engine must comply with a flatness tolerance of max. 1 mm. The engine is not permitted to be mounted on painted surfaces.

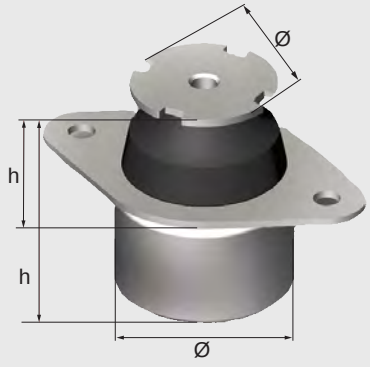
NOTICE

Depending on the application, the device manufacturer must define and set up the installation of the engine together with the appropriate vibration dampers.

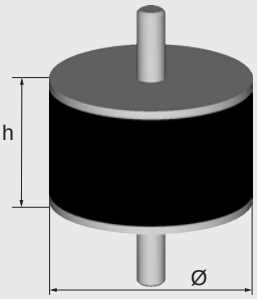
For engine installations on mobile machines (such as vehicles, trailers etc.), the engine must be secured against transverse forces. For this, either vibration dampers with a breakaway or separate mechanical safety elements should be used (e.g., arrestor cables). For this purpose, contact your nearest Hatz service.

No.	Material no.	vibration damper	Ø [mm]	h [mm]	Hardness [Shore A]
1	503 236 xx	Hydro mount V600 (M10)	64/88	32/91	45
2	402 173 xx	Hydro mount V1500 (M12)	64/89	44/103	55
3	502 602 xx	Cylindrical rubber buffer (M10)	70	45	55
4	502 603 xx	Cylindrical rubber buffer (M10)	70	45	65
5	506 617 xx	Cylindrical rubber buffer (M10)	70	45	55
6	506 618 xx	Cylindrical rubber buffer (M10)	70	45	70
7	506 679 xx	Mounting foot with breakaway (M10)	58.5/77	30	40
8	506 678 xx	Mounting foot with breakaway (M10)	58.5/77	30	60
9	506 947 xx	Mounting foot with breakaway (M10)	58.5/78	31	High damping

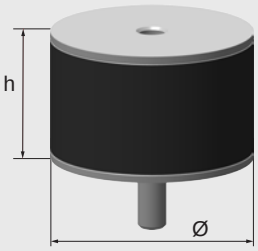
Hydro mount (1, 2)



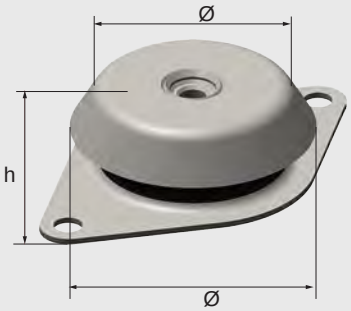
Cylindrical rubber buffer (3, 4)



Cylindrical rubber buffer (5, 6)



Mounting foot with breakaway (7, 8, 9)

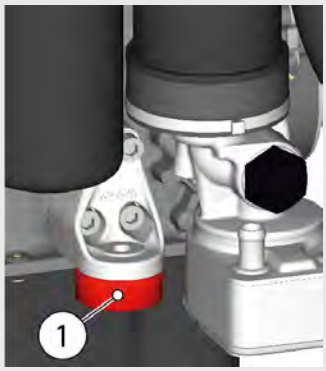


8.2.5 Vibration damper fastener kits

Fastener kit overview

For the mounting options of a horizontal/vertical oil filter, A/C compressor or hydraulic pump, the clamping position must be corrected using spacers (1) or else there will be a component collision.

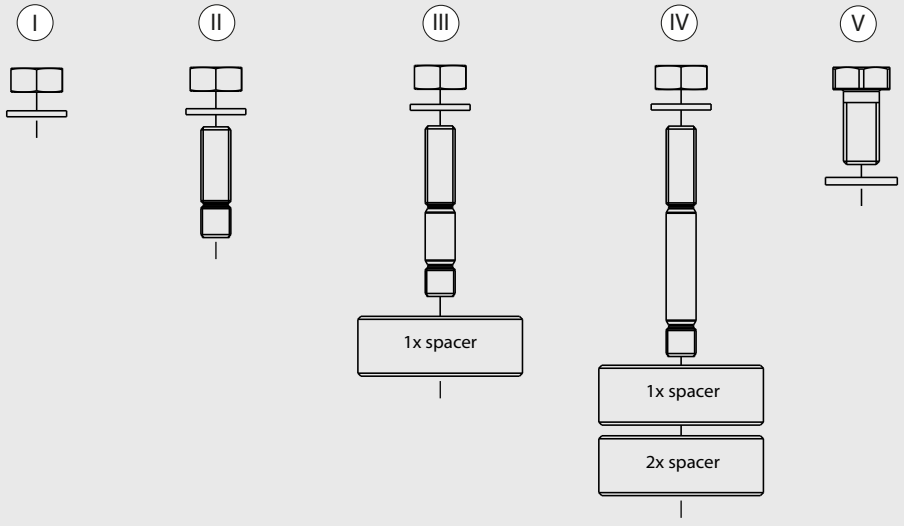
The fastener kit overview shows how many spacers are needed.



Basis	F2F	F2F	F2F	OPU
	Vertical	Vertical	Vertical	Vertical

Selection of fastening set (I – V)					
No.	vibration damper	F2F	F2F	F2F	OPU
1	Hydro mount V600	✓ + IV	✓ + IV	✓ + IV	–
2	Hydro mount V1500	–	–	–	✓+ V
3/4	Cyl. rubber buffer	–	–	–	✓+ I
5/6	Cyl. rubber buffer	✓ + III	✓ + III	✓ + III	✓+ II
7/8/9	Mounting foot with breakaway	✓ + IV	✓ + IV	✓ + IV	✓+ II

F2F = Fan2Flywheel, OPU = Open Power Unit



Tightening torques of nuts, screws and set screws

M10: 40 Nm

M12: 70 Nm

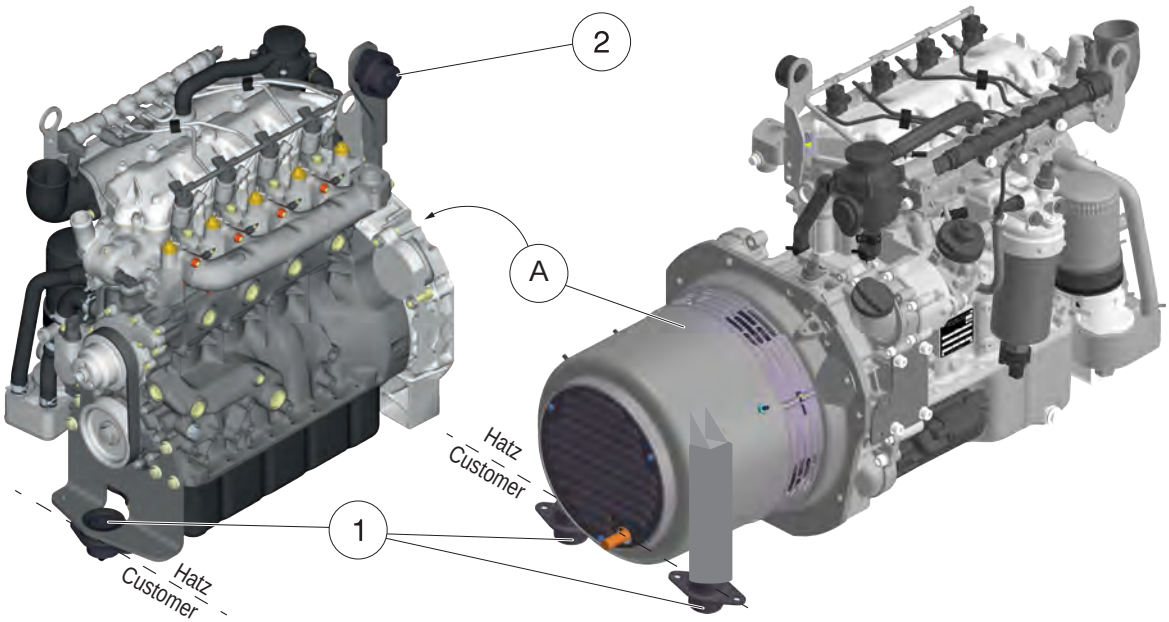
8.2.6 Vibration damper recommended

Recommendation for cylindrical rubber buffer for flexible mounting of stationary systems with vertical installation and use of four vibration damper per system.

The support surface for the fixing of the engine must comply with a flatness tolerance of max. 1 mm. The engine is not permitted to be mounted on painted surfaces.

The vibration elements must be developed in detail by the customer as a function of the excitation frequency and mass. Vibration velocities < 80 m/s (ideally < 20 m/s) are permissible. Intrinsic excitation is not permissible in the excitation range of the engine.

	NOTICE
	Depending on the application, the device manufacturer must define and set up the installation of the engine together with the appropriate vibration dampers. For engine installations on mobile machines (such as vehicles, trailers etc.), the engine must be secured against transverse forces. For this, either vibration dampers with a breakaway or separate mechanical safety elements should be used (e.g., arrestor cables). For this purpose, contact your nearest Hatz service.

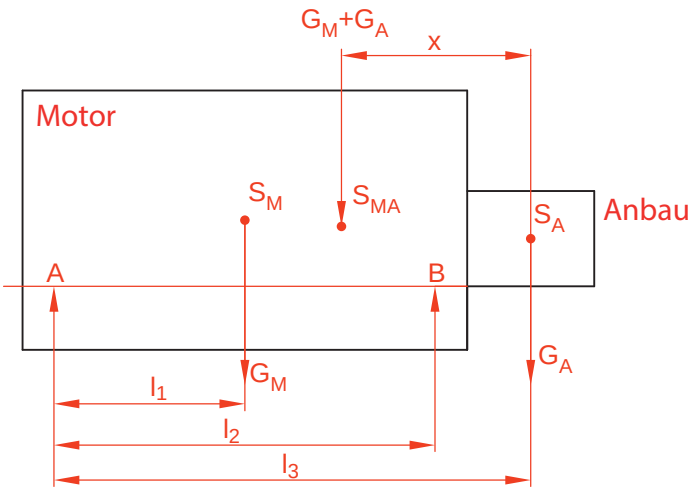


If 3 vibration elements (1) are used, a torque support (2) is recommended. For mounting the engine via a flange-mounted power take-off (A), see description in chapter *8.2.3 Flexible engine mounting, page 36*.

8.2.7 Uniform bearing load

When using bearing elements, ensure the bearing load is uniform. No more than 60% of the total weight should rest on A or B; if in doubt, contact your nearest **Hatz service center**.

Determination of bearing forces (if centers of gravity of the engine, attachments such as hydraulic pump, generator, and their intrinsic weights are known)



$$A = \frac{G_M \, x \, (l_2 - l_1) - G_A x \, (l_3 - l_2)}{l_2} \; [N]$$

$$B = \frac{(G_M \, x \, l_1) + (G_A x \, l_3)}{l_2} \; [N]$$

Abbreviation	Meaning
S_M	Center of gravity of engine
S_A	Center of gravity of attachment (e.g. hydraulic pump, alternator,…)
S_{MA}	Overall center of gravity (engine + attachment)
G_M	Engine weight force[N]
G_A	Attachment weight force [N] (e.g., hydraulic pump, generator etc.)
A	Bearing load A
B	Bearing load B
$L_{1,2,3}$	Distances [m]

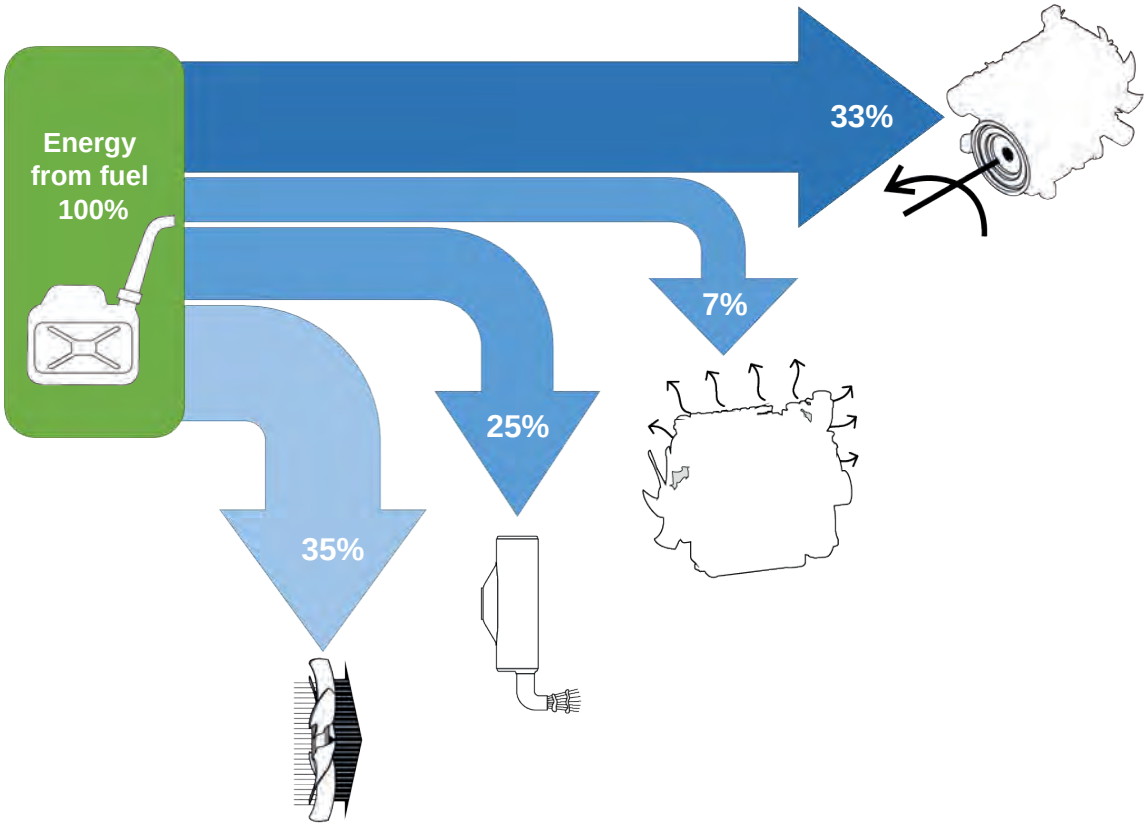
For the position of the overall center of gravity (engine with attachment):

$$x = \frac{l_3 - l_1}{1 + \frac{(G_A)}{(G_M)}} \; [m]$$

8.2.8 Installation of engines under a cover

Energy is supplied to the engine in the form of fuel.

The energy balance looks something like this:
Approx. 33% of the engine power available for effective work
Approx. 25% contained in the exhaust gas
Approx. 35% contained in the cooling air or cooling water
The remainder (approx. 7 %) is radiated from the engine surface



To successfully enclose a system, it is necessary to dissipate the radiated heat of the engine, the exhaust pipe and the applied machines from the engine compartment again. In most cases, the natural circulation of air through the fan is sufficient.

However, if the cooler is mounted away from the engine, forced ventilation is often necessary. It is important here that the air flowing through the fan can escape unhindered and that no heat buildup occurs in the engine interior.

An exhaust pipe lying in the air flow has proven to be effective here.

A temperature of maximum +80 °C should not be exceeded in the engine interior because sensitive (electronic) components can be impaired in their function or even damaged.

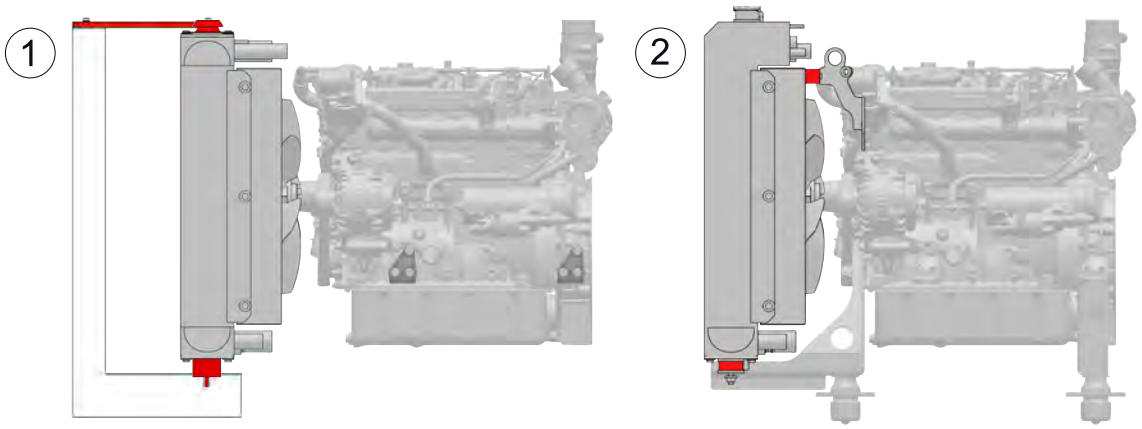
8.3 Engine cooling

The cooler and the coolant reservoir, hoses, seals, etc., **must not** contain **non-ferrous metals**, i.e. neither copper or zinc compounds.

8.3.1 General: Attachment of the engine radiator

The engine radiator must be decoupled from the engine vibrations.
The cooler (from HATZ) is permitted to be subjected to maximum vibration values of 5 g only.
With the Open Power Unit (OPU), the cooler is vibration-decoupled with rubber buffers ex-works.

If using third party coolers, please consult and come to agreement with the cooler manufacturer.

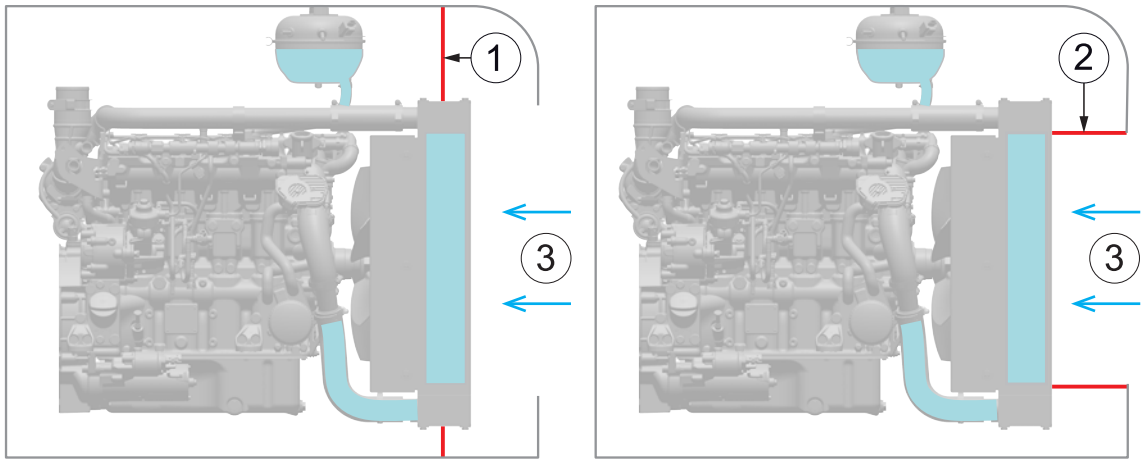


1	Fan2Flywheel (F2F)
2	Open Power Unit (OPU)

The engine cooler should be protected against external contamination. In addition, during installation ensure that accessibility for maintenance work is not restricted.

8.3.2 Installation under a cover

Example: extractor fan



1	Separation
2	Cooling air duct
3	Air flow

The connections of the separating plates to the cooler must be flexible in design (e.g. rubber sealing lip). The separating plates must not have an air gap to the cooler and must have a flexible range of min. 20 mm.

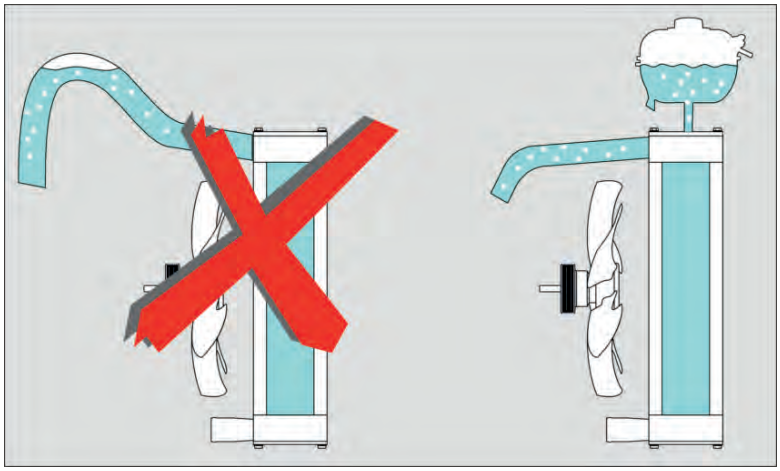
8.3.3 Cooling water hoses

Cooling water hoses in accordance with DIN 73411 / EPDM must be used.

Min. wall thickness of 4 mm, pressure resistance of 2 bar, temperature resistance of -40 °C to +120 °C.

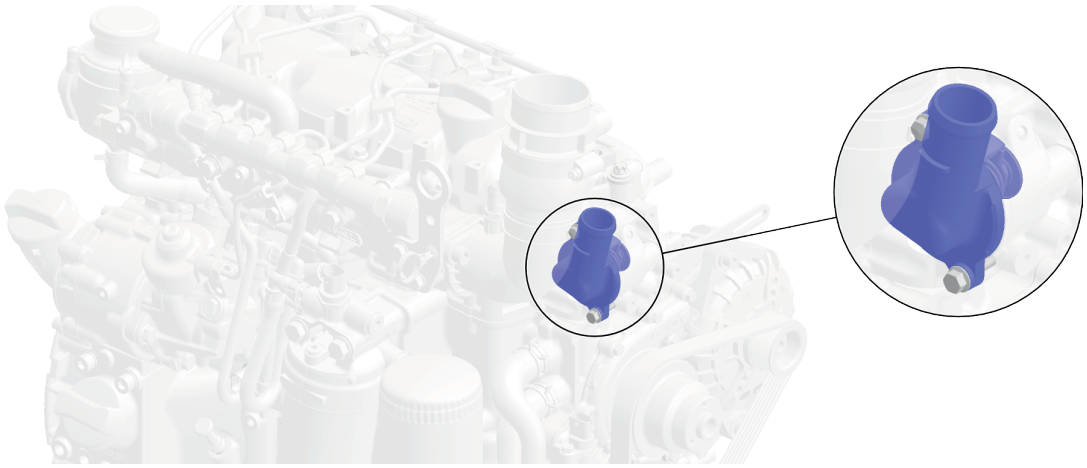
The use of nonferrous heavy metals is not permitted.

Avoid air pockets when laying the hoses.



8.3.4 Thermostat

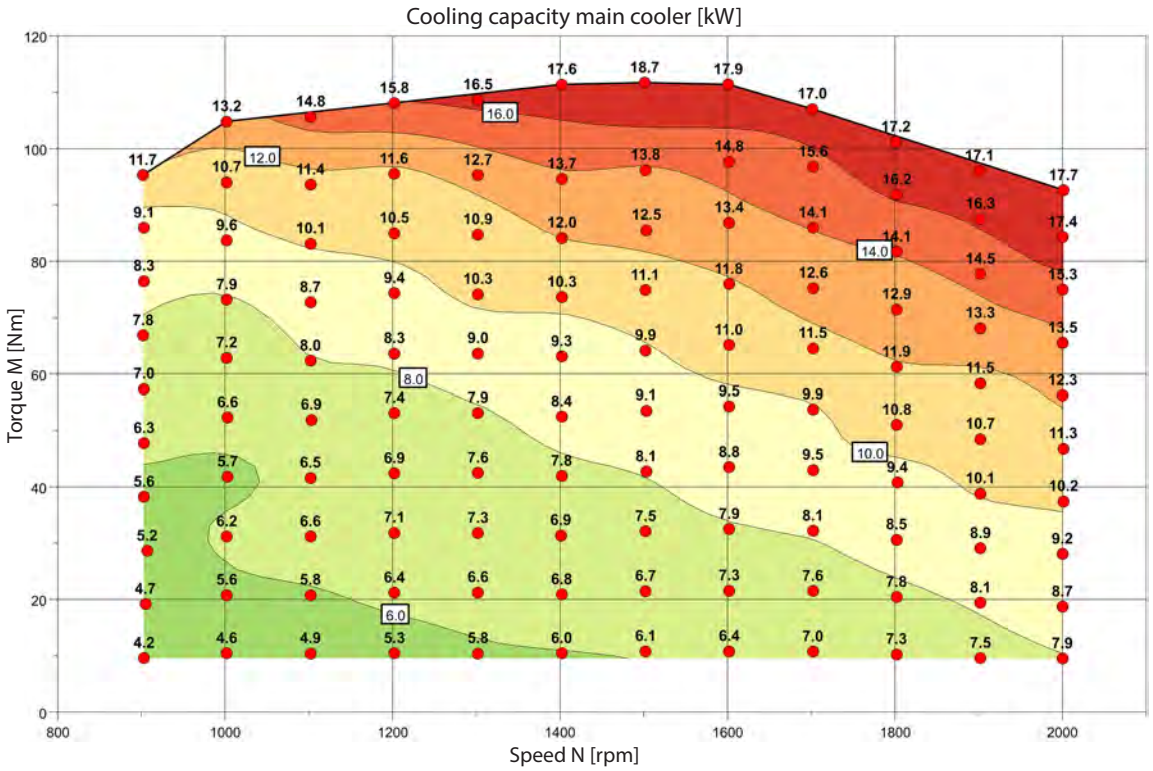
The wax element of the thermostat opens the coolant flow to the cooler at 80 °C and is fully open at 95 °C. The engine is thus kept in the optimum temperature range.

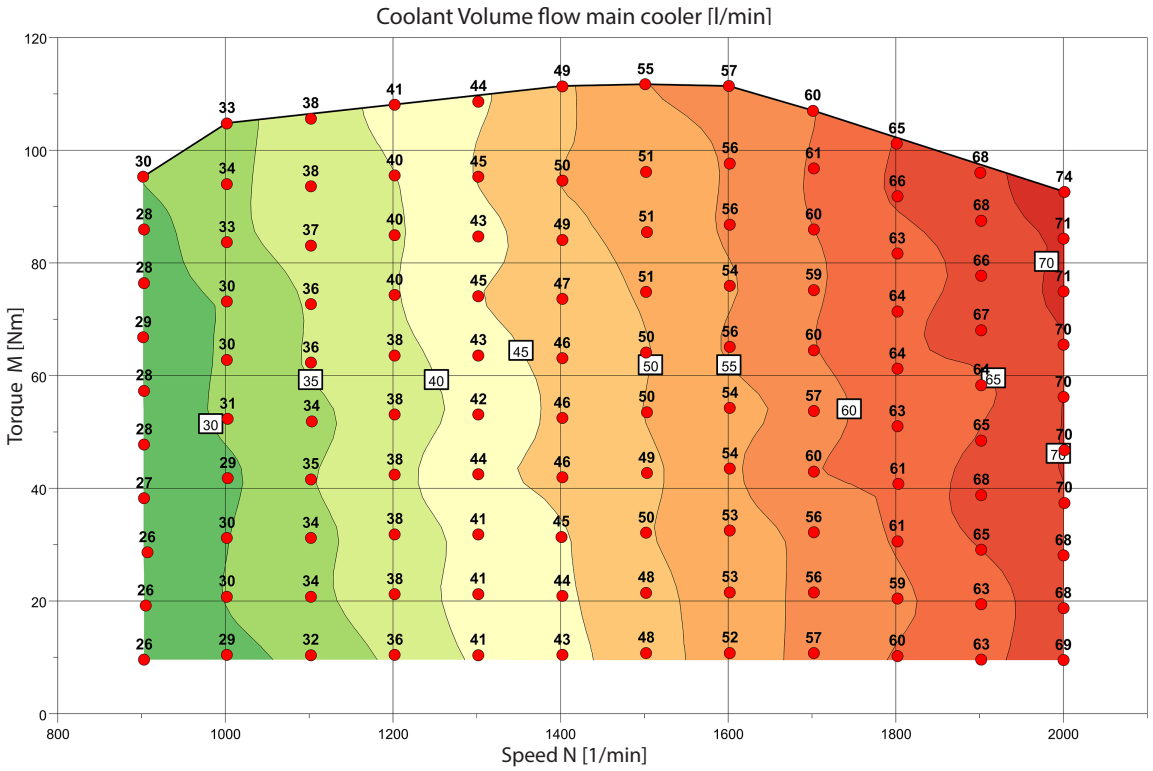


8.3.5 Amount of heat to be dissipated at the full load curve (100 % engine load)

NOTICE

In the design of the cooler, a reserve for efficiency losses amounting to 10–15 % should be taken into account due to soiled coolers.

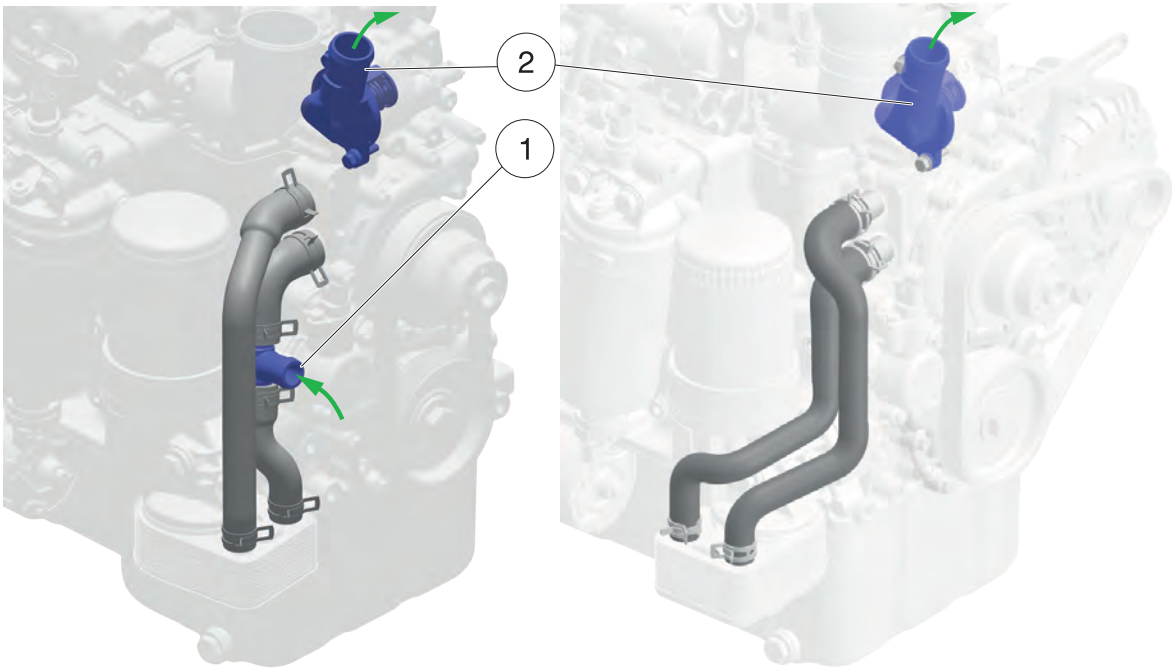




8.3.6 Engine radiator

Maximum coolant temperature T_{max} is 110 °C. Warning "high coolant temperature" from 105 °C.

Water circuit piping



Pos.	Transfer point	Connection diameter [mm]
1	T-piece of cooler	Outside diameter 22
2	Thermostat for cooler	Outside diameter 32

Expansion tank

The capacity of the expansion tank should be approx. 20% of the total cooling water quantity.

At this expansion tank size, it must be ensured that there is an overpressure of 0.3 bar upstream of the water pump when the thermostat is open (95 °C cooling water outlet temperature at the engine).

Positioning of the expansion tank

As a rule, it is adequate for the Min marking of the expansion tank to be above the highest component that is immersed in water (cylinder head).

In order to gain a little safety, however, the Min marking should be located "significantly" above this point. If the expansion tank is mounted above the cooler, this is quite sufficient.

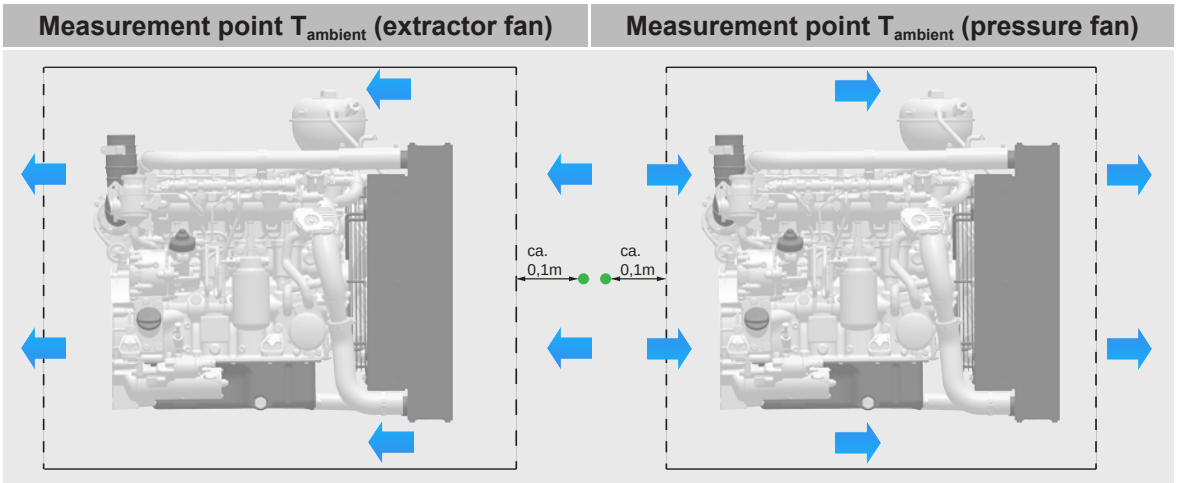
Higher installation situations of the expansion tanks are preferable.

8.3.7 Design / Dimensioning

Determination of thermal energy to be dissipated

See chapter *8.3.5 Amount of heat to be dissipated at the full load curve (100 % engine load), page 46*.

Determining the maximum ambient temperature



The temperatures are determined with the machine operating at full load, where the coolant liquid thermostat must be bridged (widened thermostat with full opening). With the exhaust fan, the air temperature is determined at the cooling air inlet in the engine compartment.

The formula can be used to calculate the maximum ambient temperature up to which the installed cooling system can be used.

Example:

$T_{ambient}$ = 7 °C
$T_{coolant}$ = 60 °C
T_{max} = 105 °C

$$T_{ambient\_max} = T_{ambient} + (T_{max} - T_{coolant})$$
$$T_{ambient\_max} = 7°C + (105°C - 60°C)$$
$$T_{ambient\_max} = 52°C$$

$T_{ambient}$	Ambient temperature (see measurement point)
T_{max}	The **maximum temperature** is 110 °C, calculated design on the warning threshold 105 °C
$t_{coolant}$	Coolant temperature in full load test
$T_{Ambient\_max}$	Maximum ambient temperature

The cooling system can be used up to an ambient temperature of 52 °C.

8.4 Fuel system

8.4.1 Fuel

DANGER

Fire hazard from fuel.

Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries.

- Only refuel when the engine is switched off and has cooled down.
- Never refuel in the vicinity of open flames or sparks that can cause ignition.
- Do not smoke.
- Do not spill fuel.

CAUTION

Danger of engine damage from low quality fuel.

The use of fuel that does not meet the specifications can lead to engine damage.

- Only use fuel that is very low in sulfur or that contains no sulfur at all.
- The use of fuels that do not meet specifications require approval by Motorenfabrik HATZ (main plant).

NOTICE

Max. permitted fuel temperature is +80 °C. If exceeded, the engine switches to the engine emergency run program. Therefore, place the tank in a cool area of the machine.

Even trace amounts of zinc, lead and copper can lead to deposits in the injection nozzles, which is why elements containing zinc, copper or lead are not permitted to be used in the fuel system.

Zinc flake coating and hot-dip galvanizing produces a bare zinc surface and must be avoided.

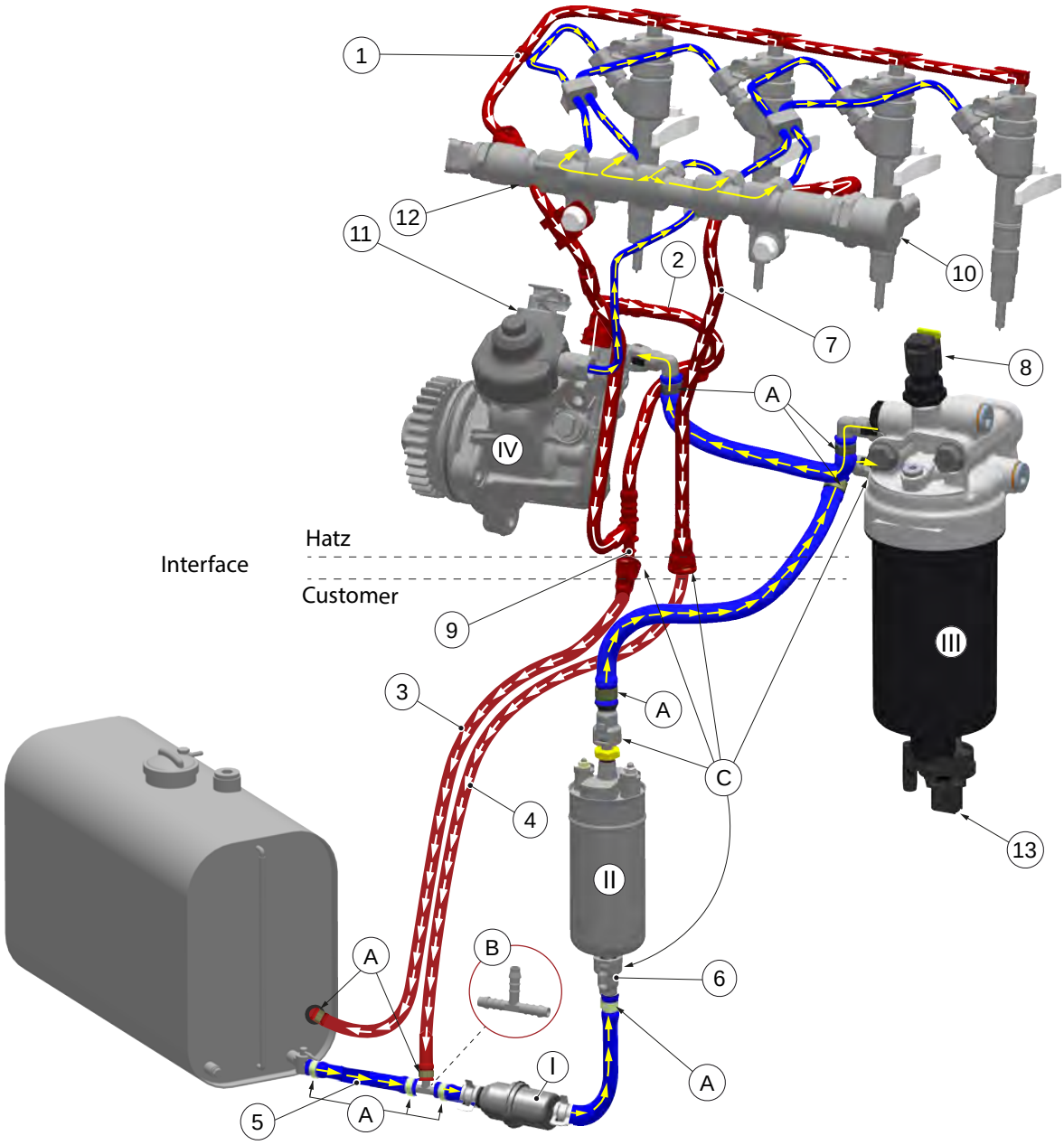
- Zinc ions lead to accelerated clogging of the injection holes in the injectors.
- Copper acts as a catalytic converter and massively lowers the fuel oxidation stability in combination with the FAME (**F**atty **A**cid **M**ethyl **E**ster) content in modern fuels of up to 7 %. This also causes injection nozzles to clog more rapidly with combustion residue.

Galvanized (passivated) components may be used.

8.4.2 Fuel specification

See the **Diesel Engine Manual**.

8.4.3 fuel circuit diagram



1	Injector return
2	High-pressure pump return
3	Return to tank
4	Return to prefilter
5	Supply from tank
6	Measuring point for fuel feed pump supply
7	Rail return
8	Low fuel pressure and temperature sensor
9	Measuring point for return to tank
10	Pressure control valve
11	Metering unit (→volume control valve)
12	Common rail
13	Water separator (with water in fuel sensor)

Installing fuel lines

The connection points of the fuel lines must be fixed at the T-connector (B) – supply from the tank (5), return from the rail to the pre-filter (4) and the connecting line to the fuel prefilter – with suitable hose clamps (A).

It must be ensured that all other connections of the fuel lines, which are also mounted by the customer, are secured using suitable hose clamps (A), with the exception in the following **note** and **figure**.

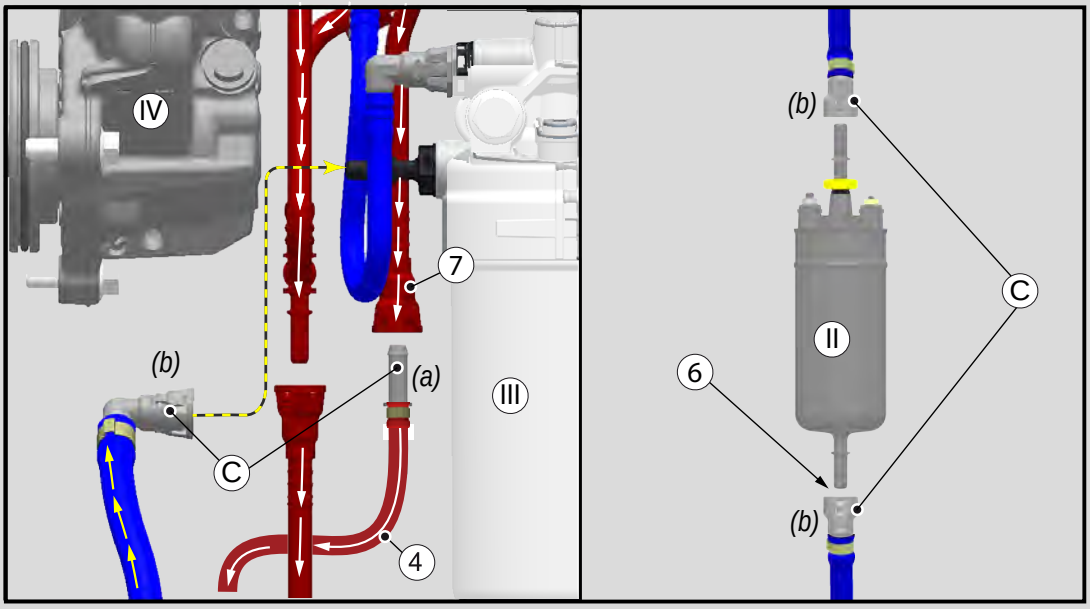
Spring band clamps are recommended on the fuel prefilter (I) due to easier maintenance.

After installation, a leak tightness test must be performed on all lines.

I	Fuel prefilter
II	Electrical fuel feed pump
III	Main fuel filter
IV	High-pressure pump
A	Hose clamps
B	T connection piece
C	Adapter (a) / QuickConnector (b) - (optional)

Note: If the customer does not use the following adapter (C) from Hatz, the customer is responsible for ensuring that a fitting adapter (a) / QuickConnector (b) is used for the fuel hoses (customer side).

Any other connection of the fuel supply line to the main filter (III) and the connection of the return rail (7) with the return to the prefilter (4) is not permissible!



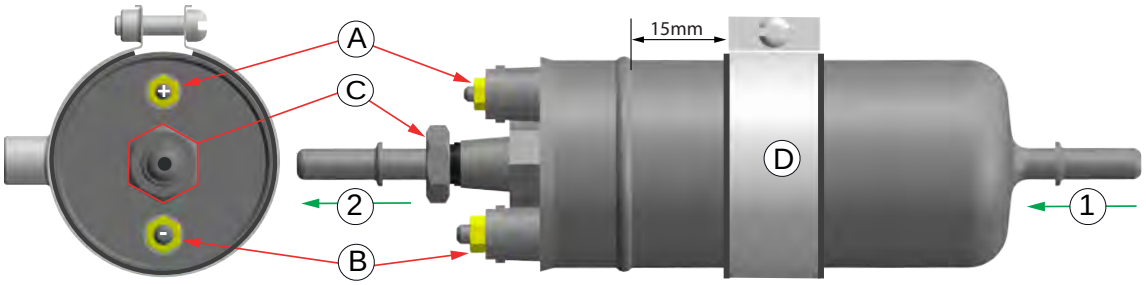
Fuel line specification: DIN 73379-8x3-A6, DIN 73379-8x3-B1 or better.

8.4.4 Electric fuel pump

Technical data

Rated and test voltage	12 V
*Supply/return length with Ø 8 mm	Max. 5 m
Permitted negative pressure at delivery pump	0.3 bar (tank level and flow resistance of line/loaded pre-filter) pos. 6
Feed pressure	4.5 bar (can be read via diagnostics) pos. 8
Engine stop	≤ 1.5 bar
Required return flow rate	At least 80 l/h (measuring point pos. 9)
Pmax	7 bar
Max. pressure in return	0.3 bar (measurement point for return pressure) pos. 9

**The specified pressures and volumes are important in all cases.*



Pos	Tightening torque connections for electrical fuel pump 12 V
A	(M4) 1.2 Nm
B	(M5) 1.6 Nm
Tightening torque of screw-in fitting	
C	(M8) 20 – 24 Nm
1	Intake side
2	Pressure side

The electric fuel feed pump is mounted with a rubberized fastening clamp (D). The clamp must be fastened at distance of at least 15 mm from the bead.

Mounting of the fuel pump directly on the engine is not permitted due to engine vibrations!

NOTICE
For engines with 24-V equipment, a **DC/DC converter** is used to regulate the voltage for the engine control unit C81 and the fuel feed pump down to 12 V. If a **customer-supplied fuel pump** is used, make sure that the pump is rated for 12 V.

**Current consumption of DC/DC converter in standby mode < 2 mA.*

8.4.5 Rail pressure control

Position fuel prefilter (I) and fuel feed pump (II) as close as possible to the tank.. Since the engine has a special cold-running control, no fuel filter heating is necessary.

- **Rail pressure control as fuel heating**

During a cold start, the high-pressure pump (IV) delivers the maximum possible flow rate into the rail (12), thus heating the fuel. Excess fuel is drained through the pressure control valve (10) and returned to the fuel supply (5) via the return rail (7) and return to the prefilter (4). This control works like a filter heater.

Once the fuel is heated sufficiently, the delivery amount is regulated back to the actually required amount via the metering unit (11).

This control is deactivated when the fuel temperature exceeds 15 °C and is reactivated when the fuel temperature during operation drops below 10 °C.

- **Rail pressure control during normal operation**

During normal operation, the fuel supply to the high-pressure pump (IV) is controlled by the metering unit (11). Consequently, only the necessary amount of fuel is delivered to the rail (12) and the pressure control valve (10) can remain closed. This avoids excess heating of the fuel and power loss.

8.4.6 Fuel filtration

During initial start-up, the ignition key must be turned to the "ignition on" position so that the fuel feed pump (II) fills the fuel main filter (III) with fuel and forces the air out of the system. This is important because air bubbles in the fuel system damage the high-pressure pump (IV). See chapter **"Starting the engine for the first time/after a filter change" in the Diesel Engine Manual"**.

8.4.7 Fuel main filter

NOTICE

The fuel line between the high-pressure pump and the main fuel filter must never be detached.

WARNING

Danger of injury due to fuel splashes.

Fuel can exit under pressure when the main fuel filter is removed.

- Carefully remove the main fuel filter.
- Wear safety goggles.

Due to the different ways of storing fuel in the various fields of application, the fuel cleanliness cannot always be guaranteed. Condensation and deposits can occur in the fuel. For this reason, a fuel main filter (III) with a water separator (and water in the fuel sensor) pos. 13 is required.

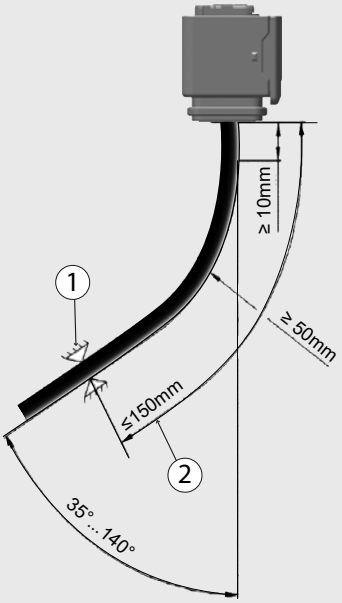
The engine may only be operated with HATZ main fuel filters! Use of products from other manufacturers is not permitted! The water in fuel sensor contained inside is integrated in the engine control unit (ECU). See chapter *8.4.3 fuel circuit diagram, page 50*.

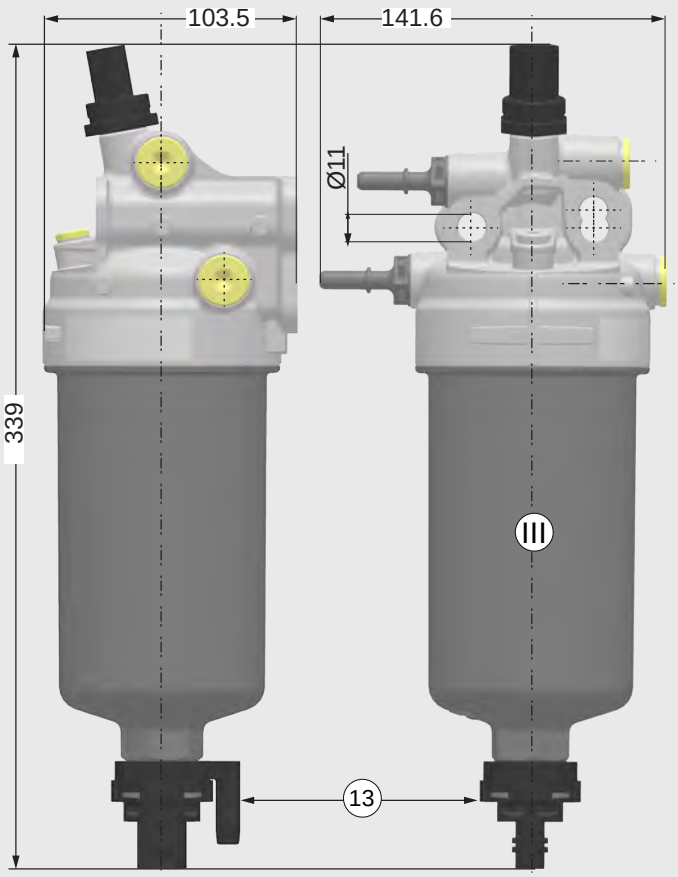
Fuel line installation instructions:

No non-ferrous metals, copper, lead nor zinc compounds are permissible in the tank, lines, gaskets and delivery pumps.

Exception:

Galvanized components with a passivated surface may be used.





Separated volume until signal:

135 cm³ to min. 0° tilt position,

60 cm³ to max. 30° tilt position

1	Support point on the unit support
2	Length up to support point

8.4.8 fuel tank

DANGER

Fire hazard from fuel.

Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries.

- Only refuel when the engine is switched off and has cooled down.
- Never refuel in the vicinity of open flames or sparks that can cause ignition.
- Do not smoke.
- Do not spill fuel.

CAUTION

Danger of environmental damage from spilled fuel.

Do not overfill the fuel tank and do not spill fuel.

- Collect any leaking fuel and dispose of it according to local environmental regulations.

When a fuel tank is installed, make sure that it does not have any processing residues, impurities, water, etc.

A discharge port must be provided at the lowest point on the fuel tank to drain water and dirt when needed. The reason for this is deposits and fuels with FAME content.

Due to the penetration of water (hygroscopic action of FAME) in the fuel tank, biocultures (fungi) can occur in the transition layer between the fuel and water.

This can cause damage to the injection system, which can lead to failure of the system. It is therefore imperative to keep the fuel tank clean.

This also applies to the fuel main filter, for which (despite the water in fuel sensor) the maintenance intervals must be carried out in accordance with the **Diesel Engine Manual**. This is especially the case before extended storage periods (e.g., winter breaks).

NOTICE

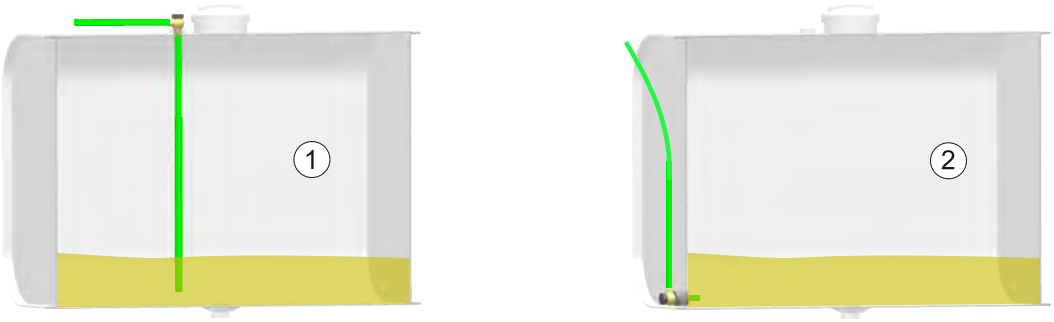
If possible, never run the fuel tank empty, otherwise air can enter the fuel system and the engine switches to the emergency program.

Furthermore, there is a risk of damage being caused in the fuel high-pressure area. A fuel level sensor should be implemented (possibly several warning levels) in order to exclude possible damage in advance.

Tank variants

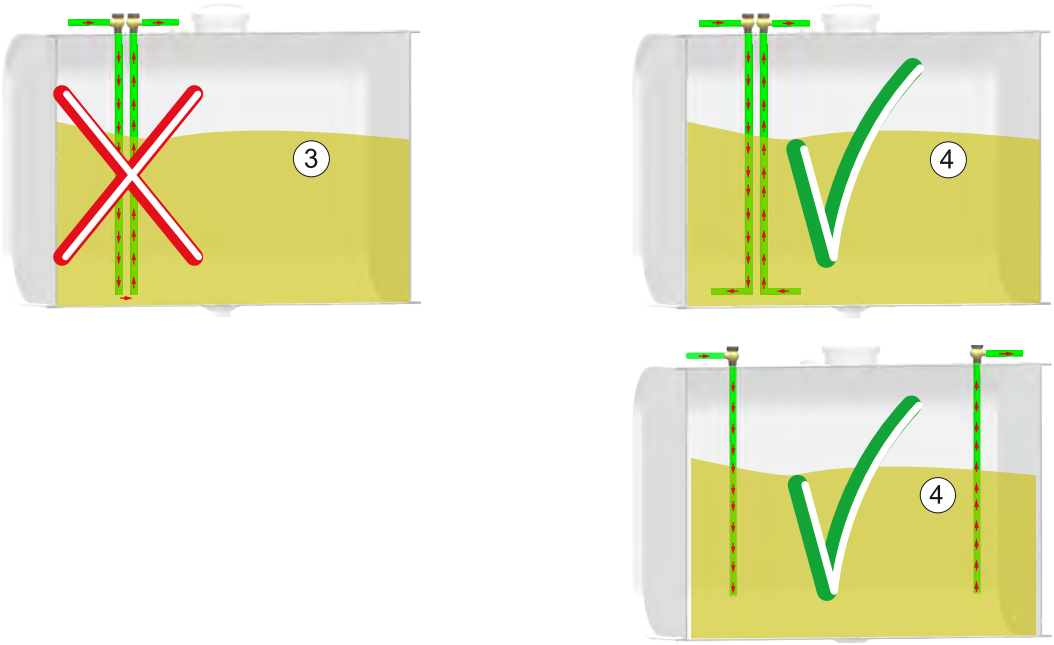
The **fuel return line to the tank must be introduced under the fuel level** to prevent the lines from emptying. If this is not possible, a check valve must be installed. The permissible pressures must be observed; see section *8.4.4 Electric fuel pump, page 52*.

A check valve in the fuel supply before the electric fuel pump (EFP) is not permitted.



1	Return at the top (with standpipe)
2	Return below the fuel level

The **distance between the supply and return lines** should be as large as possible. It absolutely must be avoided that the warm fuel of the return line can enter into the supply line (thermal short circuit).



3	Supply and return flow – wrong!
4	Supply and return flow – right!

8.5 Exhaust system

CAUTION

Danger of burns from hot exhaust gas systems.

Hot surfaces on the entire exhaust system! Keep explosives and flammable materials away from the engine.

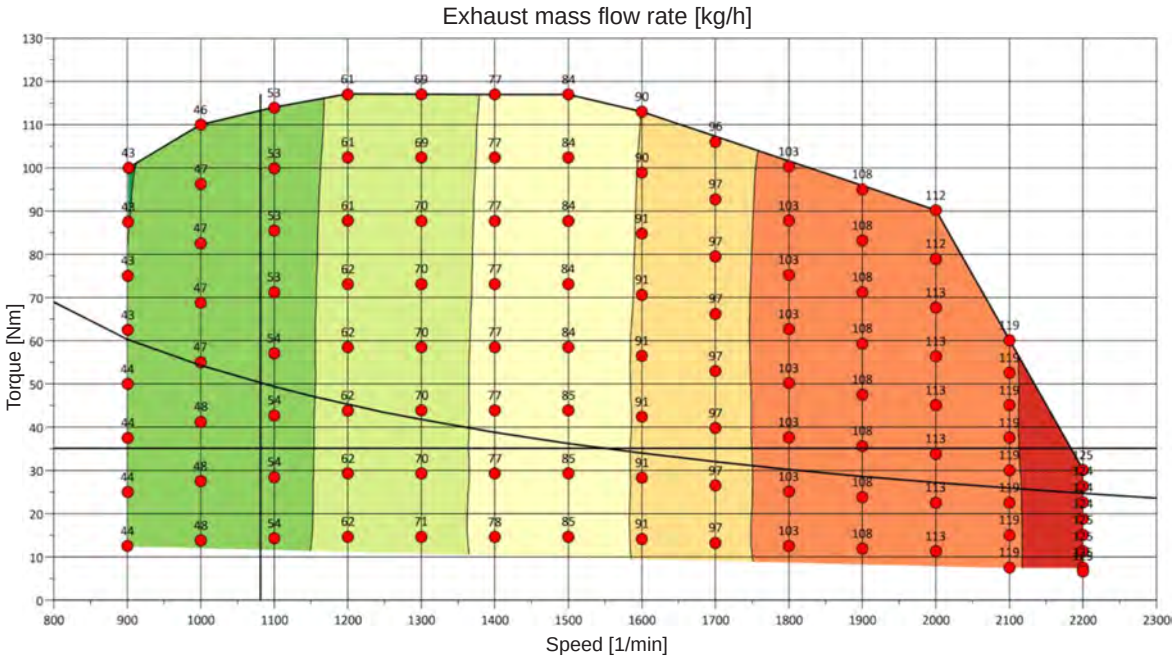
- Attach the protective device.
- Wear safety gloves.

NOTICE

The machine manufacturer is obligated to ensure that all safety precautions have been taken in the complete machine so that injuries from hot surfaces can be ruled out. Hatz can deliver a variety of safety devices. See chapter Contact protection for machine safety.

8.5.1 Exhaust mass flow rate

Engine type	Speed [1/min]	Max. exhaust gas mass flow (moist) [kg/h]
4H50N/NO	2000	112



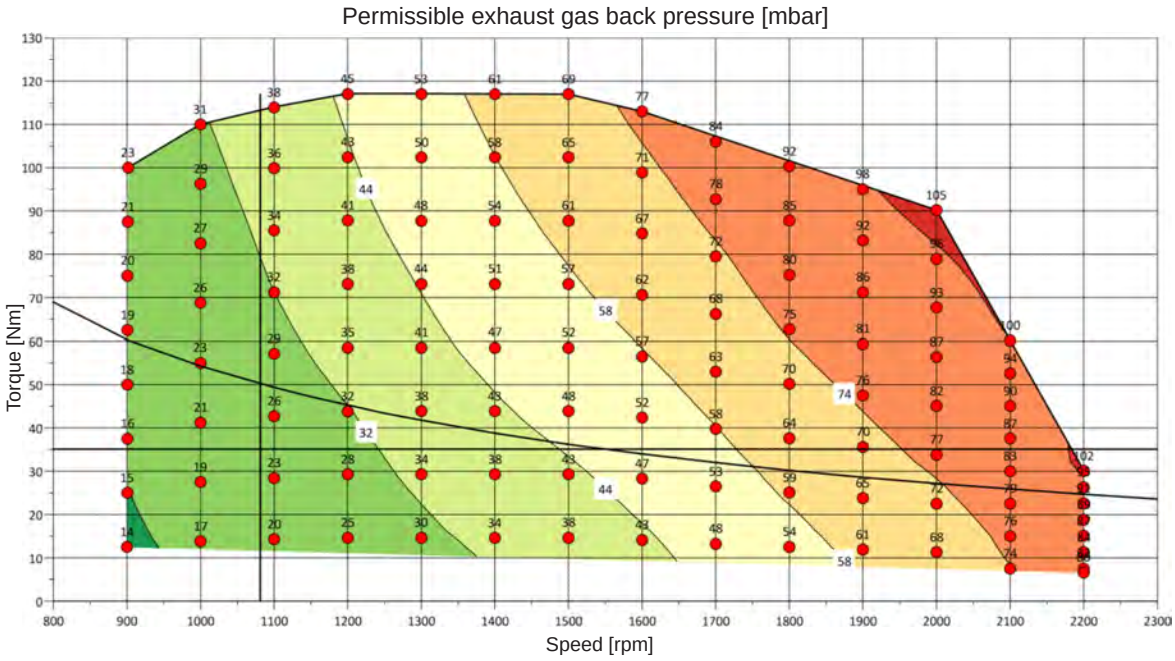
8.5.2 Permissible exhaust temperature

For the **4H50NO**, a minimum exhaust temperature of **Texh min ≥ 220°C** must be maintained under the following operating conditions at the DOC intake:

- Speed 1200 – 2000 rpm
- Torque 40 Nm

8.5.3 Permissible exhaust gas back pressure

If additional silencers are used, but also if the exhaust gas is transferred from the engine compartment through pipe elbows or flexible lines, pay attention to the permissible exhaust back pressure.



8.5.4 Recommended dimensioning of the exhaust gas system

The design of the exhaust gas system is based on the exhaust gas back pressure specified in chapter *8.5.3 Permissible exhaust gas back pressure, page 58*.

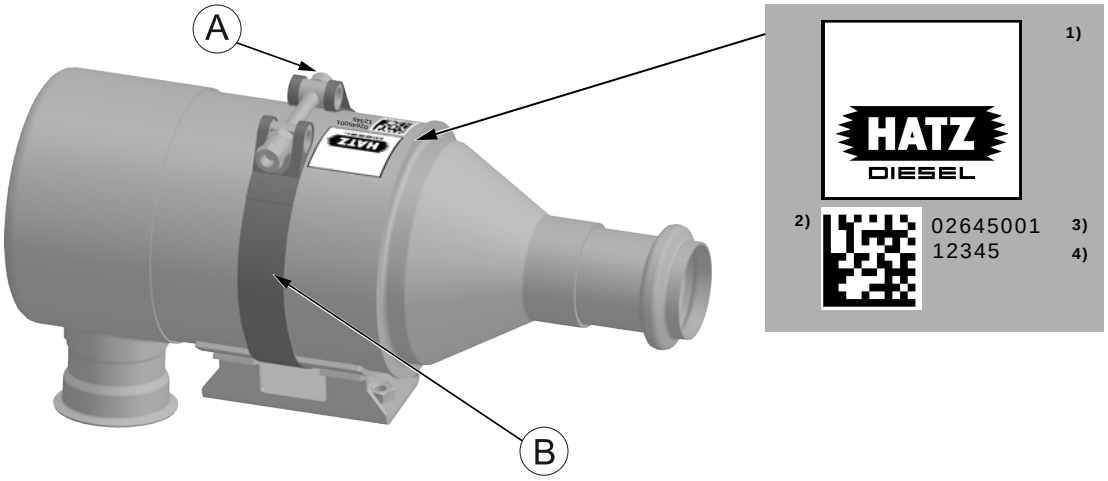
The recommended pipe diameter for the continuation of the exhaust pipe of the DOC corresponds to the inside diameter of the DOC outlet (Ø 41.5 mm) and must not be undercut.

It should be noted that pipe elbows from 45° significantly affect the exhaust gas back pressure.

8.5.5 Exhaust pipes – DOC installation (chassis-fixed)

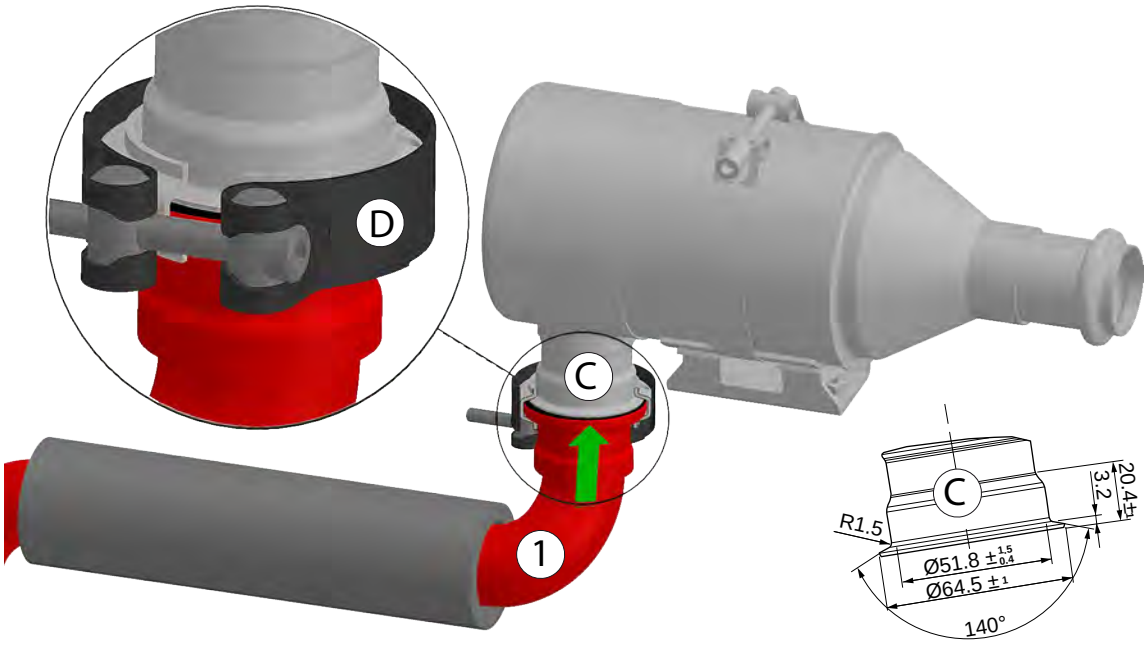
Procedure

Step	Description
1	**The diesel oxidation catalyst (DOC) is premounted!** The DOC is premounted. If a position correction is necessary, the DOC can be brought into the desired position by slightly loosening the cylinder head screw (A) and loosening the flat band clamp (B). Then tighten the socket head cap screw to a tightening torque **13–15 Nm** .

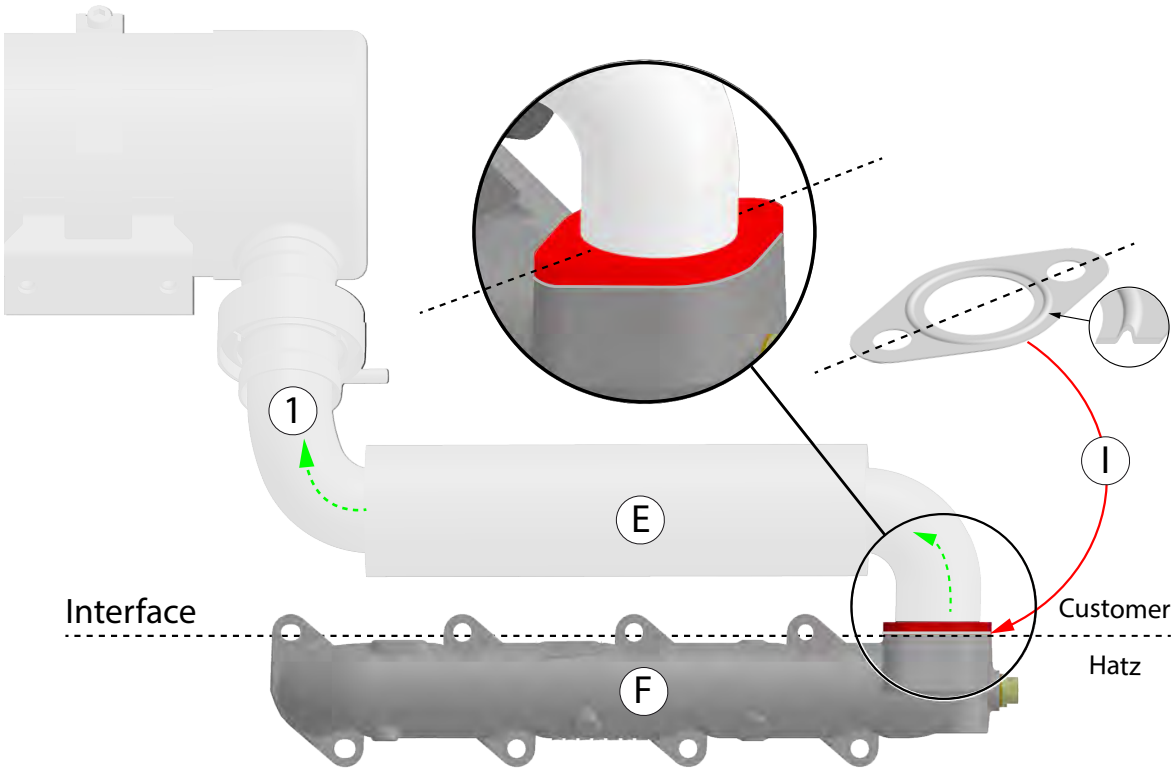


[1] Hatz logo, [2] Data matrix code, [3] Hatz article no., [4] Date of manufacture

2	**Installing the exhaust pipe downstream of the exhaust manifold and upstream of the DOC inlet** Connect the exhaust pipe (1) to the DOC inlet (D) and fasten with a suitable V-band clamp (E) according to the manufacturer's specifications.

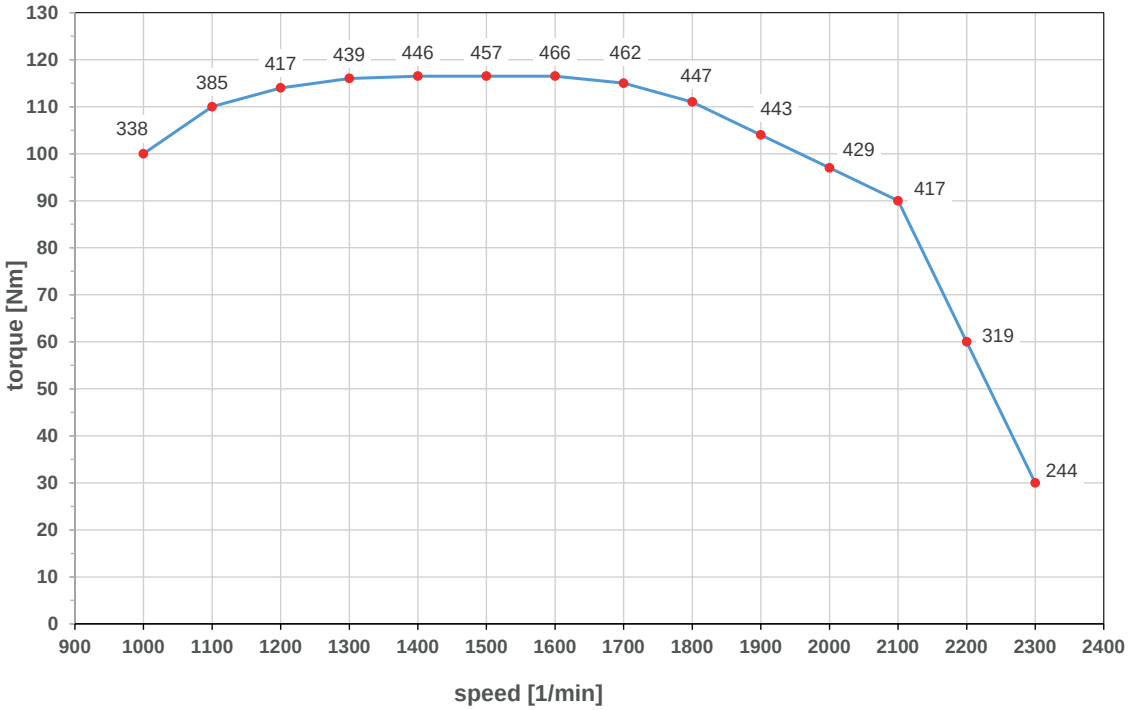


3	**Installing the exhaust pipe on the exhaust manifold** Screw exhaust pipe (1) with compensator (E) to exhaust manifold (F) using 2 x M8 screw connection (max. screw-in depth in exhaust manifold 16.5 mm), to a tightening torque of 25 Nm.



Minimum exhaust gas temperature T [°C] at DOC inlet:

Ambient conditions: temperature 20–25 °C, ambient pressure 950–1000 mbar. (Values for other loads and speeds on request.)



Installation recommendation for piping length and insulation at which the minimum exhaust gas temperatures are to be reached:

- The piping (1) between the exhaust manifold (F) and the DOC inlet may be max. 1.5 m long and contain 3 pipe elbows.
- The pipes must be insulated with suitable heat resistant material and must meet the following characteristics:
  - Stable at continuous temperature up to 450 °C, short-term 550 °C
  - U-value ≤ 6 W/(m²*K)

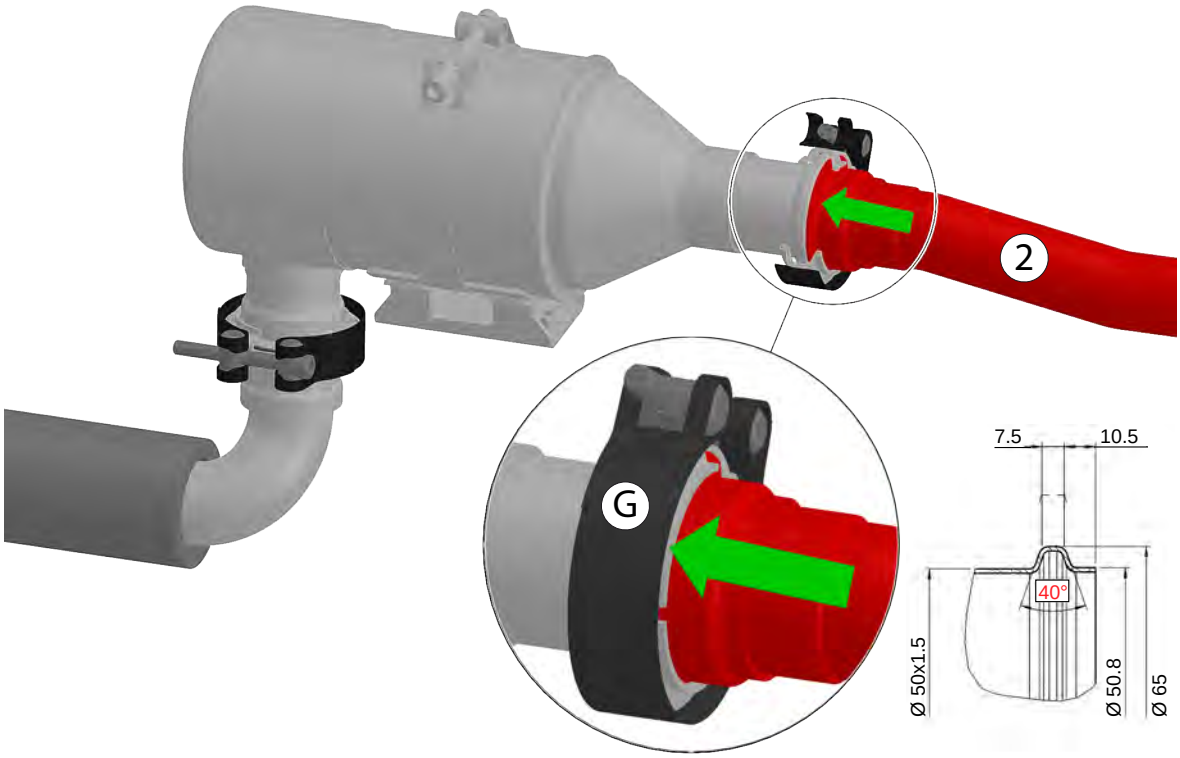
It is important to note:

- A maximum 90° bend may be used after the exhaust manifold, after which a long compensator (E) (at least 200 mm flexible length) must follow. The compensator must be attached close to the pivot point of the flexible mounting. A fixed point is required after the compensator.
- The pipe diameter must not be constricted.

	CAUTION
	The exhaust pipe between the engine and the diesel oxidation catalytic converter must be gas tight. Max. 5 l/min are permitted to escape between the exhaust manifold and the diesel oxidation catalytic converter. To be able to maintain this value, we recommend using a beaded gasket (I).

	NOTICE
	Note the radiation heat from the exhaust systems.

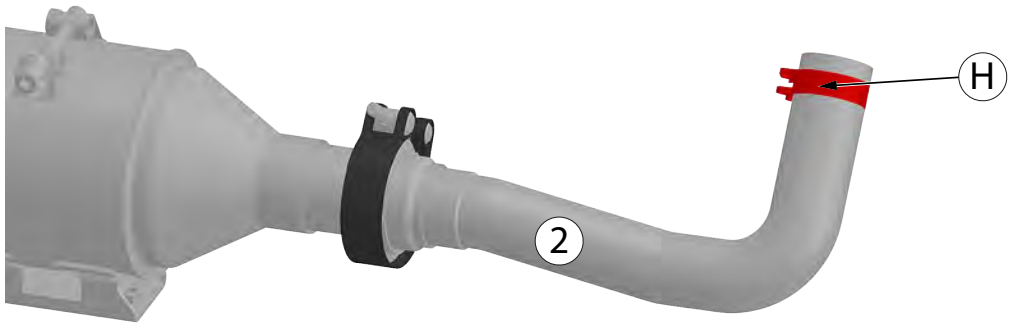
4	**Installation of the exhaust pipe after the DOC inlet** Insert the exhaust pipe (2) into the DOC outlet and fasten with a suitable V-band clamp (G) as per the drawing or the manufacturer's specifications.



It is important to note:

- In the case of long exhaust pipes, the conductor cross-section must not be constricted after the DOC outlet under any circumstances.

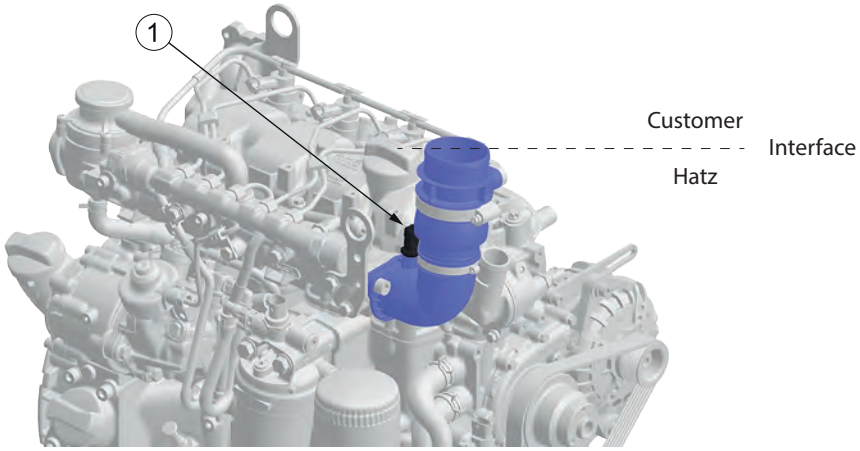
5	**Strain relief of exhaust pipe DOC outlet** To relieve the DOC, the exhaust pipe (2) must be fastened to the chassis at the DOC outlet immediately downstream of the first pipe elbow using a suitable fastening clamp (H). If necessary, use another fastening clamp.



It is important to note:

- Prevent water from entering the exhaust pipe, e.g., by means of flaps or suitable pipe elbows at the end.
- In long exhaust pipes and in engines at low load, the exhaust gas condenses. A condensate drain is urgently required here, which must be located at the lowest point of the exhaust system. The condensate can thus flow off with the help of gravity.

8.5.6 Intake and combustion air system



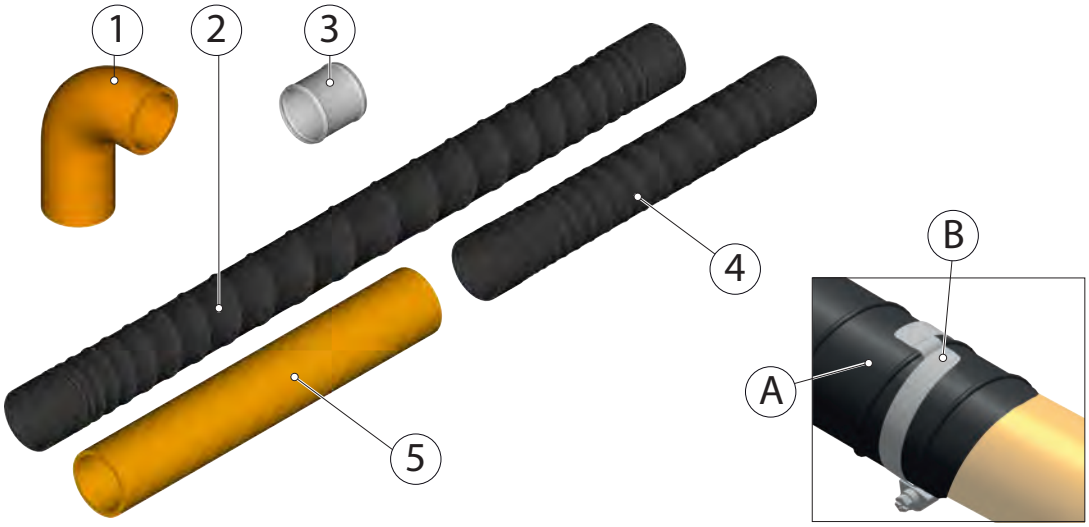
		Variable speed								
Speed (rpm)		1200	1300	1400	1500	1600	1700	1800	1900	2000
Perm. intake vacuum [mbar]		24	28	31	35	40	44	49	54	59
Pos. 1	Measurement point (temperature sensor) for intake vacuum									

8.5.7 Intake section

	CAUTION
	Note the following regarding hoses with spiral wire inserts: ▪ In very dusty and dirty environments, the hose needs to be checked regularly for leaks. ▪ The hose is very thin between the spirals (1.5 – 2 mm). Do not touch with sharp or pointed objects. ▪ Because the hose has low strength, no pressure is permitted to be applied to the hose. ▪ Minimum bending radius = 105 mm ▪ The hose has good resistance to oil, but is not approved for permanent contact with oil.

Leaks on the clean air side must be avoided. The intake line must be resistant to the pulsation in the intake air and to the engine vibrations. For example, a hose with a spiral wire insert would therefore be suitable as the line material.

The following hoses can be used upstream of the air filter as well as between the air filter and turbocharger.



1	Hose elbow 90°	Ø 70 mm
2	Flexible hose piece, cannot be shortened	Ø 70 x 1000 mm
3	Connecting sleeve	Ø 70 mm
4	Flexible hose piece, cannot be shortened	Ø 70 x 500 mm
5	Rigid hose piece, can be shortened	Ø 70 x 500 mm

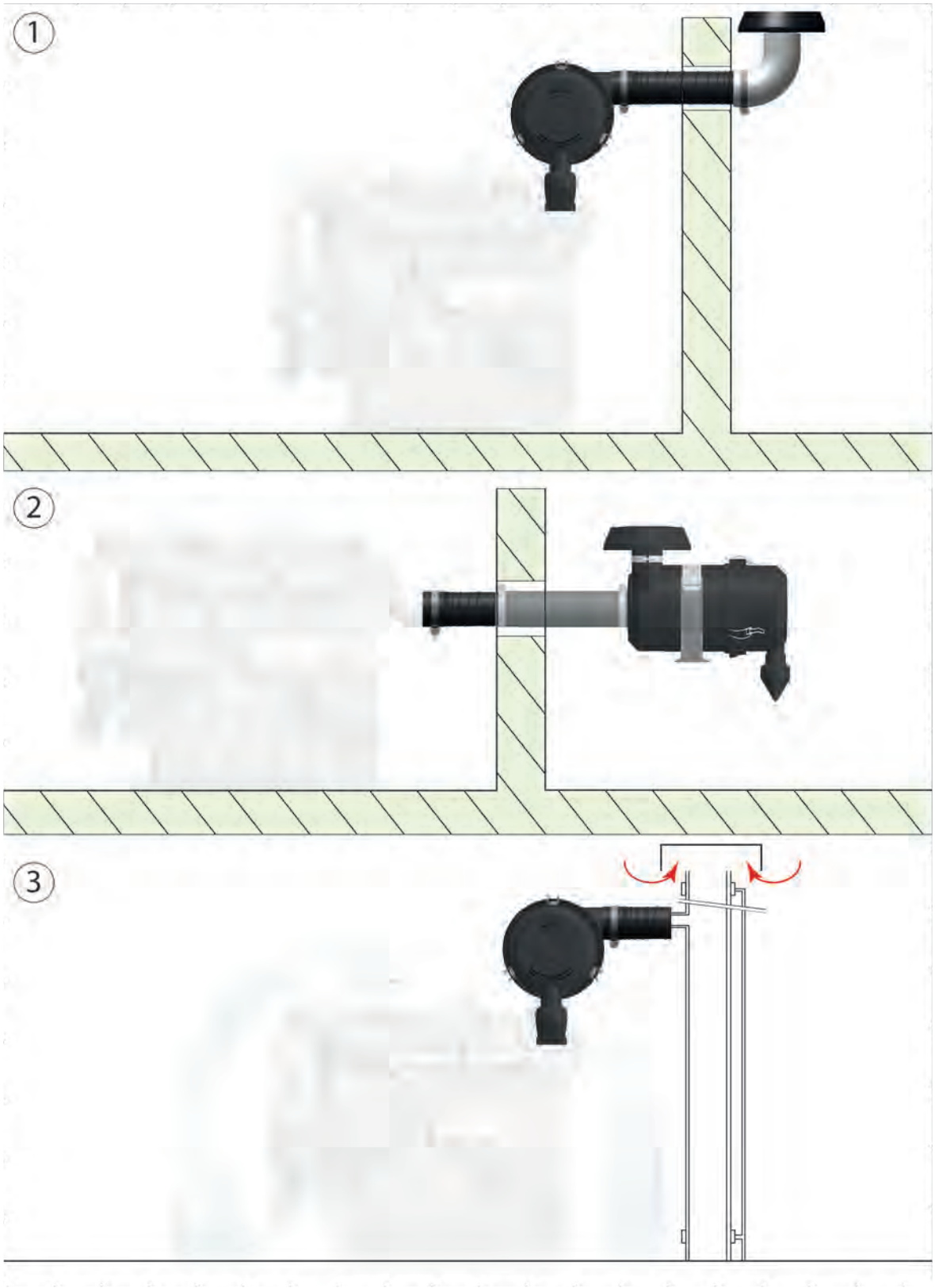
For radii greater than 45°, make sure the radius is as large as possible to prevent the boot from chafing the pipe. If a large radius cannot be realized, it is also possible to use an intermediate piece (90° pipe elbow).

If necessary, the air supply line must be supported, depending on the length, with suitable fasteners in order to avoid damage to the intake system.

	CAUTION
	The intake system line **must be gas-tight**.

	NOTICE
	If the spiral insert of the hose (A) goes all the way through, a simple hose clamp cannot be used to create a gas-tight connection. For this reason, such hoses can only be used in combination with a spiral hose clamp (B).

Intake section – possible variants



1	Recommended variant
2	Alternative variant
3	To increase the service life of the filter, the opening for the intake air must always be located in the zone with the least dust. Also, the intake opening must be protected against splash water and rain by a rain cap.

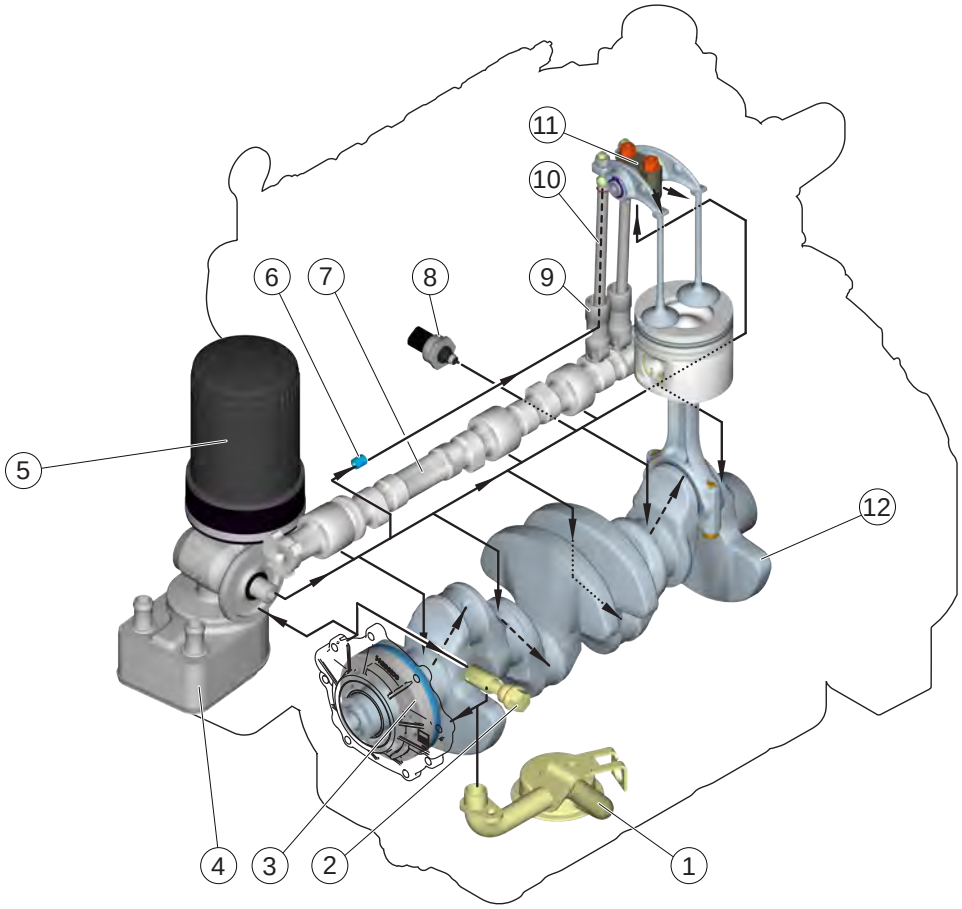
8.6 Engine oil

For operating the engine, it is important that the dipstick, oil filler, oil drain and oil filter are all easily accessible. If necessary, extensions are required for the oil filler and oil drain.

A tip: On the sample machine, try checking the oil level, filling in oil, draining the oil and changing the oil filter yourself. Only if you are convinced of the ease of carrying out this work will the series machine be maintained later in accordance with the Diesel Engine Manual.

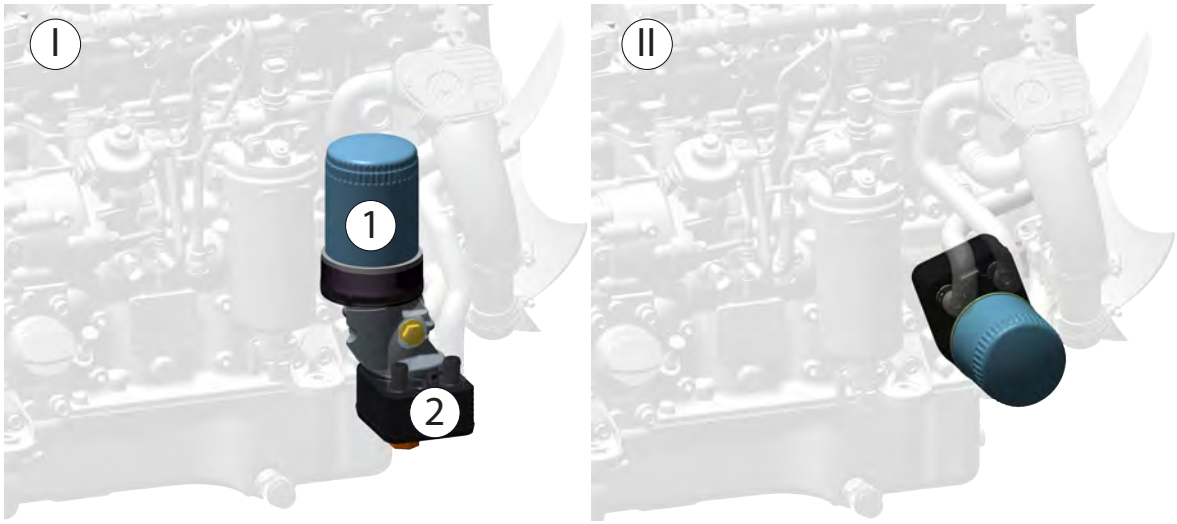
For information on oil specification and oil viscosity, see the **"Technical data - Engine oil" chapter of the Diesel Engine Manual.**For information on the **oil filling quantity,** see chapter Engine information and filling quantities.

8.6.1 Lubricating oil system



Pos.	Designation	Pos.	
1	Oil suction pipe	7	Camshaft
2	Oil overpressure valve	8	Oil pressure sensor
3	Oil pump	9	Roller tappet with hydraulic valve adjustment
4	Oil cooler	10	Push rod
5	Oil filter	11	Bell crank support with spray nozzles
6	Oil check valve	12	Crankshaft

8.6.2 Oil filter mounting options



I	Vertical mounting position (if the oil cooler is vertical, the mounting position must be lowered).
II	Horizontal mounting position (standard)
1	Oil filter cartridge
2	Oil cooler

8.6.3 Filling quantity

For more information on the engine oil capacity, see chapter *5.1 Engine information and filling quantities, page 20*.

8.6.4 Engine oil service points

⚠ CAUTION

Danger of burns.

When working on the engine, there is a danger of burns from hot oil.

- Wear personal protective equipment (gloves).

⚠ CAUTION

Danger of environmental damage from spilled used oil.

Used oil is water-polluting.

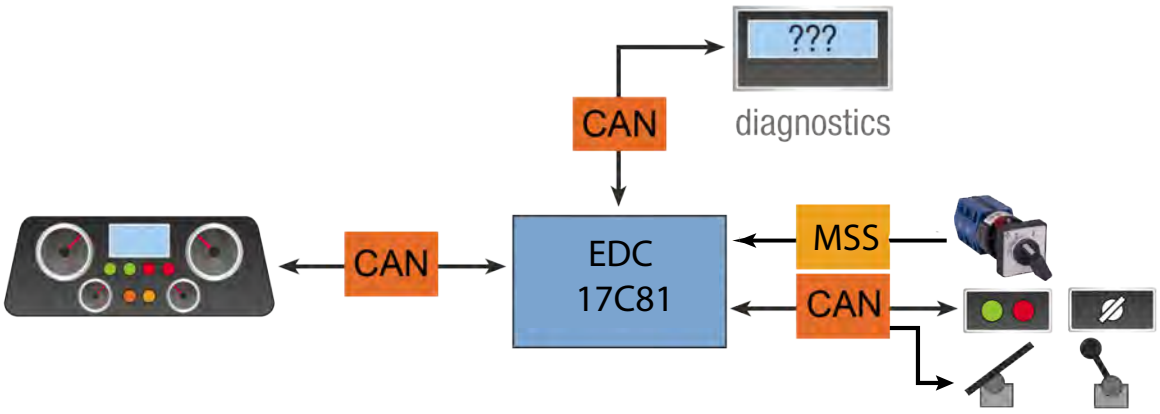
- Do no allow them to enter the ground water, water bodies, or sewage system.
- Collect the used oil and dispose of it according to local environmental regulations.

Information on the service points and maintenance intervals is contained in chapter .

9 Electrical system

9.1 Engine control

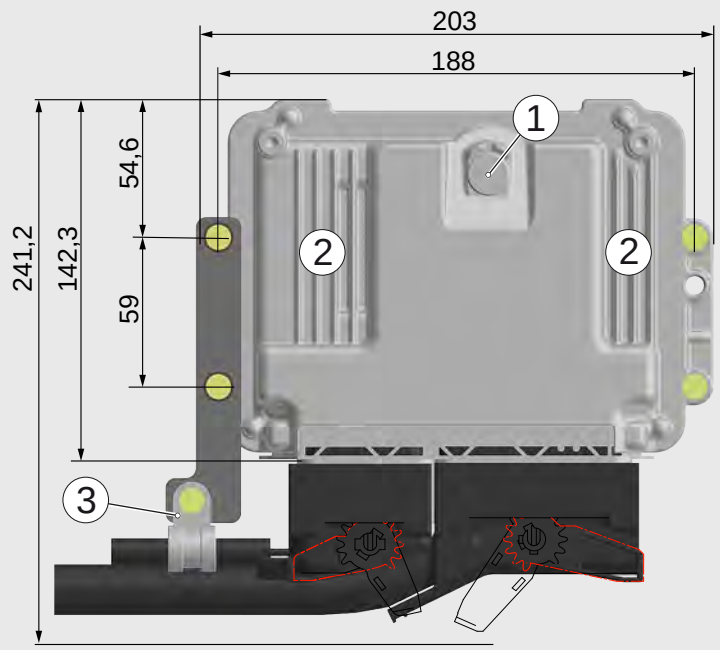
Control unit optionally with analog/digital control and CAN display **or** full CAN bus control



Completely optional CAN control panel	Machine basic control
▪ Torque check ▪ Torque limiting ▪ Speed check ▪ Speed limiting ▪ P-degree check ▪ Vehicle speed check ▪ Engine start/stop via CAN	▪ Throttle pedal ▪ Brake pedal ▪ Hand throttle ▪ Engine start/stop

NOTICE	
	When using multiple CAN devices, the resistance between CAN-high and CAN-low must be between 60 and 120 ohms.

9.1.1 Control unit setup



**Wiring harness connector plugged in (red dashed line)/not plugged in (black dashed line)*

1	Area of the ambient pressure sensor
2	Temperature measurement points (to max. +105 °C)
3	Bracket for securing the cable

9.1.2 Installation conditions for control unit

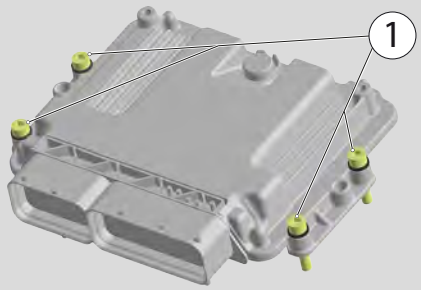
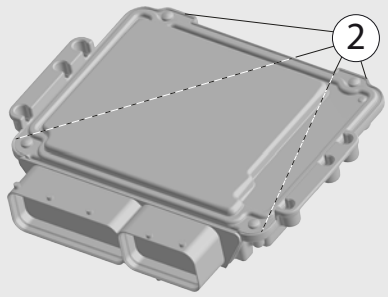
Bosch control unit EDC17C81

The control unit is mounted on the four (1) available locations (**4 x M6 x 30, max. tightening torque 10 Nm**).

The installation in a vehicle must be executed in such a way that the control unit cannot collide with other vehicle parts due to additional fasteners.

After the control unit is installed, it must be ensured that:

- No water can enter into the control unit along the wiring loom.
- No standing or permanently running water is located in the area of the ambient pressure sensor.
- No standing or permanently running water is located in the area of the groove area (2).
- Adequate ventilation is provided since the maximum ambient temperature of 80 °C must not be exceeded.
- The two wiring harnesses must be mechanically fastened after no more than 100 mm to protect the plug-in connections against pulling, pushing and vibration forces (strain relief).
- Vibration decoupled from engine separated

Technical properties of control unit:	
▪ Ambient temperature -32° to 80° ▪ Spray water protected ▪ Dust tight ▪ Tropicalized ▪ Heavy duty ▪ Nominal voltage: 12 V ▪ Permissible voltage range 8-16 V ▪ Current consumption with ignition off: 0.1 mA	 

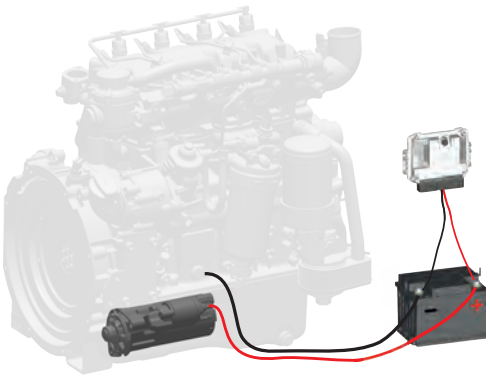
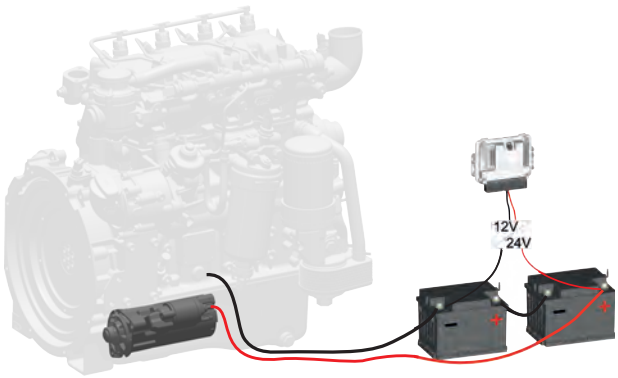
9.1.3 Control unit - connections

EDC 17C81
Inputs/outputs:
CAN bus SAE J1939
ANALOG
▪ **M**ulti-**s**tate **s**witch **MSS**
DIGITAL
▪ Remote starting/stopping ▪ Diagnosis lamp

9.1.4 Voltage supply for control unit

NOTICE
The control unit must be separated from the engine and vibration-decoupled.

NOTICE
The power supply of the control unit must be connected directly to the battery; see the following figure. If the voltage supply is implemented via the starter cable, a voltage undersupply or a fault in the control unit during the starting procedure is probable.

EDC17C81 12V	EDC17C81 24V
	

NOTICE
If using a battery master switch, the power supply of the control unit must be tapped downstream of the main switch. This ensures the full de-energization of all components. Before actuating the battery main switch, wait at least 30 seconds after "ignition off (ignition start switch)" to complete internal processes in the control unit. If the 30 seconds are not adhered to several times, an error is output by the motor control unit.

9.1.5 Diagnosis tool HDS²

The **HDS²** diagnostics tool (Hatz Diagnostic Software) is available for troubleshooting and analyzing the engine parameters. The **HDS²lite** is available in addition to the desktop-based diagnostic system. It is connected via a Bluetooth adapter, app and smartphone or tablet. If necessary, please contact **Hatz service** or go directly to www.hatz-diesel.com/hds2-lizenz.

9.1.6 Diagnostic interface HDS²

An additional diagnostic interface must be provided on the wiring harness to connect the HDS diagnostic tool. The correct pin assignment on the engine control unit (ECU) for mounting a diagnostic interface can be found on the ECU wiring plan.

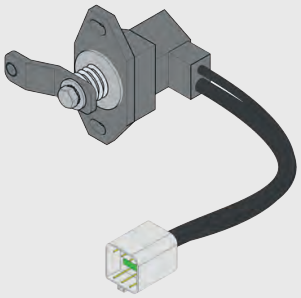
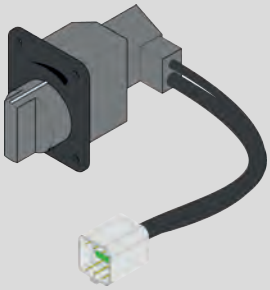
9.1.7 CAN lists and wiring plans

The CAN lists and the ECU wiring plan can be viewed under the link: www.hatz.com/docu (to access these, you will require your engine serial number).

9.2 Engine monitoring

9.2.1 Actuators (speed control), display instrument

Between the control unit interface and the operating module (instrument box), the max. cable length is 10 m with a cable cross section of 1 mm².

Speed control		IP degree of protection
bowden cable (CAN)		IP66
Rotary knob (CAN)		IP66
Pedal (CAN)		IP69K
Manual lever (CAN)		IP66
Multi-state switch (MSS) (optional 2, 3 or 4 steps)		IP65

NOTICE	
	Speed limiting for CAN-enabled speed control possible. As a safety precaution against overspeed, the unprogrammed CAN speed controls are set to 900-1500 rpm.

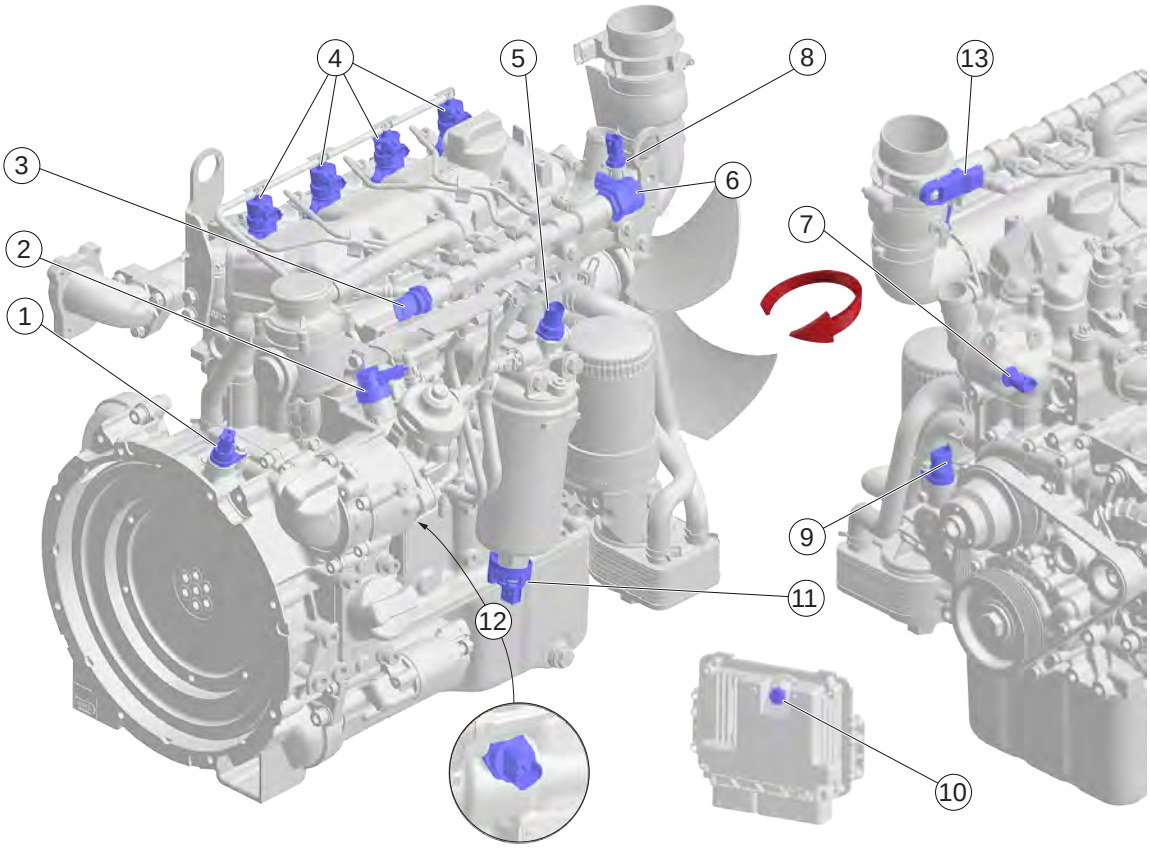
9.2.2 Overview of instrument box

HATZ instrument box		IP protection class	Use
HSP CAN display		IP65	For all variants

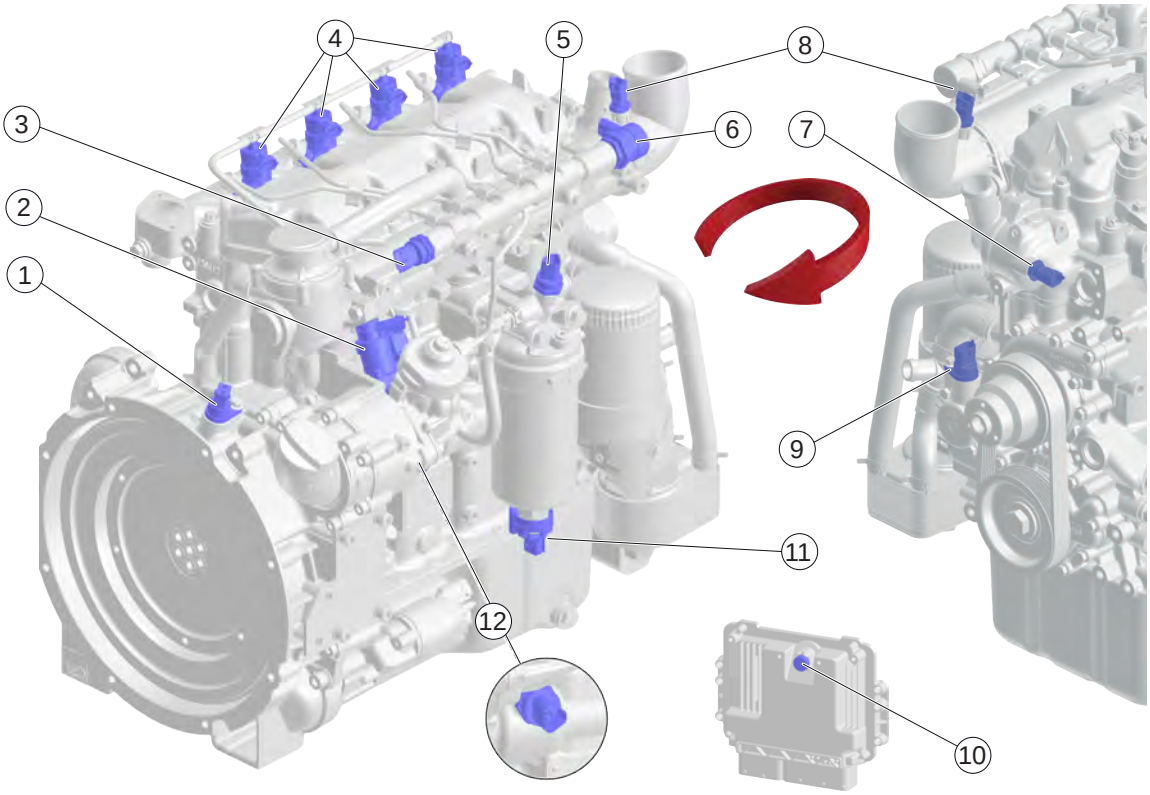
Connection of customer wiring harness to CAN display HSP, see *9.6.1 Plug retaining plate, page 86*Customer control unit wiring harness.

9.2.3 Sensor/actuator overview

Mounting positions



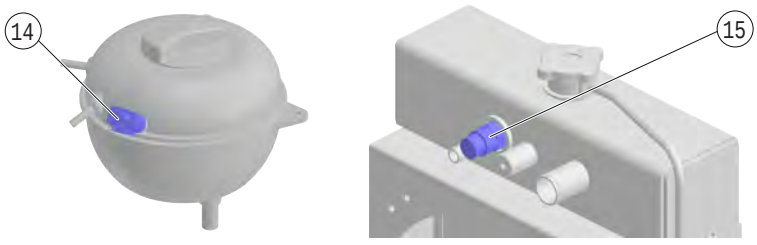
Mounting positions - TRU



Pos.	Designation	Sensor
1	Crankshaft speed sensor	
2	Metering unit in the high-pressure pump(actuator)	
3	Rail pressure sensor	
4	Injectors (4 actuators)	
5	Low fuel pressure and fuel temperature sensor	
6	Rail pressure control valve (actuator)	
7	Coolant temperature sensor	
8	Intake air temperature sensor	

Pos.	Designation	Sensor
9	Camshaft speed sensor	
10	Ambient pressure sensor (integrated in the engine control unit) Installation position: chassis-side	
11	Water in fuel sensor	
12	Oil pressure and oil temperature sensor	
13	Air filter differential pressure sensor (engine model 4H50N)	
14	Coolant level sensor (with external expansion tank)	
15	Coolant level sensor (OPU cooler)	

Installation position: chassis-side



9.3 Battery

DANGER

Danger to life, danger of injury or danger of property damage due to incorrect use of batteries.

- Do not place tools or other metal objects on the battery.
- Before performing work on the electrical equipment, always disconnect the negative battery terminal.
- Never swap the positive (+) and negative (–) battery terminals.
- When installing the battery, first connect the **positive cable** and then the **negative cable**.
- When removing the battery, first disconnect the **negative cable** and then the **positive cable**.
- It is imperative to prevent short circuits and mass contact of current carrying cables.
- If faults occur, check the cable connections for good contact.

DANGER

Danger of explosion from flammable substances.

There is a danger of explosion from flammable gases.

- Keep batteries away from open flames and incendiary sparks.
- Do not smoke when working with batteries.

CAUTION

Danger of chemical burns

Chemical burns can occur when using batteries for the electrical operation.

- Protect your eyes, skin, and clothing from corrosive battery acid.
- Immediately rinse areas affected by splashed acid with clear water and consult a physician if necessary.

Temperature limits of normal batteries:

- From approx. +60 °C, the self-discharge increases significantly and the service life decreases significantly.
- From approx. -22 °C, half-charged batteries can freeze. A frozen battery must be thawed prior to charging.
- Fully charged batteries have a freezing threshold of approx. -60 °C.

Conclusions concerning the charge state of a battery are possible from measuring the voltage when loaded (min. 1 A). A discharged battery has the rated voltage at the terminals when unloaded!

9.3.1 Battery recommendation

Recommended max. battery capacity of a 12-V lead battery during starting.	Power, 12-V starter [kW]	Max. permissible capacity [Ah]	Low-temperature test current [A] as per			
Engine type			EN[1)]	SAE[2)]	DIN[3)]	IEC[4)]
4H50NO, 4H50N	2.2	110	760	800	450	510

Recommended max. battery capacity of a 24-V lead battery (2x12V) during starting.	Power, 24-V starter [kW]	Max. permissible capacity [Ah]	Low-temperature test current [A] as per			
Engine type			EN[1)]	SAE[2)]	DIN[3)]	IEC[4)]
4H50NO, 4H50N	3.0	66	510	520	300	335

[1)] European Standard 60095-1

[2)] Society of Automotive Engineers, United States standard

[3)] German Institute for Standardization (DIN) 43 539 Part 2

[4)] International Electrotechnical Commission) 95-1

NOTICE

The required battery capacity may deviate, depending on the installation case (e.g., resistances in the hydraulic system).

NOTICE

In the case of lead batteries, a self-discharge of approx. 5% of the total capacity per month must be taken into account.

9.3.2 Battery compartment

The positioning of the battery installation in the engine space must be verified by temperature measurements.

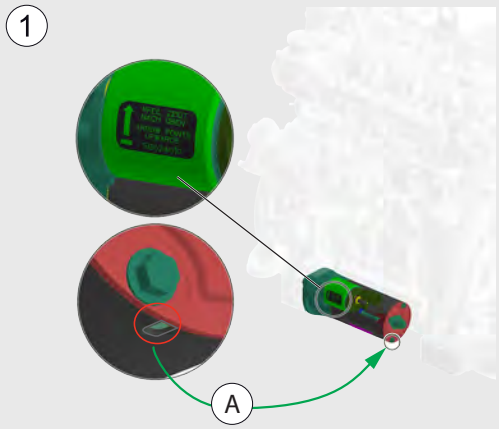
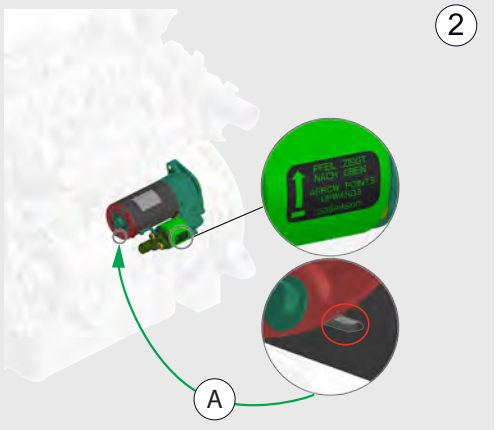
NOTICE

- The max. ambient temperature of the batteries is +60 °C
- Installation of the battery easily accessible for maintenance work
- Secure the battery mount against inherent movement
- Ventilation of the battery installation compartment
- Mounting of electrical switches in the vicinity of the battery is not permitted due to sparking and the potential explosion hazard.

9.4 Starter

Mounting positions

Depending on the installation situation of the engine, a suitable "low" starter (1) or "high" starter (2) needs to be selected. The water drain opening (A) of the starter must be positioned vertically downward in each case.

"Low" starter	"High" starter
	

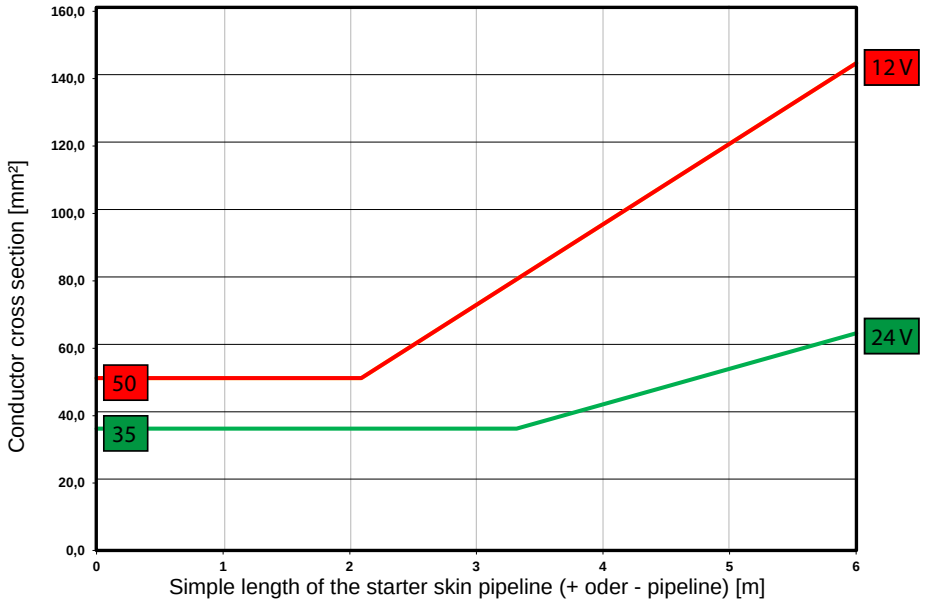
Sizing of the line between the starter and battery:

With the ignition switch, the pull-in winding and holding winding of the starter solenoid (terminal 50) (1) are switched on via the starter relay (short-term max. **56 A** in the pull-in winding and **10 A** in the holding winding). At the end of the pull-in path (starter pinion engaged in the sprocket), the main starter current is switched on (depending on the starter and condition, approx. **1200 A**). The starter motor is now connected directly to the battery by terminal 30 (2) and the main starter line.

NOTICE
The hexagon nut M8 for fastening the main power line T.30 to the starter must be tightened with max. 22 Nm.

NOTICE
It is recommended to protect the starter terminal 30 (B+ connection) against short circuits (e.g., caused by electrically conductive foreign bodies) with a suitable cover (e.g., rubber protective cover). Short circuits can cause cable fires and damage to other electronic components.

Line cross section for main starter line:



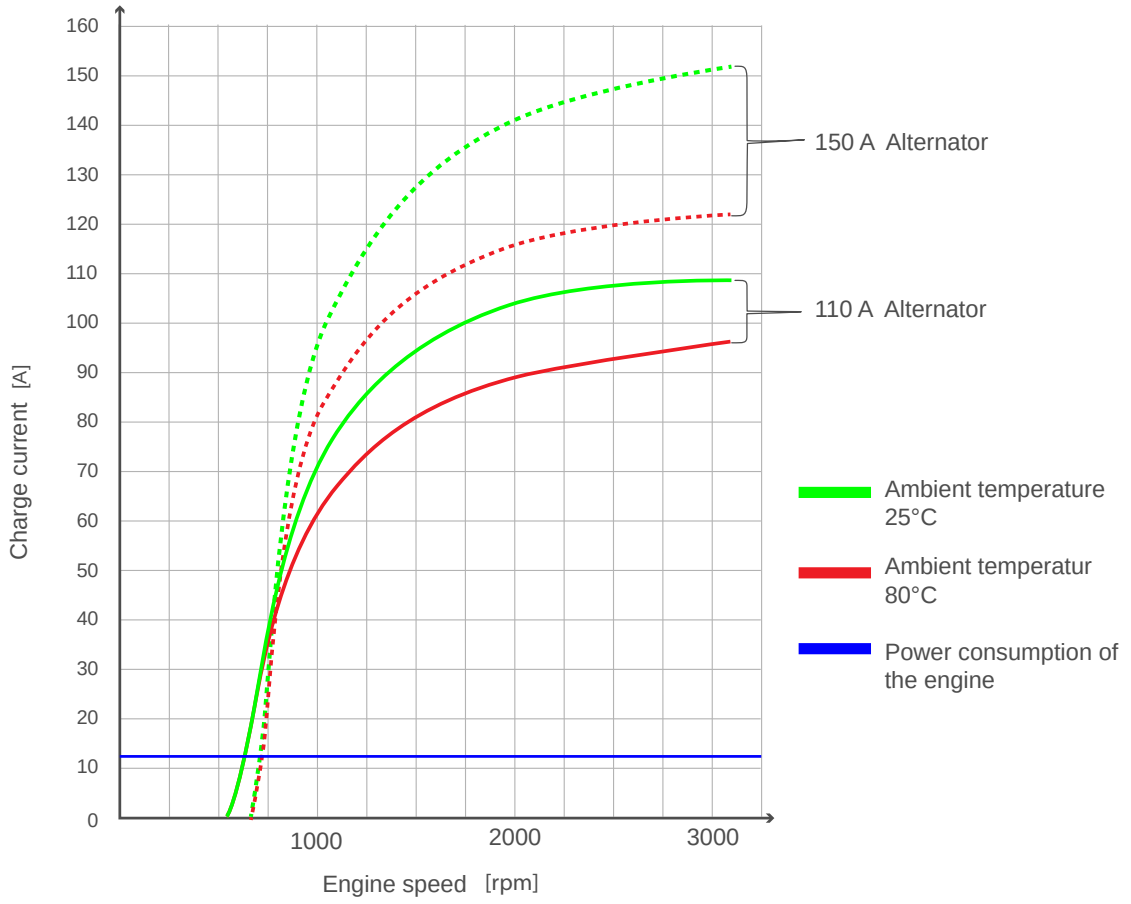
NOTICE
Select the battery capacity according to HATZ plant specifications. If it is necessary to have a larger battery capacity, the line cross section and/or the length of the main starter line must be adapted accordingly. This will prevent overloading the starter and damaging it. To determine the right line cross section, please contact HATZ service.

9.5 Alternator

Type	Air cooled compact alternator with internal fan
Belt drive	Poly v belt profile 6PK 768 (6 grooves, Ø49 mm)
Ratio with crankshaft pulley Ø103 mm	$n_{alternator}$ = 2.08 * n_{engine} [min-1]

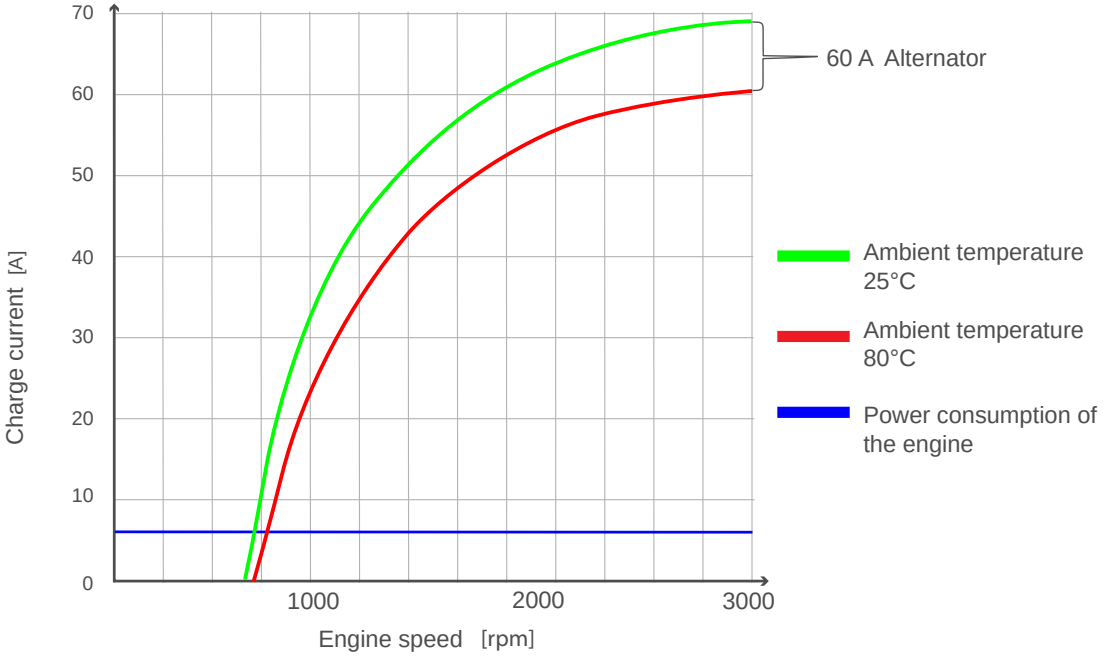
Type	12 V (standard)	12 V (option)	24 V (option)
Max. current at engine speed 2880 rpm	110 A	150 A	60 A
Max. current at engine speed 860 rpm	55 A	Approx. 70 A	18 A
Control voltage 20 °C	14.25 – 14.75 V	14.25 – 14.75 V	28.10 – 28.70 V

9.5.1 Charge curve 12 V



The power consumption of the engine is an approximate value that depends on multiple conditions (such as temperature, voltage, etc.). The starting procedure consumes approx. 2 Ah.

9.5.2 Charge curve 24 V



The power consumption of the engine is an approximate value that depends on multiple conditions (such as temperature, voltage, etc.). The starting procedure consumes approx. 1 Ah.

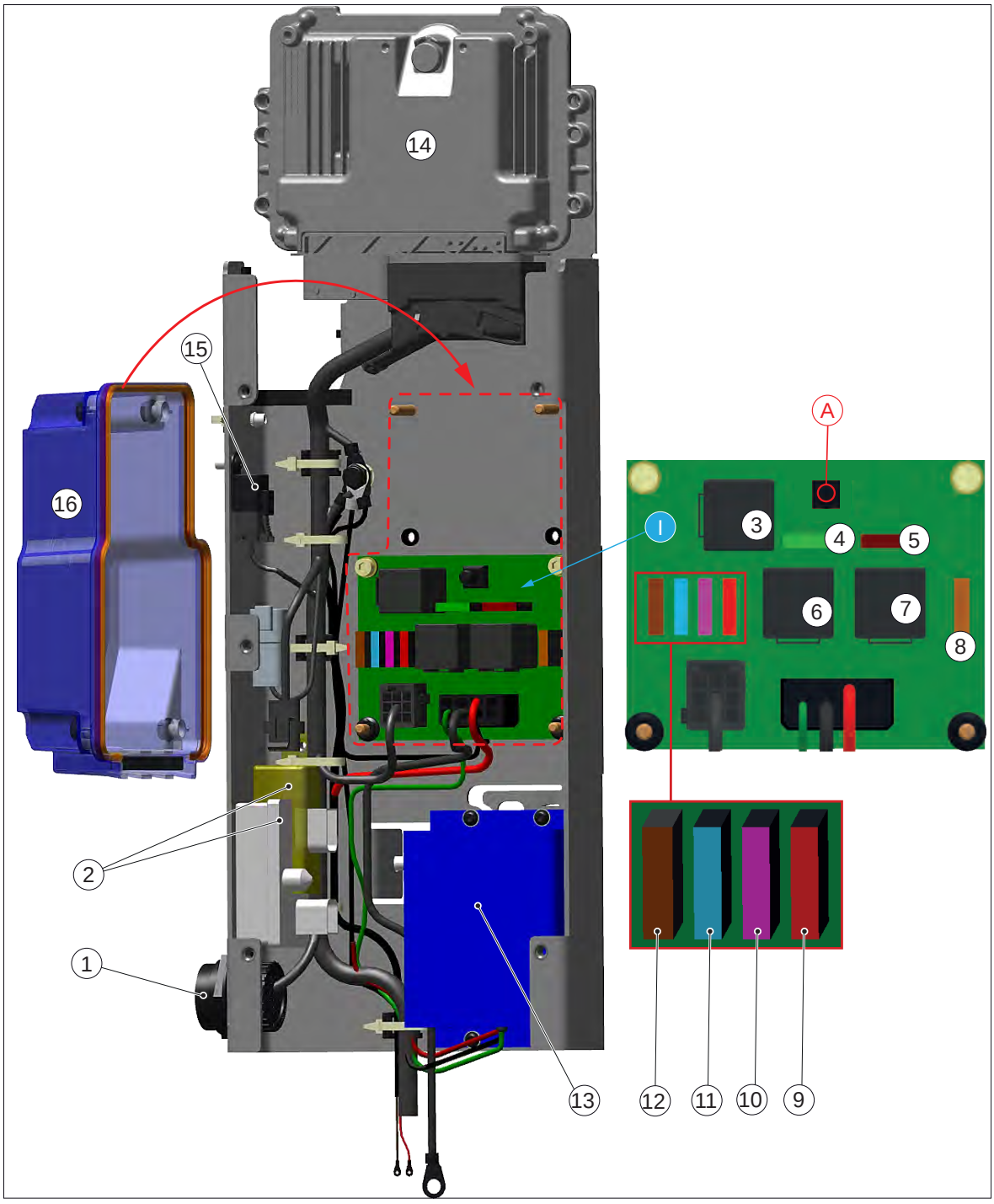
9.6 Cabling

NOTICE
All wiring harnesses and lines behind stationary plug connections must be feature a tension relief mechanism after a maximum distance of 100 mm.

NOTICE
All wiring harnesses must be laid in such a way that their properties are not endangered. Note the following criteria here: ▪ Protection against external influences, e.g., high temperatures, chemical substances, (spray) water etc. ▪ Protection against motor vibrations, shocks, direct pressure on cables, sharp edges and thus against mechanical damage to the cables. ▪ Compliance with permissible bending radii and tensile forces.

NOTICE
Line ends that are not connected to a connector (open wire) must be insulated against short circuits.

9.6.1 Plug retaining plate



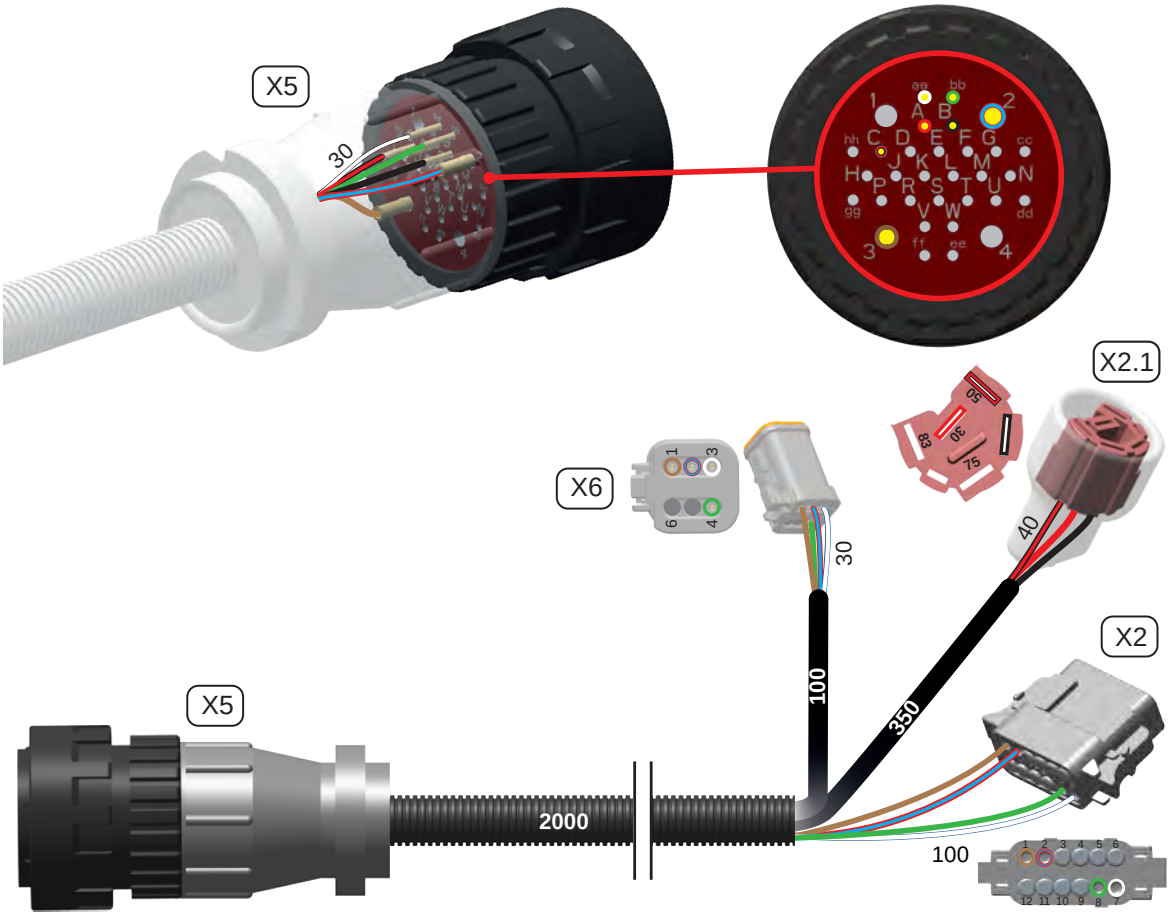
0	Pos.	Use	Circuit diagram designation	Fuse
I	Central electrics C81			
	A	B+ power supply for central electrics (tightening torque 9 Nm)		
	1	Instrument panel/customer control: ITT Cannon, Plug 28+4 192900-0549		
	2	Glow time control unit 12 V/24 V (depending on model)	GCU or GPCU	
	3	Control unit main relay on	1K6	
	4	Starter fuse, terminal 50	1F6	30 A
	5	Fuel pump fuse	1F2	10 A
	6	Starter relay	1K4	

0	Pos.	Use	Circuit diagram designation	Fuse
	7	Fuel feed pump relay	1F3	40 A
	8	Glow plug fuse	1K5	
	9	Ignition on fuse, terminal 15	1F5	10 A
	10	Ignition on fuse, terminal 15 customer	1F7	4 A
	11	Control unit B+ fuse	1F4	15 A
	12	T15/T50 fuse	1F1	5 A
	13	DC/DC converter, only with 24-V version (option)		
	14	Engine control unit EDC17C81 12V		
	15	Diagnosis connector		
	16	**Central electrics cover** Note: Assemble the seal strip for the cable connections with the 45° edges facing down (see figure below).		

NOTICE

Ensure a good ground connection. Do not attach the control box to the engine; attach it to low-vibration parts instead. Max. permissible voltage drop on all control cables 1.5 V.

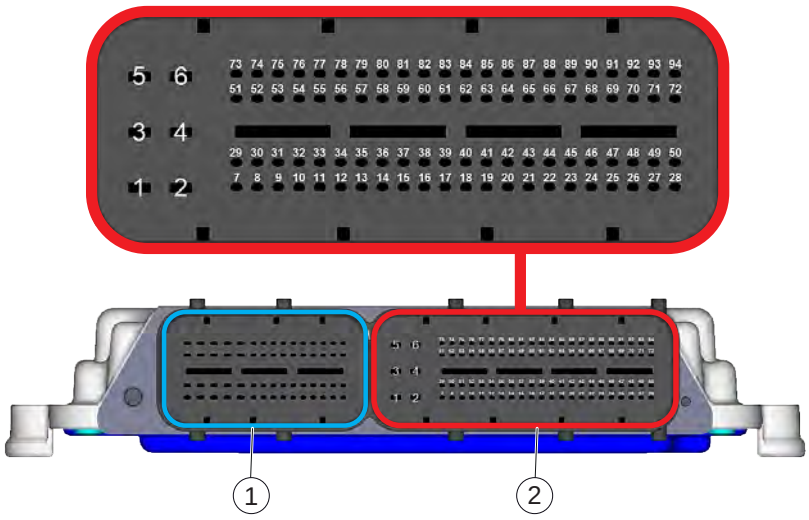
Customer control unit wiring harness



Connector pin assignment					
X5* **Pin no., connector designation (ITT Cannon, Plug 4/28 192900-0549)**		**Color coding**	**X6 Diagnostics interface**	**X2 CAN display (HSP)**	**X2.1 Ignition switch**
2	Ignition on T.15 with post-running	Red/blue	2	2	
3	B- T.31	Brown	1	1	
A	B+ / 5A power supply T15/50	Red			30
B	Ignition on T.15	black			15
C	Start signal T.50	Red/black			50
aa	CAN 0 high (customer CAN)	White	3	8	
bb	CAN 0 low (customer CAN)	Green	4	7	

***X5** *consists of two parts: the circular connector sleeve housing (actual pinning) and the circular connector housing.*

9.6.2 Pin assignment/Cabling by customer



Pos.	Control unit (ECU) plug connections
1	Engine-side (X2)
2	Customer-side/chassis-side (X1)

Pin	Connector designation (X1)	Bosch designation
K01	Battery B- 1 of 3	V_V_BAT1R
K03	Battery B- 2 of 3	V_V_BAT2R
K05	Battery B- 3 of 3	V_V_BAT3R
K02	Battery B+ 1 of 3	G_G_BAT1
K04	Battery B+ 2 of 3	G_G_BAT2
K06	Battery B+ 3 of 3	G_G_BAT3
K46	Ignition "On" T.15	I_S_T15
K74	Starter signal T.50	I_S_T50
K93	Engine running lamp (ERL)	O_S_ERL
K92	Diagnostic lamp (DIA)	O_S_DIA
K18	Multi-state switch (ground)	G_R_MSSRPM
K09	Speed selector switch	I_A_MSSRPM
K50	Engine start/stop switch	I_S_ENGSA
K66	CAN 0 High	B_D_CANL0
K87	CAN 0 Low	B_D_CANH0
K86	CAN 1 DIA High	B_D_CANH1
K64	CAN 1 DIA Low	B_D_CANL1
K37	Alternator D+ (alternator monitoring)	I_S_AM
K47	Main relay signal	O_S_MRLY
K72	Control, electrical fuel pump relay	O_S_PSPRLY1
K57	Glow time control unit DI control	O_T_GCU
K42	Glow time control unit ST control	O_T_GCU
K77	Water in fuel sensor	I_S_WFS
K14	Coolant level sensor	I_S_CLS

Pin	Connector designation (X1)	Bosch designation
K17	Coolant level sensor (ground)	G_R_CLS
K85	Air filter differential pressure sensor (ground)	G_R_AFDPS
K82	Air filter differential pressure sensor (signal)	I_A_AFDPS
K23	Air filter differential pressure sensor (5 V)	O_V_5VAFDPS
K32	Parking brake switch	I_S_BRKPS
K89	Neutral gear switch	I_S_GNSW
K38	Brake pedal switch (normally open contact)	I_S_BRKMN
K78	Brake pedal switch (normally closed contact)	I_S_BRKRED

ECU-PIN nomenclature:

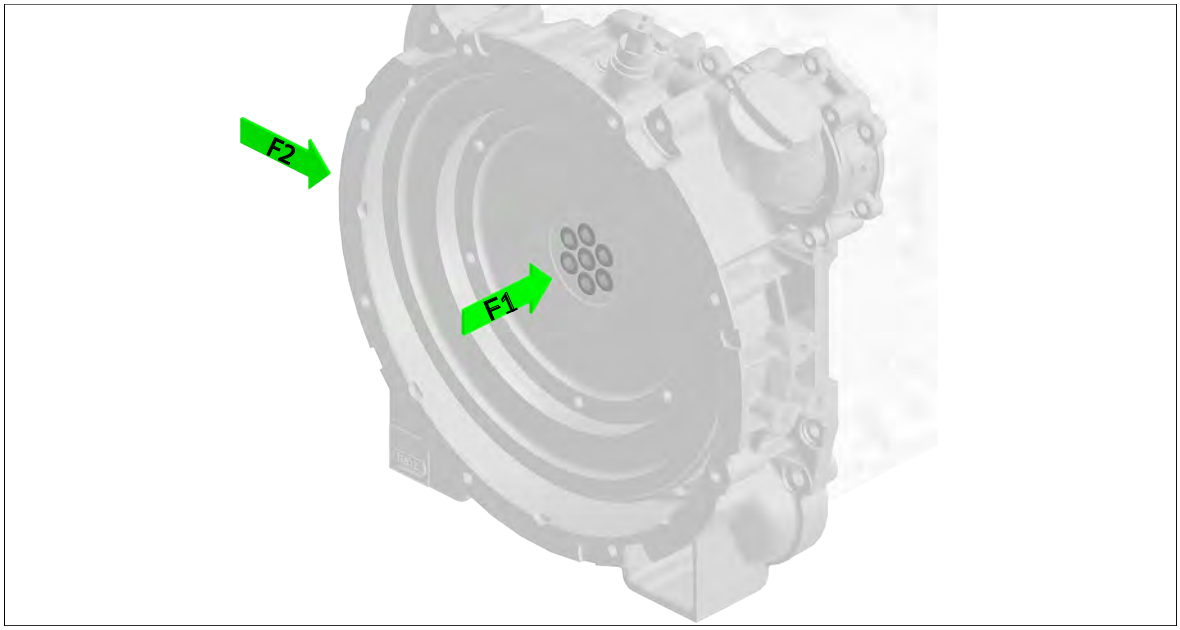
I_A_XXXX	Analog input
I_S_XXXX	Digital input
O_S_XXXX	Low side (ON/OFF)
O_T_XXXX	PWM output
O_V_XXXX	Switched battery output (high side)
B_D_XXXX	Bi-directional line
V_V_XXXX	Sensor supply voltage
G_R_XXXX	Sensor ground
G_G_XXXX	Ground

10 Power take off

10.1 Main take off – flywheel side

NOTICE

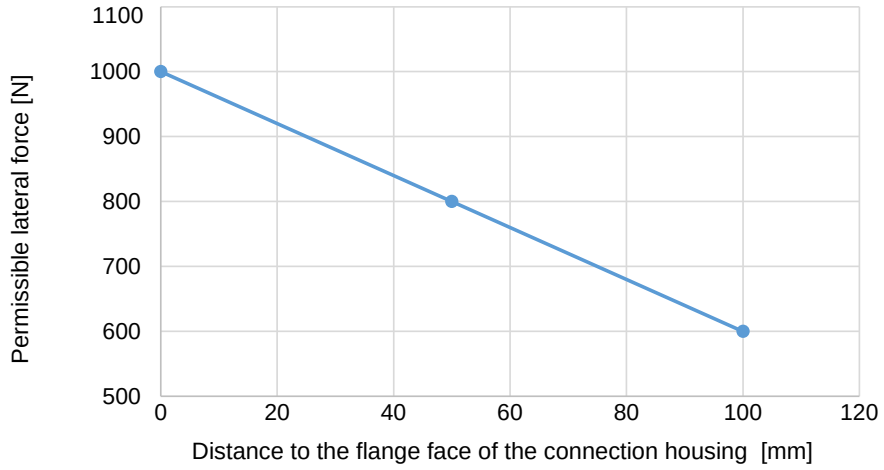
Before installing further add-on parts, the preservation wax must be removed from the screw-on surfaces and the surfaces must be cleaned.



Axial (F1)	3000 N, direction-dependent
Radial (F2)	See diagram
Max. perm. mass moment of inertia	0.2 kg/m²
$J_{flywheel+engine}$ 4H50	0.234 kg/m²
Fixed mass on flywheel	Up to 10 kg at 80 mm centroidal distance to flywheel flange

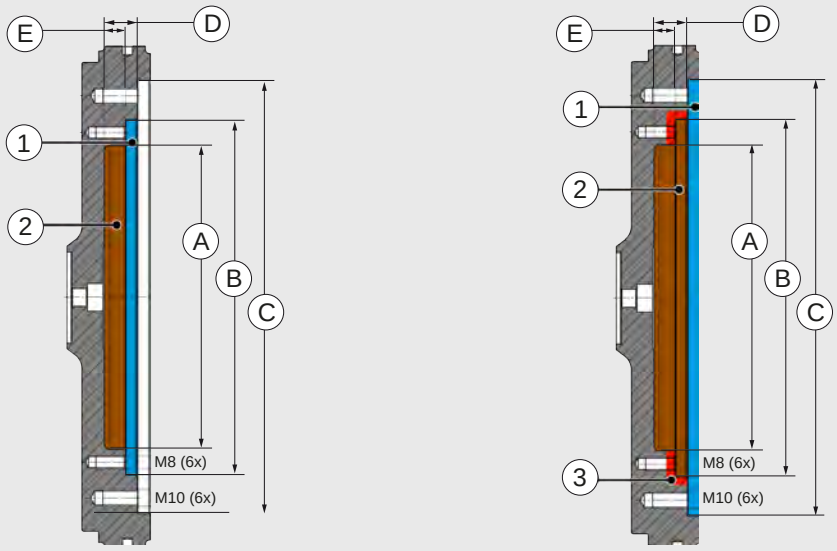
SAE 5 (standard), SAE 4 or SAE 3 connection housing and the 6.5"/8" or 10" flywheels will be available for the main take off.

Lateral force on flywheel without additional mount



10.2 Combined flywheel 6.5"/8" with connection housing/10" flywheel

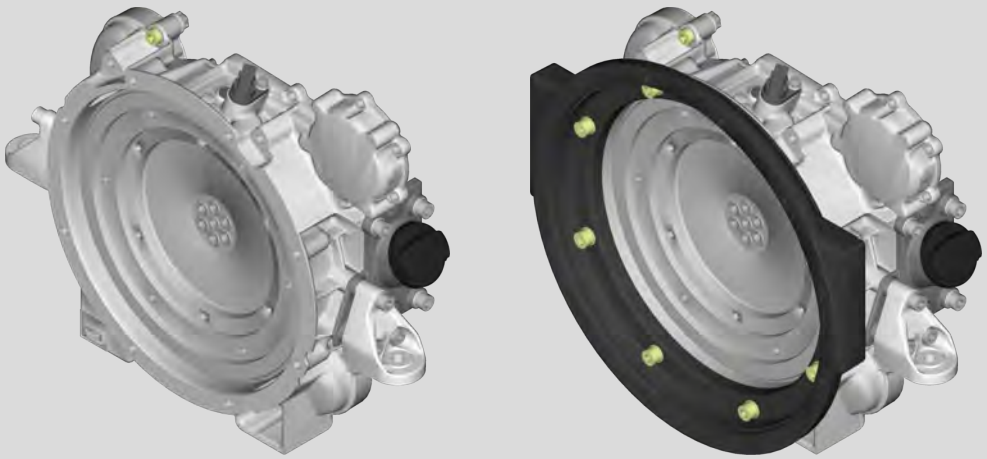
6.5 inch	8 inch



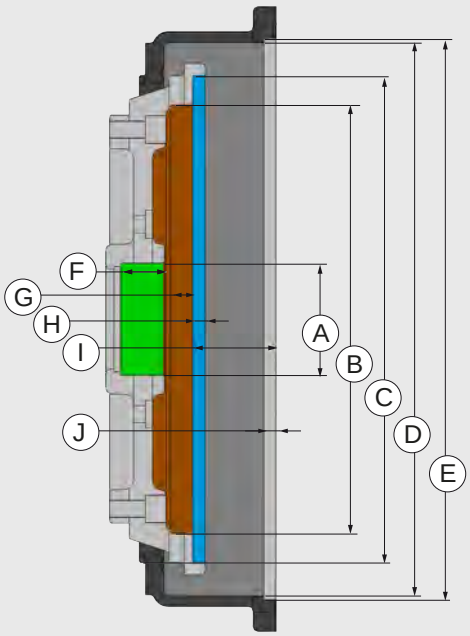
1	Coupling diameter
2	Indentation
3	For the manufacture of a combined flywheel required deviation from the SAE standard

A		B		C		D		E	
mm	inch	mm	inch	mm	inch	mm	inch	mm	inch
184.2	7 ¼	215.90	8 ½	263.52	10 ⅜	12.9		20.1	

connection housing	flywheel	connection housing	flywheel
SAE 5	**Combined flywheel 6.5" and 8"**	**SAE 4**	**Combined flywheel 6.5" and 8"**



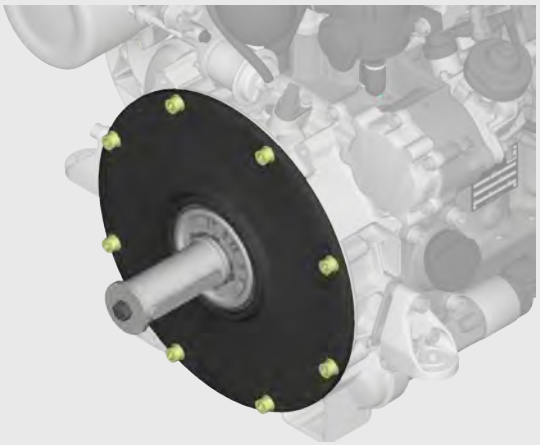
Connection housing SAE 4 with 10" flywheel



A	72 mm	**F**	28.4 mm
B	276.4 mm	**G**	14.3 mm
C	314.32 mm	**H**	8.3 mm
D	357 mm	**I**	53.8 mm
E	361.95 mm	**J**	8 mm

10.3 Connection housing with outside bearing

Permissible transverse forces on outside bearing



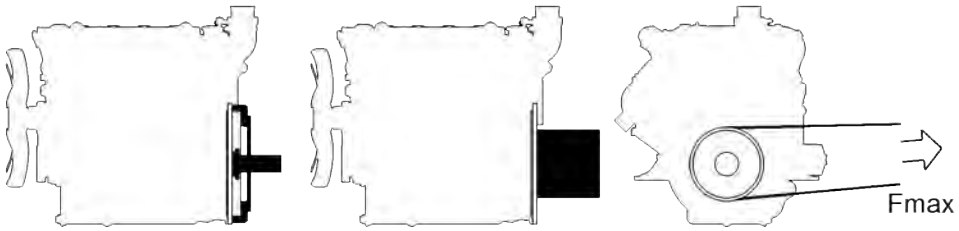
Distance to flange level [mm]	Permissible tensile force [N]
0	9,000
45	9,000
90	4,500
135	3000
180	2,250
225	1800
270	1500

stub shaft	Ø48 h7 x 110, mass inertia 0.023 kg/m²
stub shaft	Ø50 h7 x 110
feather key	100 x 14 P9

10.4 Power take off

10.4.1 Not separable

The offered drive elements may only be used according to the instructions in the dimensional drawings. The permissible radial load capacity of the stub shafts or the permissible axial offset of elastic couplings must not be exceeded.



The calculation of the load capacity of the power take off on the engine can be found at Main take off – flywheel side.

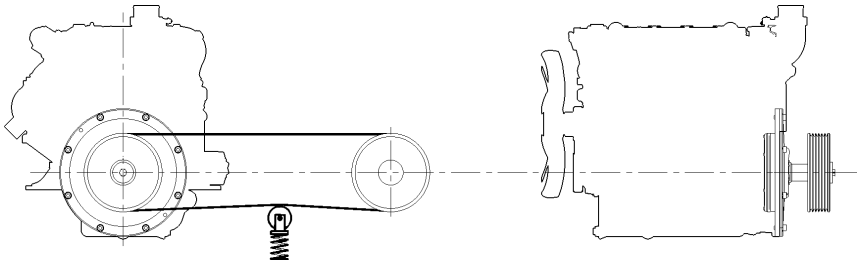
The overload of power take offs, particularly by uncontrollable belt tensioning devices, can cause damage to the bearings and shaft fractures.

If the permissible limits cannot be adhered to, please contact your responsible **HATZ subsidiary**. They will show you possible solutions.

10.4.2 Belt drives

Since the type of belt tension can have a greater impact on the size of the bearing load than the size of the torque to be transmitted, the following applies:

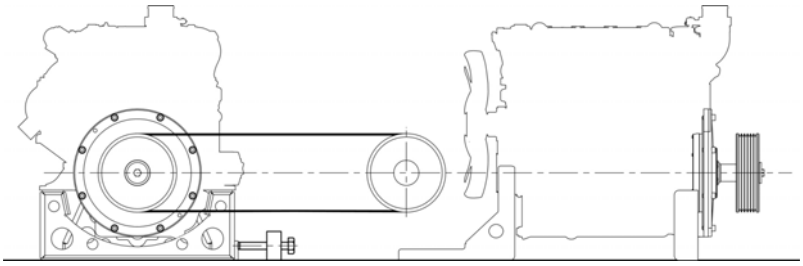
- **Controllable belt tensioners guarantee** that bearings and shafts are not overloaded and do not break. The belt tension is controllable by a spring-loaded idler pulley or hydraulic belt tensioner, for example.



The **actual force effect** in case of **flexible** belt tension can be calculated as follows:

$$\mathrm{Fges} = (33\ x\ \mathrm{P}max)/(\mathrm{n}/1000\ x\ \mathrm{d}w)$$

- **Uncontrollable belt tensioners** have the risk of overloading the bearings due to excessive tension forces. These tensioners include tensioning screws, prestressing via flexible belts etc.



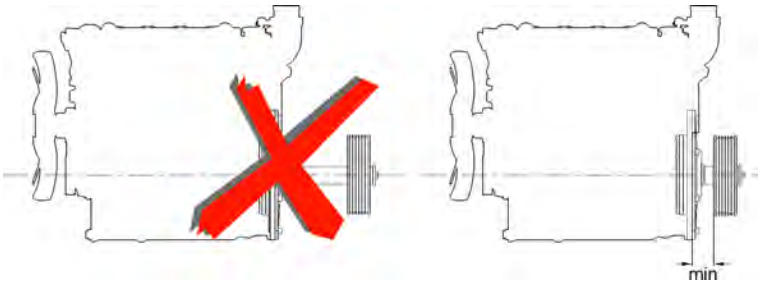
The **actual force effect** in case of rigid belt tension can be calculated as follows:

$$Fges = (47.8 \; x \; Pmax)/(n/1000 \; x \; dw)$$

Ftot	Actual force effect [N]
Pmax	Engine output [kW]
n	Speed [min^{-1}]
dw	Diameter of engine pulley [m]

Two further recommendations for belt drives:

- Mount the pulley as close as possible to the bearing to keep the bearing load low; see chapter *10.3 Connection housing with outside bearing, page 91*.
- The pulley on the engine must be as large as possible in order to keep the belt tension low.



10.4.3 Hydraulic pump on main take off

⚠ CAUTION	
	Risk of injury or danger of engine or hydraulic pump damage caused by failure to comply with the installation instructions/Operator's Manual of your hydraulic pump. As the operator of the machine, you must ensure that all people working on the machine are familiar with the content of this manual. Read the instructions and especially the safety conditions before working on the machine.

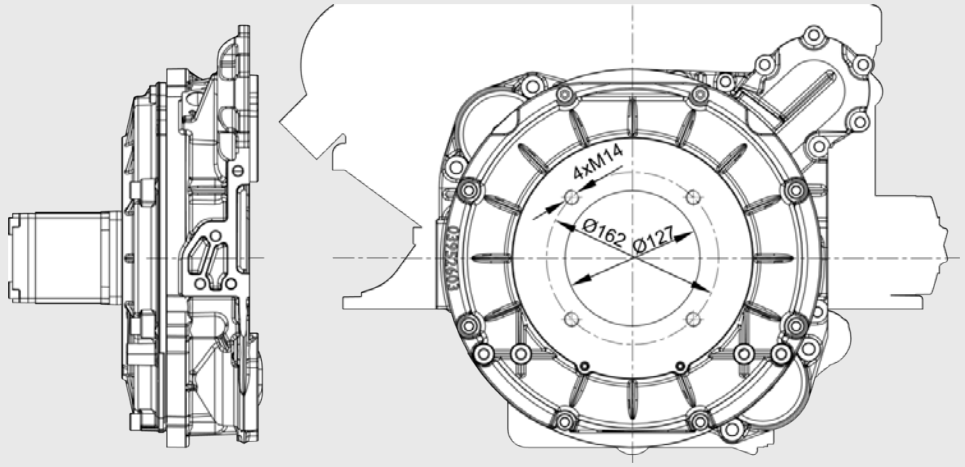
$$F_{zul} = \frac{1{,}7 * 10^6 [Nmm]}{(l + 53{,}1)[mm]}$$

F perm	Maximum permissible alternating load
l	Distance of attack point to the flange connection on the connection housing

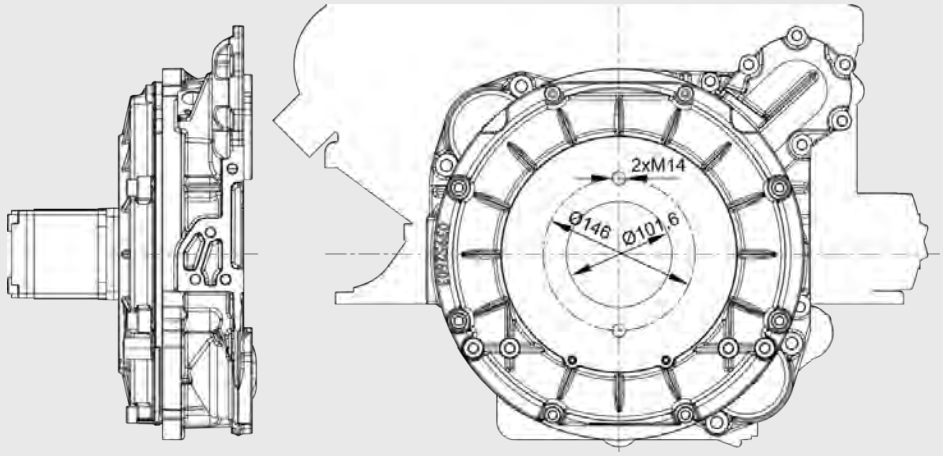
To install your hydraulic pump, only use the screw dimensions and qualities recommended by the hydraulic pump manufacturer. For mounting on the engine, heed the most recent installation instructions for your hydraulic pump.

If you have any other questions, please contact the hydraulic pump manufacturer.

SAE 4



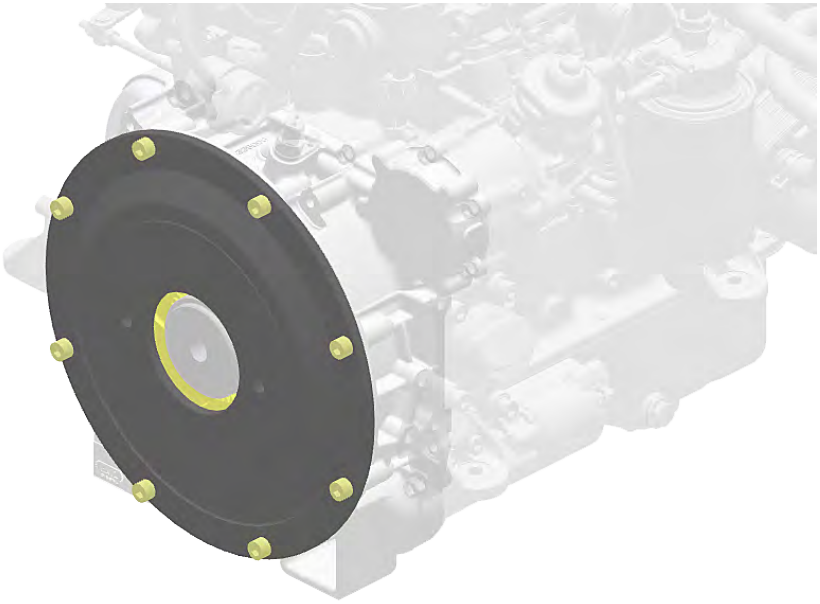
SAE 5

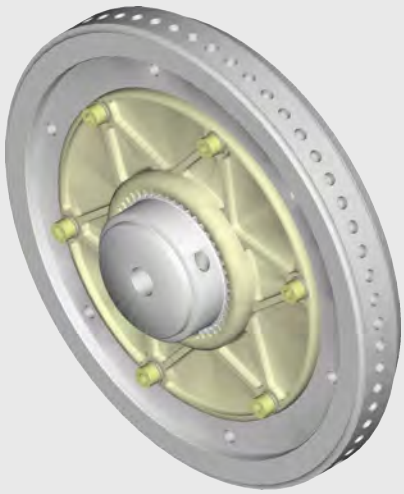
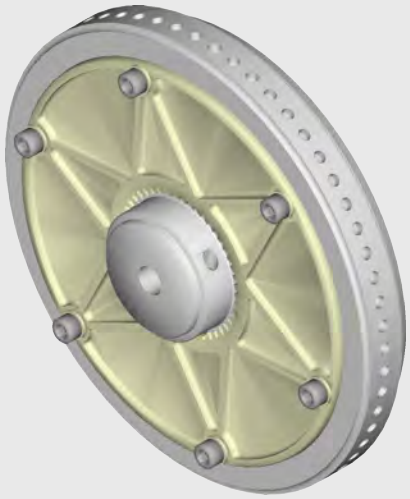
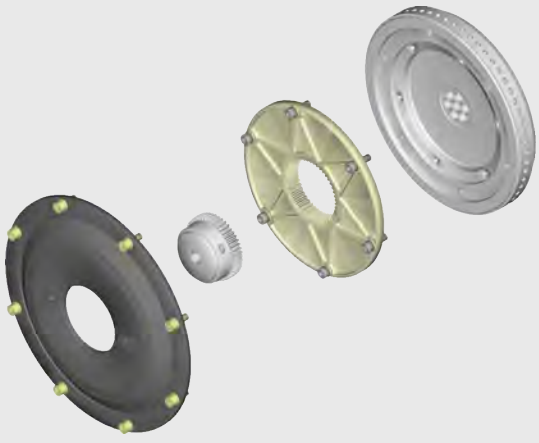
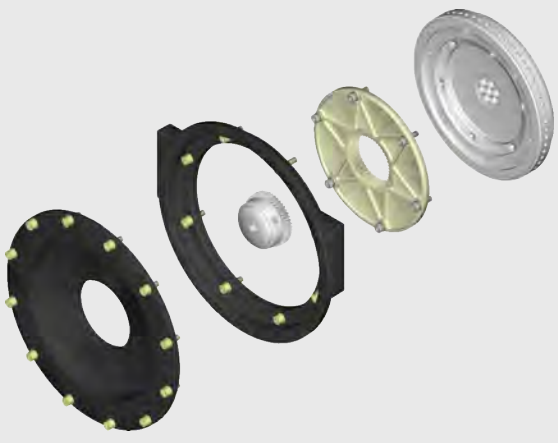


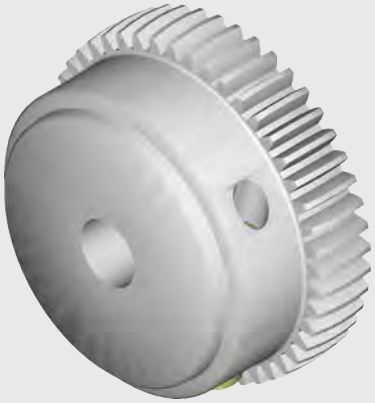
For details on the flange and shaft dimensions of the planned hydraulic pump, please contact your **HATZ Service Station**. Apart from hydraulic pumps of various sizes, Hatz also has additional add-on parts for hydraulic pumps available on request. Please contact your **Hatz subsidiary**.

10.5 Couplings

Couplings are available in 6.5 and 8 inches. Both are combinable with SAE5 and with SAE4 connection.

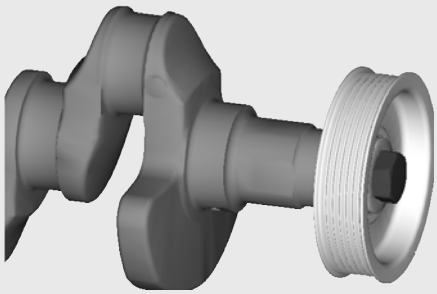


6.5 inch coupling	8 inch coupling
	
SAE 5 inch connection	**SAE 4 inch connection**
	
Drilled hole Ø 101.6 / M14 – 2-hole flange Pitch circle Ø 146	Drilled hole Ø 101.6 / M14 – 4-hole flange Pitch circle Ø 162

Coupling hubs	
Hubs are available in the following sizes: ▪ Pre-drilled Ø 18.9 mm ▪ 7/8 inch, 13 teeth as per ANSI B92.1a/1976 ▪ 1 inch, 15 teeth as per ANSI B92.1 Further hubs on request.	

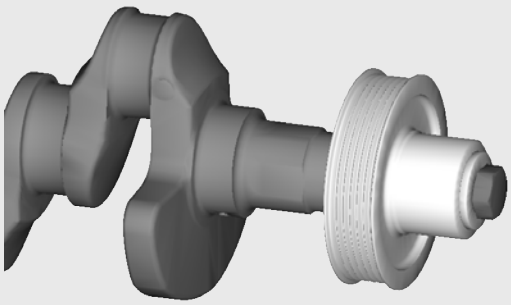
10.6 Main drive - timing cover side (crankshaft/fan)

Standard crankshaft

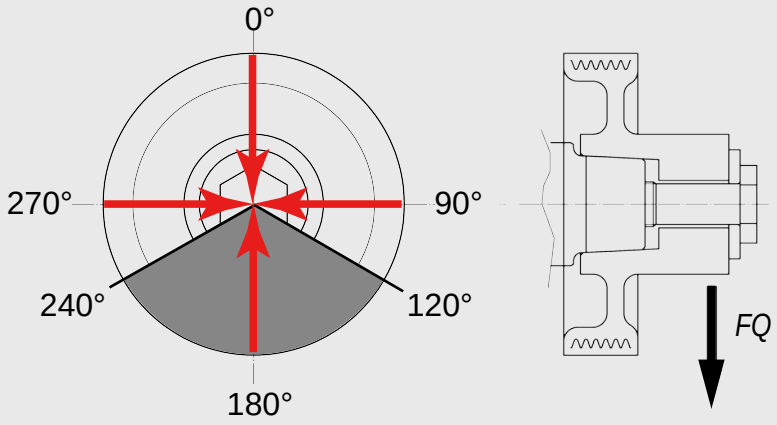


Without lateral force	42 Nm
With air conditioning compressor	12.5 Nm

Tapered crankshaft



Without lateral force	200 Nm
With lateral force, see the following diagram ▪ The maximum lateral force FQ 2 kN may be tapped at 120° to 240°.	50 Nm



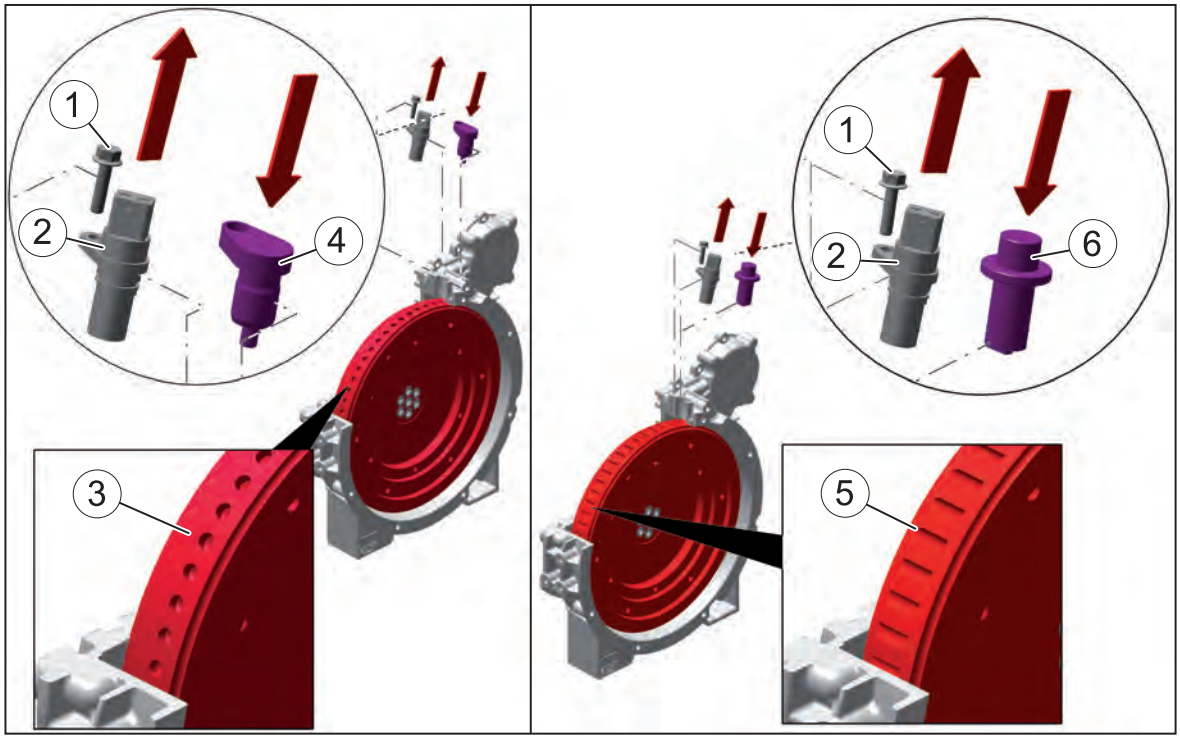
FQ = transverse force

10.7 Blocking the crankshaft

Introduction

To fix and tighten add-on parts to the flywheel, it is often helpful to block the flywheel against rotation. For this purpose, Hatz offers two blocking tools - depending on the flywheel version.

Overview of the different flywheel versions



1	Fixing screw
2	Crankshaft speed sensor
3	Markings on the flywheel (example: version with round markings)*
4	Blocking tool for flywheel with round markings (order number 841 797 10)
5	Markings on flywheel (version with slotted markings)*
6	Blocking tool for flywheel with slotted markings (order number 657 842 00)

* The markings serve as pulse generators for the crankshaft speed sensor.

Procedure

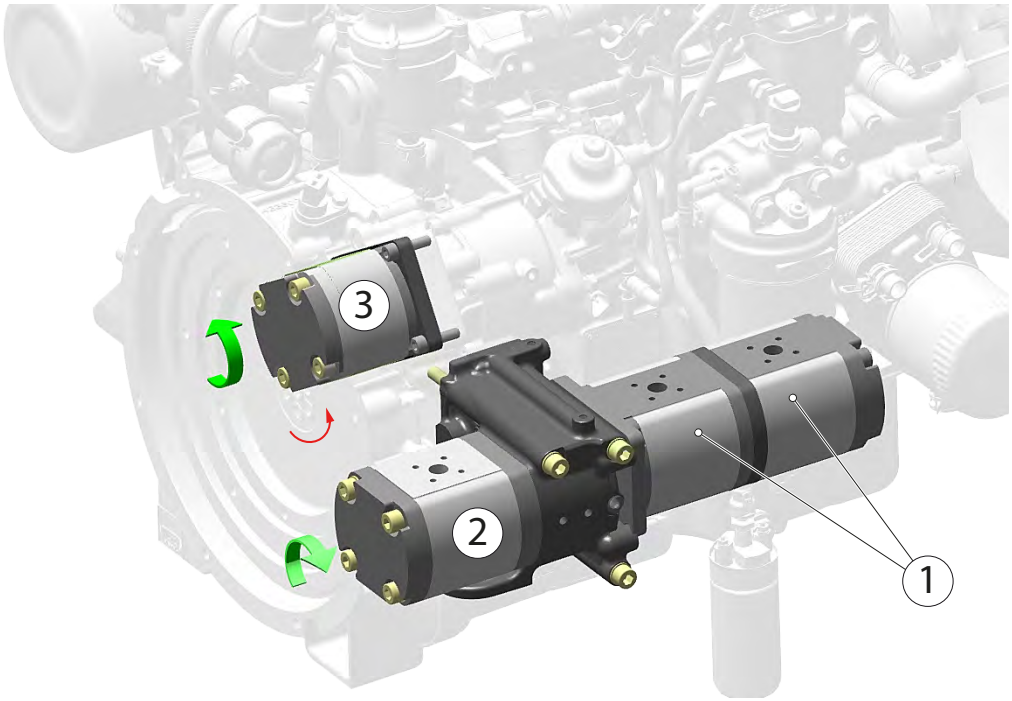
Step	Activity
1	Unscrew the fastening screw (1).
2	Carefully remove the crankshaft speed sensor (2).
3	Insert blocking tool (4) or (6) - depending on the type of flywheel markings - into the hole for the speed sensor. Turn the flywheel slowly until the tool engages.
4	Fix the blocking tool with the fastening screw (1).

NOTICE	
	The blocking tool can absorb torques of 250 Nm at the crankshaft center. Off-center bolted connections are to be calculated with the maximum displacement of the lever force.

The **blocking tools** - depending on the flywheel version - **841 797 10 or 657 842 00** are mandatory. Other tools are not allowed!

10.8 Power take off - hydraulic pump

A maximum of four hydraulic pumps must be flangeable on the two power take-offs.



1/2	M_{max} = 100 Nm / $n_{hydr.}$ = 1.1 x n_{engine} [min^{-1}]
3	M_{max} = 80 Nm / $n_{hydr.}$ = 1.0 x n_{engine}[min^{-1}]

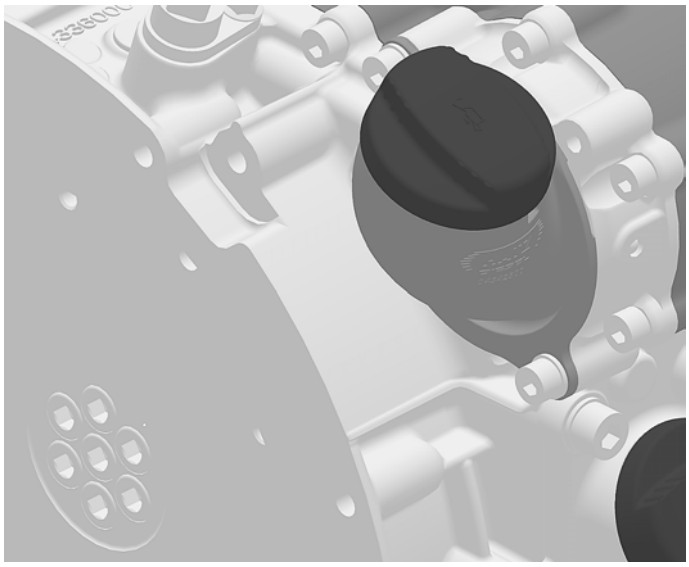
Standard available hydraulic pumps:				
Pos	**Hydraulic pump**	**Description**	**Sense of rotation**	**Available [cm³]**
1	4-hole HP Ø 80	4-hole flange, 4.6 to 31 cm³/rev. splined shaft DIN 5482 B17x14 - 9 teeth	Clockwise hydraulic pump	4.65, 6.45, 8.25, 12, 13.8, 15.52
1	SAE-A HP Ø 82.55	2-hole flange, 4.6 to 31 cm³/U splined shaft SAE J744 16-4 9T – 9 teeth	Clockwise hydraulic pump	None
2	2-hole HP Ø 50	Without flange, 4.6 to 31 cm³/rev. splined shaft DIN 5482 B17x14 - 9 teeth	Counterclockwise hydraulic pump	12, 22.87, 31.2
3	4-hole HP Ø 80	4-hole flange, 4.6 to 31 cm³/rev. splined shaft DIN 5482 B17x14 - 9 teeth	Clockwise hydraulic pump	4.65, 6.45, 8.25, 12, 13.8, 15.52

NOTICE

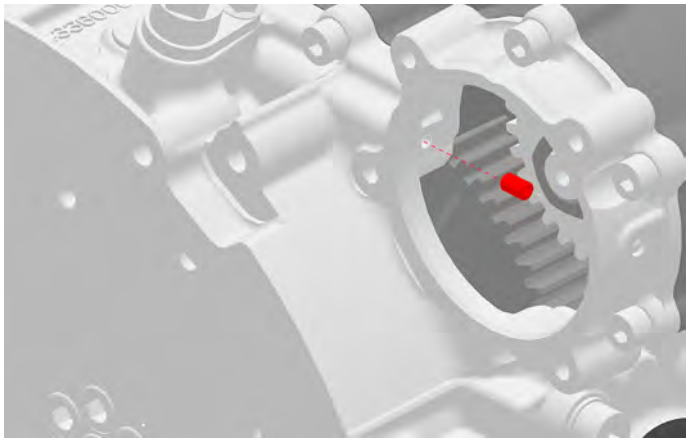
The sum of the torques of all power take-offs must not exceed 100 Nm.

Top power take-off with pressure oil hole

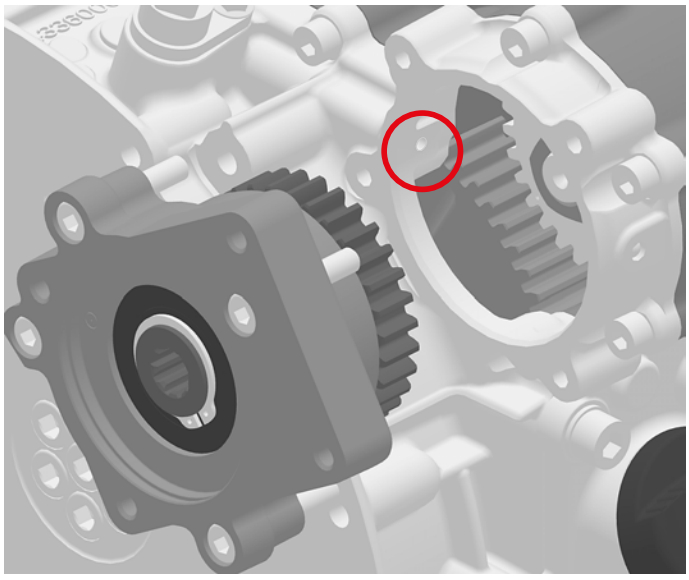
Engine with oil filler on top power take-off (PTO); see *10.8 Power take off - hydraulic pump, page 98*, position 3.



To enable the top PTO to be supplied with pressure oil, the set screw M6x10 must be removed. Failure to do so can lead to **serious engine damage**!

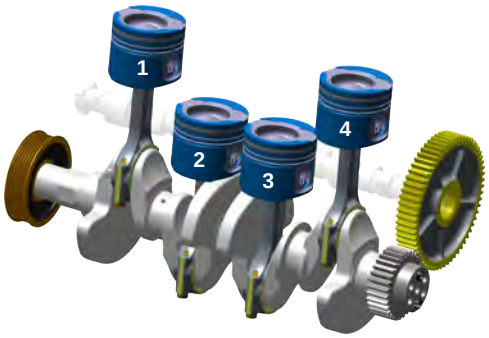


The PTO may only be mounted on CP4 after the pressure oil hole is open.



10.9 Drive data

Drilled hole [mm]	84
Stroke [mm]	88
Conrod length [mm]	141.5
Oscillating mass [g] (Mosc)	988



4H50						
	Pulley	1	2	3	4	**Gear drive**
J [kgmm²]	1323	6511	6511	6586	6664	2893
Pos [°]		0	540	180	360	

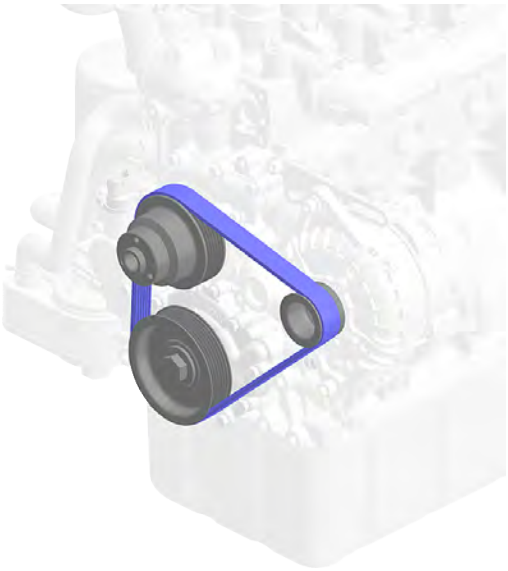
4H50					
	A	B	C	D	E
N [Nm/mrad]	263.473833	511.11184	511.11184	511.11184	827.921236

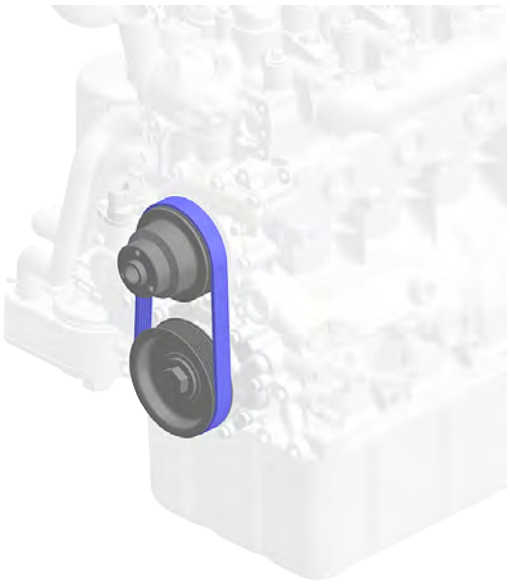
Remark:

- Belt and system are not taken into account.
- Gear drive including parts not shown reduced to crankshaft speed.
- Rotating conrod part is taken into account in the crank.
- Flywheel inertia 6.5/8" 0.19 kgm², adapter SAE10 0.15 kgm²

10.10 Belt driver

4H50N/NO - TRU





NOTICE
When using an elastic belt* without an alternator, an additional power take off on the water pump is not permissible.

**A belt tensioning tool is not required..*

11 General limits of use

11.1 Cold start capability

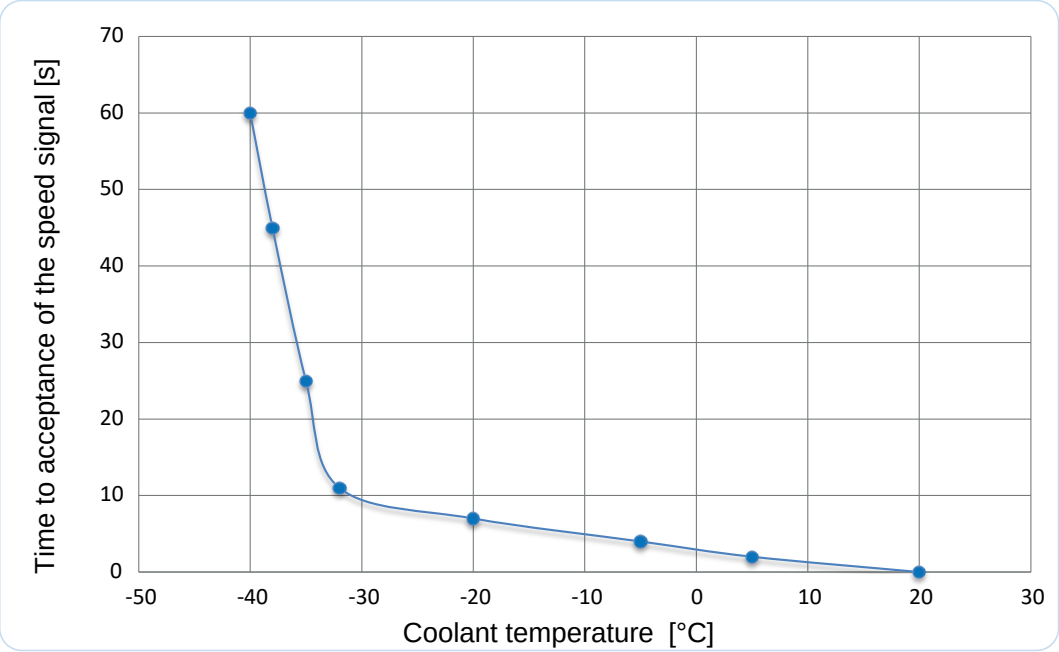
The following specifications are valid up to an altitude of approx. 1460 m above sea level. At higher altitudes, the cold-start capability deteriorates compared to these values.

Cold start with 12-V equipment	-25 °C
Cold start with 24-V equipment	-32 °C
Cold start with 24-V equipment	-40 °C (with special release)

The driven machines should now draw a load during the starting process. If this cannot be guaranteed, e.g., in hydraulic systems, an increase in the minimum cold starting temperature can be expected. This cold start limit temperature must always be determined experimentally, depending on the application and use case.

Engine protection function: delayed speed acceptance after cold start

Because the establishment of the oil pressure is delayed at cold temperatures due to the high oil viscosity, the engine does not accept the engine speed until after the time indicated in the diagram.



11.2 Extreme conditions

The engine is mostly not used at the standard reference point of the **performance standard ISO 3046-1**, (+ 25 °C, 100 m above sea level, 30 % rel. humidity), but in places with **higher altitude and higher/lower temperatures, usually also with higher relative humidity**.

Also **temperature increases** caused by sunlight under a cowling must be considered.

Due to climatic conditions that differ from the standard reference location (altitude, temperature, humidity, contamination), the capacity of the engine leads to power reductions or system adjustments for extreme operating conditions.

It is necessary therefore to consult the **HATZ main plant** in order to best match the system to the application.

12 Contact protection for machine safety

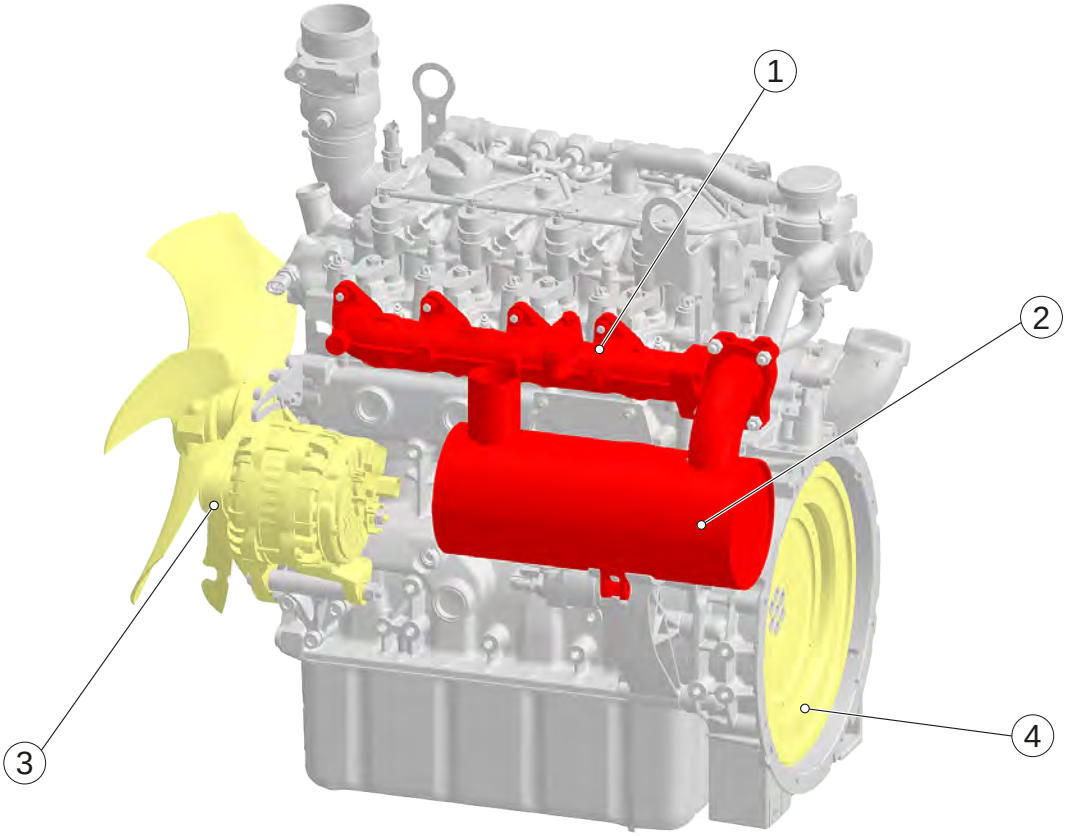
It is the responsibility of the manufacturer to heed and comply with the safety rules that apply to an engine in a finished machine.

The following chapter shows which contact protective devices are available from HATZ.

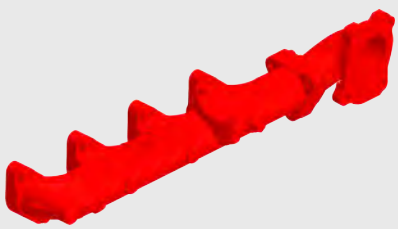
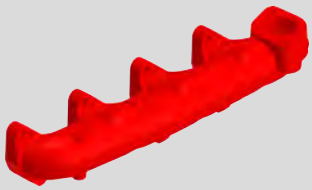
The following overview shows the hot surfaces (exhaust manifold etc.) and rotating parts (flywheel, fan, poly v belt etc.). There is an increased risk of injury here.

It is the duty of the machine manufacturer to ensure that all safety precautions (e.g., contact guard at the exhaust manifold) are taken for the whole machine so that any injury from hot surfaces and rotating parts is ruled out.

12.1 Hot surfaces and rotating parts

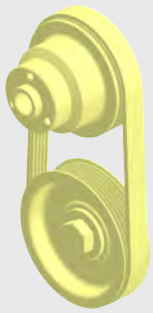
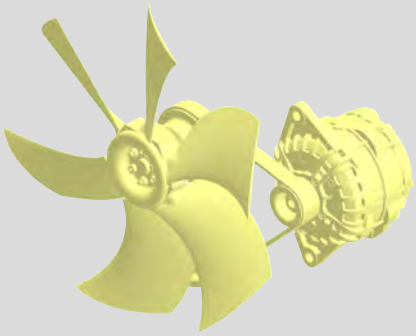
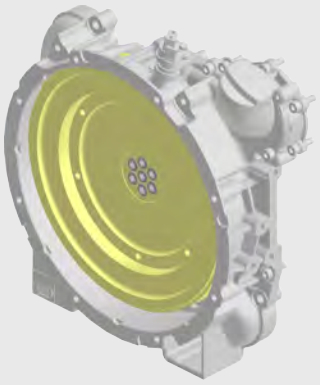


Hot surfaces:

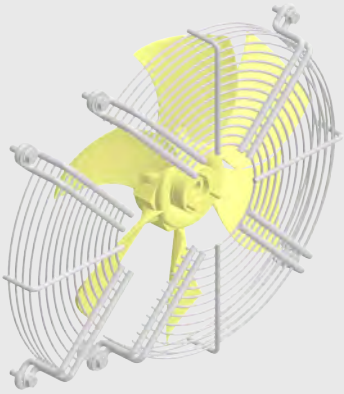
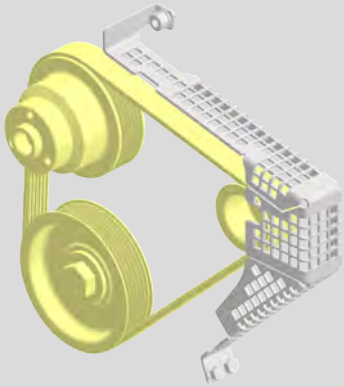
1	Exhaust manifold for silencer (engine model – N)	
1	Exhaust manifold (engine model NO – TRU)	

2	Silencer (engine model – N)	
2	Diesel oxidation catalytic converter (DOC) and piping (engine model – NO)	

Rotating parts:

3	V-belt drive	
3	V-belt drive (fan, poly v belt, alternator)	
4	Flywheel	

12.2 Contact guard

Contact guard for fan (optional)	
Contact guard for poly v belt (optional)	

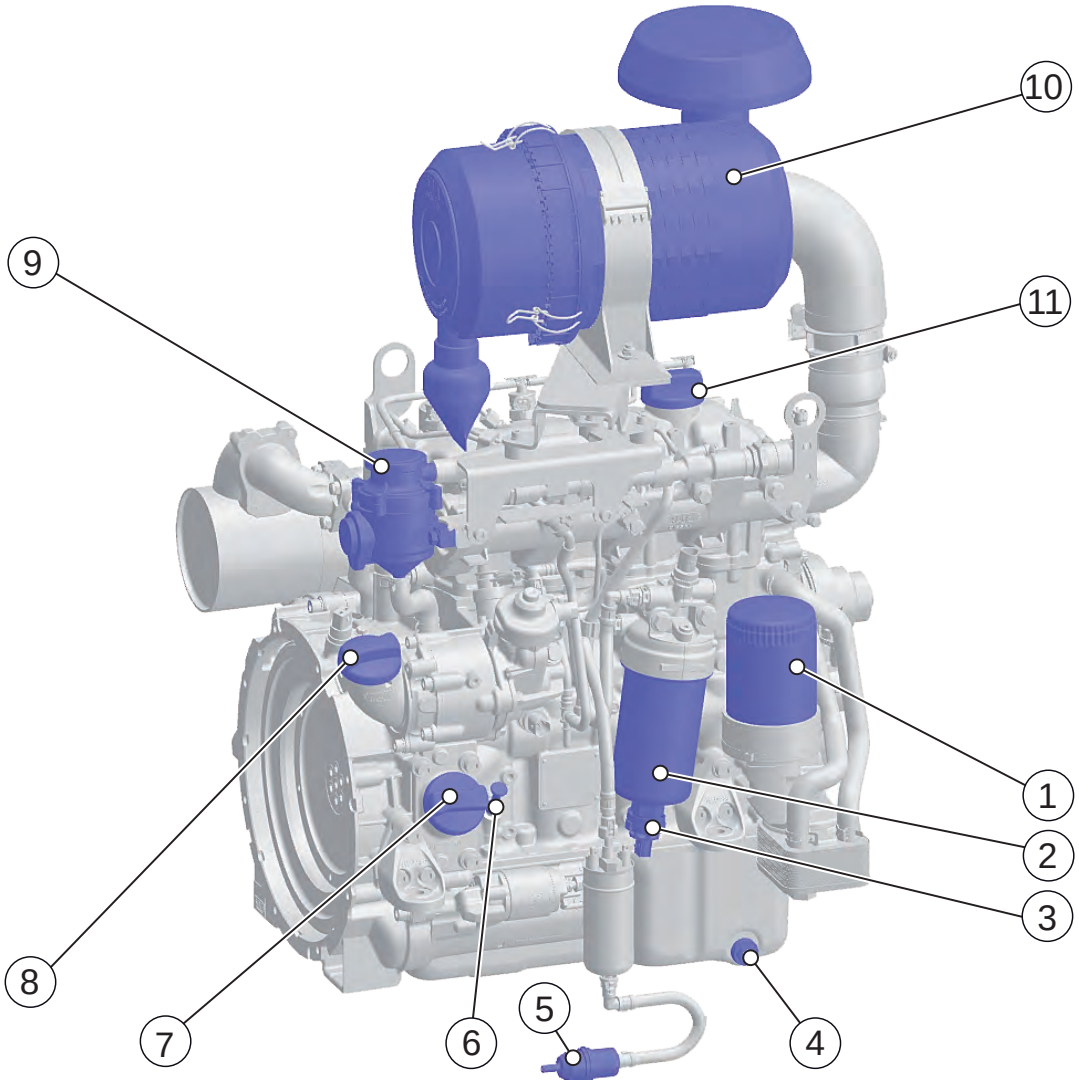
13 Maintenance

13.1 Accessibility of service points

When installing the engine, make sure that all service points are easily accessible and the service label on the engine and/or machine is legible.

If there is no easy access, there is a risk that the necessary maintenance work is not carried out at all or not carried out at the right time. This can lead to increased wear and premature engine failure.

Service points – operating side



1	Oil filter	7	Oil filler plug, middle
2	Main fuel filter	8	Oil filler plug, bottom
3	Drain screw with integrated water in fuel sensor	9	Crankcase ventilation
4	Oil drain screw	10	Air filter
5	Fuel prefilter	11	Oil filler plug, bottom
6	Dipstick		

13.2 Maintenance intervals

Detailed information on maintenance intervals and carrying out maintenance work can be found in the **Diesel Engine Manual**.

14 Engine preservation

	NOTICE
	If an extended storage period,> 12 months, is planned, preservation procedures as per the Hatz Preservation Instructions 043 450XX must be followed.

15 Test of the engine installation (checklist)

The engine can only function so well as its installation situation dictates. Engine damage caused by an unfavorable engine installation, a neglected power calculation or a non-matching speed selection are **not considered as warranty cases**.

Please use the previous guidelines as a checklist during the final test on the engine installation.

We recommend proceeding as follows:

15.1 Installation note

HATZ diesel engines are efficient, robust, and have a long service life. Therefore, they are usually installed in machines that are used for commercial purposes. The machine manufacturer must follow the applicable regulations regarding machine safety – the engine is a part of a machine.

Depending on the use and installation of the engine, it may be necessary for the machine manufacturer and machine user to install safety equipment to prevent inappropriate use. Note the following:

- Parts of the exhaust gas system and the engine surface become hot during operation and may not be touched until they cool down after the engine is switched off.
- Incorrect cable connections and operation of the electrical equipment can lead to sparking and must be avoided.
- After the engine is installed in the machine, rotating parts must be protected against contact.
- Comply with all notices and warning labels on the engine and keep them in a legible condition. If an adhesive label should become detached or difficult to read, it must be replaced promptly. For this purpose, contact your nearest Hatz service.
- Any improper modification of the engine will result in a loss of liability coverage for resulting damage.

Only regular maintenance, as specified in manual for diesel engine, will maintain the operating readiness of the engine.

The Assembly Instructions contain important information on how to safely assemble the engine. They are available from any Hatz service.

If you have any questions, please contact your nearest **HATZ** Service Station prior to commissioning the engine.

15.2 Initial startup

Before initial startup, check the delivered parts for completeness, damage, and other noticeable issues.

DANGER

Danger to life from inhaling exhaust gases.

Toxic engine exhaust gases can lead to loss of consciousness, and even death, in closed-off and poorly ventilated rooms.

- Never operate the machine in closed-off or poorly ventilated rooms.
- Do not breathe in the exhaust gases.

CAUTION

Health hazard due to inhalation of flue gas.

To protect exposed metal parts against corrosion, the parts concerned are coated with a protective wax. When the engine is started for the first time, this protective wax evaporates on hot components. This can lead to the generation of smoke for a brief period.

- Do not inhale flue gas.
- Ensure sufficient ventilation.

CAUTION

Danger of engine damage from the use of starting fluid.

- Engine damage from the use of starting fluid can lead to uncontrolled ignition.
- Engine damage from uncontrolled ignition.
- Never use starting fluid.

NOTICE

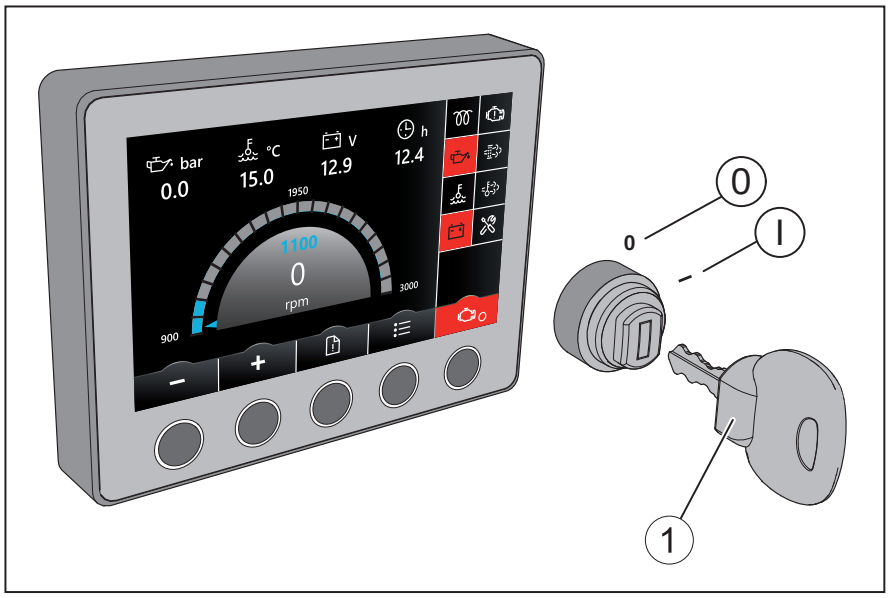
Before installing further add-on parts, the preservation wax must be removed from the screw-on surfaces and the surfaces must be cleaned.

Before starting

Before starting the engine, several tests need to be performed to ensure the machine is working properly.

Step	Test
1	The machine is standing securely and on a level surface.
2	The installation location is adequately ventilated.
3	Sufficient amount of fuel in the fuel tank.
4	Sufficient amount of engine oil in the engine housing.
5	Sufficient amount of coolant in the expansion tank.
6	The cooler and cooler hoses are leak-free.
7	No persons are located in the danger zone of the engine or machine.
8	All safety equipment is in place.

Overview – HATZ fixtures box



1	Starting key
Ignition lock	
0	Off
I	Operation (ignition on)

Switch on

Step	Activity
1	Insert the starting key all the way and turn to position "I". The image appears on the display after a few seconds.

Switch off

Step	Activity
1	Turn the starting key to position "0". The display switches off after approx. 20 seconds.

NOTICE

For further details on the instrument box, see chapter Overview of instrument box.

NOTICE

- In case of irregularities, switch off the engine immediately.
- Identify the fault and eliminate it.
- For details on troubleshooting measures, see the Operator's Manual for the machine.

15.3 Starting the engine

NOTICE

For details, see the Diesel Engine Manual.

15.4 Checking of engine choice and engine environment

- Is the speed correctly chosen, properly adjusted and matches the operating hours per year?
- Is the load on the engine in order?
- Has the climate at the place of use been taken into account?
- When installing the engine under a cover or in a room, has the climate change been taken into account in the power calculation?
- As small a temperature difference as possible between the ambient temperature and the temperature immediately in front of the Exhaust manifold is decisive for as long a service life as possible.
- Is the machine **vibration free/oscillation decoupled** as far as possible?
- Have our recommendations for **engine attachment** been taken into account?

15.5 Testing of engine equipment

- Is the **engine cooling system correctly** designed?
- Was the **engine mount correctly** designed?
- Are the **fuel lines laid in a flexible and ventable manner**?
- Is the **fuel tank content** large enough for the intended operating time?
- Is the engine adequately protected against **environmental influences**?
  - Dust formation
  - Driving rain
  - Corrosive substances in the air
  - Rock fall
- Where present, are the supply and return air lines flexible, laid with the correct dimension, and in the right place?
- Were the lines and hoses laid without chafing and are they free of collision?
- Was the correct fault compensation response option chosen?
- Has the exhaust pipe, if present, been selected so that the **exhaust gas back pressure is within the limit values** and has the exhaust pipe been laid flexibly?
- Are the load limits adhered to at the power take off points?
- Do the following parameters of the engine installation correspond to the requirements of the machine?
  - Vibrations
  - Speed stability
  - Start-up time
- Is the max. oil capacity sufficiently large for the intended operating period?
- Is the max. possible machine skew ≤ the max. engine skew?
- Does the machine correspond to
  - the **noise regulations** in the specified fields of use?
  - the **exhaust gas regulations**?
  - the **safety regulations**?
  - all relevant **statutory regulations** (e.g. noise emission, exhaust gas emission, low voltage, electromagnetic compatibility, functional safety …)?

15.6 Checking the accessibility of the operating and service points

- Carry out maintenance work only when the engine is switched off.
- Adhere to legal regulations when handling and disposing of used oil, filters, coolants, and cleaning agents.
- Protect the starting key from unauthorized access.
- Disconnect the negative terminal of the battery before carrying out maintenance work.

- After completing maintenance work, check that all tools, screws, aids, and other objects are removed from the machine, and that all safety equipment has been replaced.
- Before starting, ensure that no persons are located in the danger zone of the engine or machine.

It must be possible to carry out operating and maintenance work easily. The more accessible the service points, the more reliable the engine is maintained and the better it will work.

Poorly accessible service points are not recognized by service personnel as service points, which affects the service life of the engine.

Please ensure that there is good accessibility to the operating and service points by carrying out the necessary manual actions personally.

Operating points/service points:

See also chapter Accessibility of service points.

- Dipstick
- Oil filler
- Oil drain
- Oil filter
- Cooling water filling
- Coolant drain
- Air filter
- Crankcase ventilation filter (ProVent)
- Belts
- Cooling air passages
- Battery
- Fuel main filter with water separator
- Fuel prefilter
- Is the engine easy to remove for repair work?
- Diagnostics interface
- Fuseholder

15.7 Installation log

Hatz Ruhstorf reserves the right to perform the installation check and the installation log for the engine in series machines. For this, please contact the respective subsidiary. The installation check is carried out by **Hatz Ruhstorf** or the relevant **Hatz representative/subsidiary**. The warranty commitment for the engine in series machines is linked to the installation log.

15.7.1 Prerequisite for carrying out the installation check

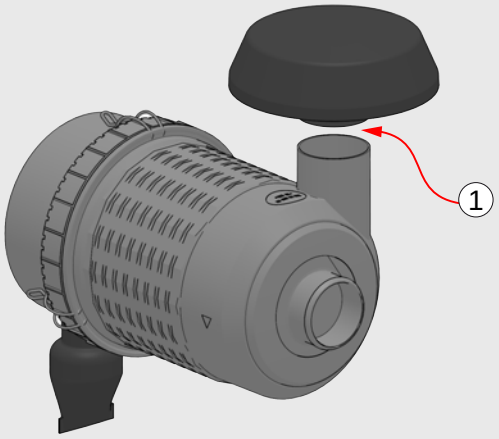
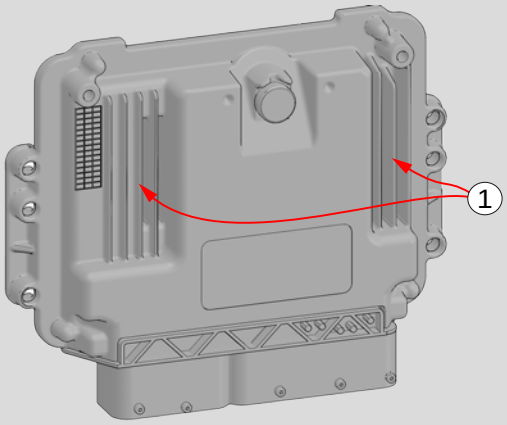
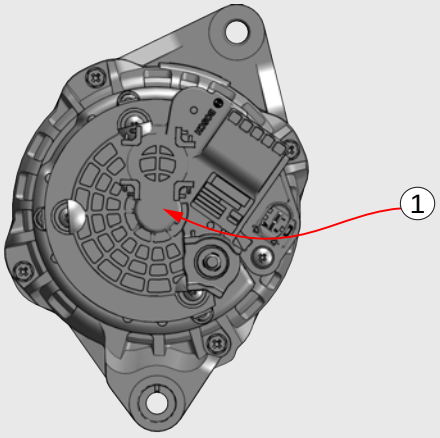
Before an installation check with cooling capacity measurement is carried out, the following prerequisites must be fulfilled by the machine manufacturer:

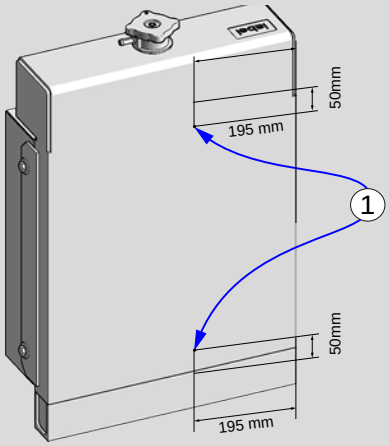
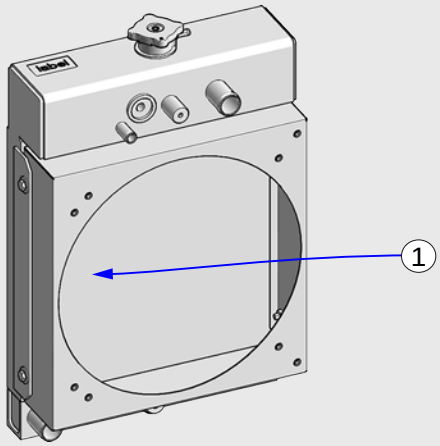
- The application should correspond as close as possible to the series condition
- The application must be operational for the measurements
- Any covers (e.g. for sound optimization) on the machine must be fitted for measurements and correspond to the series status
- Cables, hoses etc. must be laid and connected
- The complete machine electronic system must be installed and fully operational
- Display and warning elements must function properly
- All power take offs must be operational and tight
- The duration and carrying out of the installation check can vary due to the complexity of the application

15.7.2 Measuring point overview

Note: For temperature measurement, a permanently opened thermostat must/should be installed in the engine!

Analog measuring points

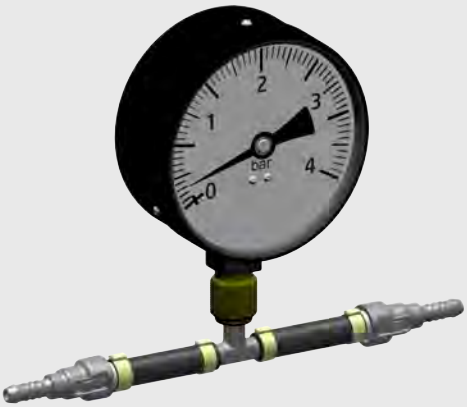
Ambient temperature	
	Measuring position (1) at the air filter intake, intake temperature The temperature should rise as little as possible compared to the ambient temperature.
	Measuring positions (1) on control unit ED-C17C81 Temperature min. – 40 °C, max. + 85 °C
	Measuring position (1) on the alternator Temperature min. – 40 °C, max. + 105 °C

Ambient temperature	
	Measuring positions on the cooler on the front of the extractor fan In front of the water cooler (1) centered at the top and bottom, 15 mm in front of the radiator network The temperature should rise as little as possible compared to the ambient temperature. Note the cooler sealing!
	Measuring positions on cooler, engine side, pressure fan Side of water cooler (1) centered on the radiator frame/safety guard

Further measuring points as required

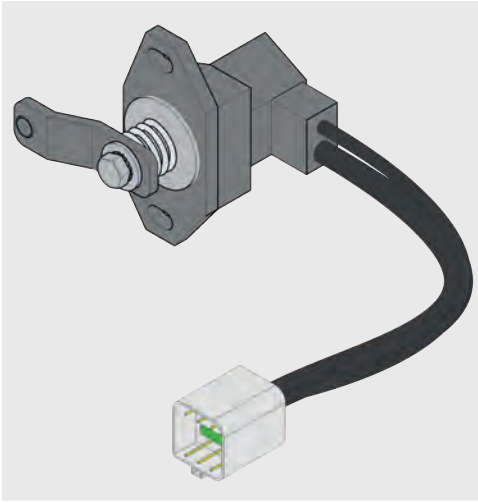
HDS recording values	
Data set/software/error memory from screen	
	Limit values (error substitute reaction)
Operating hours (optional)	
Engine speed (mandatory)	
Torque (mandatory)	
Injection quantity (optional)	
Fuel consumption (optional)	
Battery voltage (optional)	
Coolant temperature (mandatory)	
Oil temperature (mandatory)	120 °C warning, 140 °C error substitute reaction
Oil pressure (optional)	
Fuel temperature (mandatory)	80 °C
Fuel pressure, low circuit (mandatory)	
Rail pressure (optional)	
Air mass flow (TICD mandatory)	
Suction vacuum (mandatory)	
Ambient pressure (optional)	
Charge pressure, actual value (optional)	

HDS recording values	
Charge air temperature (mandatory)	Max. 15 °C above ambient temperature
Exhaust gas temperature before DOC (TICD mandatory)	
Exhaust gas temperature before DPF (TICD mandatory)	
Gas pedal 1 position (optional)	

Pressures in the fuel lines	
	Connect pressure gage between return on engine and return line. See also *8.4.3 fuel circuit diagram, page 50* pos. 9. ▪ The max. permissible pressure in the return line is 0.3 bar. Connect the pressure gage between the fuel prefilter and the fuel pump. See also *8.4.3 fuel circuit diagram, page 50* pos. 6. ▪ The max. permissible vacuum is also 0.3 bar but before the fuel pump.

16 Functional safety

16.1 Speed adjustment



All continuously adjustable rotational speed setpoint adjusters (gas pedal, manual lever, etc.) are CAN speed controls.

If the speed is specified via a speed selection switch (multi-state switch), no redundant setpoint is given.

Even with the speed setting via CAN bus, no redundant setpoint is given.

16.2 Fault replacement reaction

There are 3 different engine settings for the fault compensation response. Depending on the engine specification, the engine controller reacts as follows in case of a malfunction.

Emergency running

The engine switches over to emergency operation. In this situation, the engine power is reduced or the maximum speed is limited. The engine fault indicator lights up.

- Oil pressure error
- Temperature error (oil or cylinder head, cabling)
- Battery voltage too high
- Fuel pump output error

Failure	Fault replacement reaction
Engine speed setting, analog	If possible, emergency operation, otherwise lower neutral gear
Speed setpoint CAN	Lower idling speed
Speed setpoint MSS*	
With master data set 450E, the engine switches off upon absence of oil pressure.	

** Multistage switch*

Stop engine (standard with constant speed)

The "Stop engine" option has the same fault compensation responses as emergency running, except for engine switch-off in the event of the following errors:

- Oil pressure min./max. or sensor failure
- Max. oil temperature
- Coolant level below min.
- Water in fuel or sensor failure
- Max. coolant temperature
- Max. intake negative pressure reached (air filter clogged) or sensor failure
- Max. charge air temperature or sensor failure
- Min. fuel low pressure or sensor failure

Failure speed setting, analog	Emergency running
Speed setpoint failure	Lower idling speed

Display for engine control

If engine malfunctions occur, the engine malfunction indicator lamp lights up without a fault compensation response.

- Oil pressure error
- Temperature error (oil or cylinder head, cabling)
- Charge control
- Speed error (speed too high, speed signal malfunction, wiring)
- Battery voltage too high/low
- Sensor voltage too high/low
- Ambient pressure too high/low
- Fuel pump output error, glow plug, injection pump, wiring

Failure	Fault replacement reaction
Engine speed setting, analog	No fault compensation response
Speed setpoint CAN	Engine running with last known speed specification
Speed setpoint MSS*	

Nr.	Sensor	Min.			FER	Empfehlung
1	Kühlmitteltemperatur	-44	°C	105	110	Motor abstellen
2	Öltemperatur	-44	°C	120	140	
3	Öldruck *1	0,8	bar	7,2		
4	Kraftstofftemperatur	-44	°C	80		
5	Kraftstoffdruck *1	1,5	bar	10		
6	Raildruck	bar		1950	1990	
7	Ansaugunterdruck *2 (Luftfilter)	-14/-71 *2	-13/-57 *2	mbar		
8	Umgebungsdruck (ECU)	450	mbar	1100		
9	Ladelufttemperatur	-44	°C	85		
10	Kurbelwellensensor	-				
11	Nockenwellensensor	-				
12	Glühkerzen *3	Kein Fehler bei Glüheinrichtung		Fehler bei Glüheinrichtung		
13	Injektoren	-				
14	Kühlmittelstandssensor	Kühlmittelniveau unter min.				
*1 Kennlinie / *2 Kennfeld / *3 Glühkerzen nur Warnung, keine Fehlerersatzreakt.						
WARNUNG		FEHLERERSATZREAKTION (FER)				

NOTICE
Only in exceptional cases for engines that are not emissions-compliant

17 Declaration of incorporation

Extended Declaration of Incorporation
EC Machinery Directive 2006/42/EC

The manufacturer: **Motorenfabrik Hatz GmbH & Co.KG**
Ernst-Hatz-Straße 16
D-94099 Ruhstorf a. d. Rott, Germany

herewith declares that the incomplete machine: product designation: **Hatz diesel engine**
type designation and beginning with consecutive serial no.:
3H50T = 17811; 3H50TI = 16321; 3H50TIC = 13521; 3H50TICD = 16411;
4H50TI = 16122; 4H50TIC = 13622; 4H50TICD = 16512;
4H50N = 14712; 4H50N = 19310; 4H50NO = 19210

is in compliance with the following basic safety and health protection requirements as per Annex I of the Machinery Directive named above.

- General principles no. 1
- No. 1.1.2., 1.1.3., 1.1.5., 1.2.1., 1.2.2., 1.2.3., 1.2.4.1., 1.2.4.2., 1.3.1., 1.3.2., 1.3.3., 1.3.4., 1.3.7., 1.4.1., 1.5.1., 1.5.2., 1.5.3., 1.5.8., 1.5.9., 1.5.10., 1.5.11., 1.6.1., 1.6.2., 1.6.4., 1.7.1, 1.7.2

All relevant basic safety and health protection requirements up to the interfaces described in the following documents:
☒ Diesel Engine Manual
☒ Attached data sheets
☒ Attached technical documentation
have been met.

The following standards (or parts thereof) were applied:
- EN 1679-1: 092011
- EN ISO 12100: 032011
- EN ISO 13857: 042020
- EN 60204-1:062019

The Diesel Engine Manual is included with the incomplete machine and the Installation Instructions were made available to the customer electronically with the order confirmation.

The special technical documentation was created as per Annex VII B of Machinery Directive 2006/42/EC.
I will forward the special technical documentation specified above to the appropriate authority if necessary.

The special technical documentation specified above can be requested from:
Wolfgang Krautloher; contact the manufacturer for the address

Commissioning of the equipment is prohibited until it has been established, if possible, that the machine into which the above machine is to be installed meets the specifications of the Machinery Directive.

18/06/2024
Date

Friedrich Peter
Head of Type Series, Water-Cooled Engines

Dr.-Ing. Simon Thierfelder
Chief Executive Officer - CEO

18 Compliance with emission regulations

The certificates on the engine type plate are decisive for the necessity of a Delegated Assembly and/or a Separate Shipment Contract.

18.1 Delegated Assembly

If **EPA/CARB** emission-relevant components are not installed on the engine as part of the scope of delivery, a **Delegated Assembly Contract** must be concluded between the supplier (Hatz) and the customer.

See chapter *8.5.5 Exhaust pipes – DOC installation (chassis-fixed), page 59*.

18.2 Separate Shipment

If **EU emission-relevant components** are not installed on the engine as part of the scope of delivery and are also delivered separately from each other, a **Separate Shipment Contract** must be concluded between the supplier (Hatz) and the customer.

See chapter *8.5.5 Exhaust pipes – DOC installation (chassis-fixed), page 59*.

18.3 Delegated Assembly & Separate Shipment

If **EPA/CARB & EU emission-relevant** components are not installed on the engine as part of the scope of delivery, a **Delegated Assembly Contract** and additionally a **Separate Shipment Contract** must be concluded between the supplier (Hatz) and the customer.

See chapter *8.5.5 Exhaust pipes – DOC installation (chassis-fixed), page 59*.

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CREATING POWER SOLUTIONS

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