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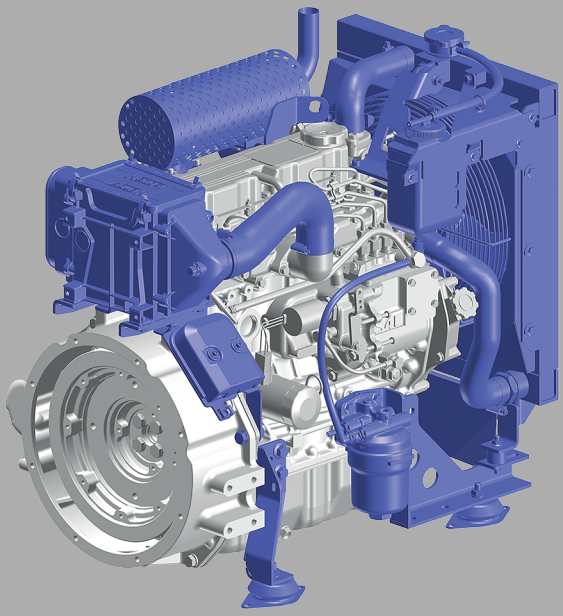


INCLUDES SUPPLEMENTAL INFORMATION TO THE OWNER'S MANUAL FOR EPA AND CALIFORNIA CERTIFIED NONROAD COMPRESSION IGNITION ENGINES.

3F30, 3F35E, 3F45 (E), 4F45 (E)

OPERATOR'S MANUAL
Diesel engine

Hatz

1 Legal notices

Contact data

© 2025
Motorenfabrik Hatz
Ernst-Hatz-Straße 16
94099 Ruhstorf
Germany

Tel. +49 (0)8531 319-0

Fax +49 (0)8531 319-418

marketing@hatz.com

www.hatz.com

Copyright

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**.

2 General information

Information on the document

This manual was created with due care. It is exclusively intended to offer a technical description of the machine and to provide instructions on commissioning, operating and maintaining the machine. When operating the machine, the applicable standards and legal regulations as well as any in-house regulations apply.

Before commissioning, during operation and before maintenance work is begun on the machine, read this manual carefully and keep it close by for ready access.

Machine

This manual describes the following machine.

Machine name	HATZ diesel engine
Type number	3F30, 3F35E, 3F45, 3F45E, 4F45, 4F45E

Customer service

Have service work performed by qualified technicians only. We recommend that you work with one of the over 500 **HATZ service stations**. Your machine will be repaired there by personnel with up-to-date training using **genuine spare parts**. The global HATZ service network is at your disposal to advise you and supply you with spare parts. For your nearest **Hatz service center**, please see **www.hatz.com** on the internet.

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 spare parts**. These parts are manufactured according to strict manufacturer specifications and achieve maximum operational reliability through their perfect fit and functionality. The order number can be found in the enclosed spare parts list or on 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.

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.

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

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 ISO 3046-1 and 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 *3.2.2 Machine-specific safety instructions for operation, page 15* and in chapter *3.2.3 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

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 how to safely install the engine and are available at your nearest **HATZ service station**.

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

In addition, please note that it is prohibited to start up the machine before it has been determined that the machine into which this engine is installed fulfills all safety-related requirements and legal regulations.

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. Operating 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, .

Obligations of the operating and maintenance personnel

Personnel assigned with operating and maintaining the machine must have read and understood this manual 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.

All work performed on the machine must be in compliance with the information provided in this manual.

Storing this manual

This manual is an integral component of the machine (also when being sold). It must be stored in the direct vicinity of the machine and be accessible to personnel at all times.

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 operating the machine and during maintenance work.

These 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.

3.1.4 Meaning of safety symbols

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 hot surfaces! (Alternative)

Symbol	Meaning
	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.
	Additional information that is useful to the reader.

3.2 Safety notes

3.2.1 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 .. ▪ 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 7*.

Compliance with other regulations

- The applicable regulations of the relevant professional associations must be observed.
- 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.
Working clothes		Wear close-fitting working clothes. It must not restrict the wearer's freedom of movement, however.

Warning labels and information signs on the machine

The warning labels and information signs on the machine must be followed.

The warning labels and information signs must be kept legible and must be replaced if necessary. For this purpose, contact your nearest **HATZ service station**.

Maintenance work

Maintenance work that goes beyond the scope described in this manual must only be performed by qualified technicians (see chapter Customer service).

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 and maintain 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 *6.1 Transport, page 28*).

3.2.2 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

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.

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.

3.2.3 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.
  Regular maintenance according to the instructions in this manual is essential for ensuring reliable operation and the correct engine exhaust quality.
- 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 this manual 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 *2 General information, page 6*).
- 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.

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.

3.2.4 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 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 cleaning, do no spray the electrical equipment components with a water jet or high pressure cleaner.
- 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-in connections to the voltage regulator.

NOTICE

- We cannot be held liable for electrical equipment that is not designed according to HATZ wiring diagrams.

4 Technical data

4.1 Engine information and filling quantities

Type Mechanical speed control Electronic speed control		**3F30**	**3F35E**	**3F45 3F45E**	**4F45 4F45E**
Type		Liquid-cooled four stroke diesel engine			
Combustion system		Swirl chamber			
Number of cylinders		3	3	3	4
Bore/Stroke	mm	76 / 70	76 / 81	78 / 92	78 / 92
Displacement	cm^3	952	1102	1318	1758
Engine oil capacity	Approx. ltr.	3.6 [1)]	4,5 [1)]	4.2 [1)]	6.0 [1)]
Difference between "max" and "min" marking	Approx. ltr.	1.3 [1)]	1.1 [1)]	1.3 [1)]	1.8 [1)]
Engine oil consumption (after running-in period) based on full load	Approx.	0.1–0.3% of fuel consumption at rated speed			
Engine oil pressure at oil temperature of max. 90 °C and low idle speed	approx. bar	0.8	1.0	1.0	1.0
Max. permissible engine oil temperature		115 °C			
Sense of rotation		Left (view toward flywheel)			
Coolant filling quantity (engine)	Approx. ltr.	1.8	1.8	1.8	2.5
Coolant filling quantity (engine with Hatz cooler)	Approx. ltr.	4.2	4.2	4.2	4.9
Max. permissible coolant temperature at engine outlet		105 °C			
Dry weight Basic engine Open Power Unit (OPU)	 Approx. kg Approx. kg	 107 141	 110 141	 153 186	 163 197

[1)] These specifications are approximate values. The max. mark on the dipstick is decisive in any case (see section *8.5 Checking the oil level, page 42*).

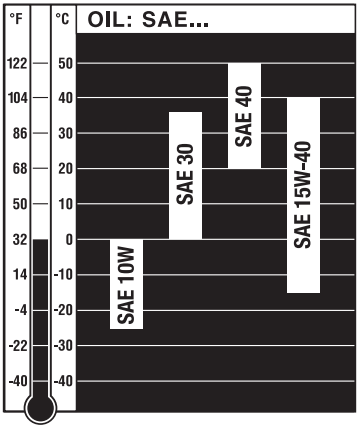
4.2 Engine oil

Oil quality

All brand name oils that satisfy the following specification are suitable:

- **API – CF / CH-4** or better

Oil viscosity



Select the recommended viscosity depending on the ambient temperature at which the engine will be operated.

	CAUTION
	Engine damage from unsuitable engine oil. Unsuitable engine oil considerably reduces engine service life. Only use engine oil that fulfills the specifications stipulated above.

4.3 Coolant

Introduction

Liquid-cooled engines require a coolant specified by the engine manufacturer for engine cooling.
Coolant is prepared in accordance with manufacturer's instructions of the product in question; please comply with the information on the packaging label.

Cooler protection fluids give effective protection against corrosion and freezing. In addition, the coolant boiling point is significantly raised and deposits of lime in the cooling system are reduced.

Safety notes

	CAUTION
	**Danger of damage to health** Cooler protection fluids are harmful to health. ▪ Avoid contact to eyes and skin. ▪ Store only in the sealed original container and in a place inaccessible for unauthorized persons. ▪ Comply with manufacturer's instructions.

	CAUTION
	**Danger of environmental damage from spilled coolant.** Coolant is water-polluting. ▪ Do no allow them to enter the ground water, water bodies, or sewage system. ▪ Collect the coolant and dispose of it according to local environmental regulations.

	CAUTION
	Danger of engine damage from cooler protection fluid. Use of a cooler protection fluid not approved by the engine manufacturer can cause engine damage. ▪ If you have any questions, please contact your nearest **HATZ Service** before commissioning the engine.

Specification

All long-term cooler protection fluids that meet the specification **JIS K2234** are suitable.

Preparation of the coolant

	CAUTION
	Danger of engine damage from incorrect radiator protection fluid concentration. If the cooler protection fluid concentration is too low, this increases the risk of corrosion as well as the risk of the cooling system freezing. If the cooler protection fluid concentration is too high, this lowers the cooling effect as well as the freezing protection. Therefore, serious engine damage may result from exceeding or dropping below the cooler protection fluid concentration.

- The cooler protection fluid must be prepared according to the manufacturer's instructions before filling into the cooling circuit or some cooler protection fluids are also offered as premixed formulations. Be sure to comply with the information on the packaging label.
- If the cooler protection fluid has to be mixed with water, use only clean, soft water. Drinking water with as low a content of salt, minerals and suspended matter as possible is ideal. Demineralized or distilled water is also ideal.

The following limit values must not be exceeded:

Water quality	Chemical symbol	Unit	Recommended value	Limit value
pH value (25 °C [77 °F])	–	–	6.5 to 8.0	6.5 to 8.0
Electrical conductivity (25 °C [77 °F])	–	mS/m	≤ 25	≤ 40
Total hardness	$CaCO_3$	ppm	≤ 95	≤ 100
M alkalinity	$CaCO_3$	ppm	≤ 70	≤ 150
Chlorine ions	Cl-	ppm	≤ 100	≤ 100
Sulfuric acid ions	SO_4^{2-}	ppm	≤ 50	≤ 100
Total iron	Fe	ppm	≤ 1.0	≤ 1.0
Silicon	SiO_2	ppm	≤ 30	≤ 50
Residue from evaporation	–	ppm	≤ 250	≤ 400

The coolant mixture ratio must not be below or exceed the following concentration:

Radiator protection fluid	Water	Frost-resistant to approx. *
min. 40 vol%	60 vol%	-24 °C
max. 50 vol%	50 vol%	-36 °C

* These details depend on the product in question. Be sure to comply with the packaging label.

4.4 Fuel

Fuel type

All types of diesel fuel that meet the minimum requirements of the following specifications are suitable:

- **Europe: EN 590**
- **UK: BS 2869 A1/A2**
- **ASTM D 975-09a 1-D** or **2-D**
- **Japan: JIS K 2204**

	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).

	CAUTION
	Danger of malfunctions due to old fuel. When diesel fuel is stored in a fuel tank or canister for lengthy periods, deposits may form on account of fuel aging. These deposits result in malfunctions due to clogged fuel filters and damage to the injection system. ▪ Perform the prescribed storage steps in machines that will be out of use for more than three months (see chapter *11 Storing the machine, page 82*). ▪ Only refuel with fresh diesel fuel such as can be obtained from filling stations.

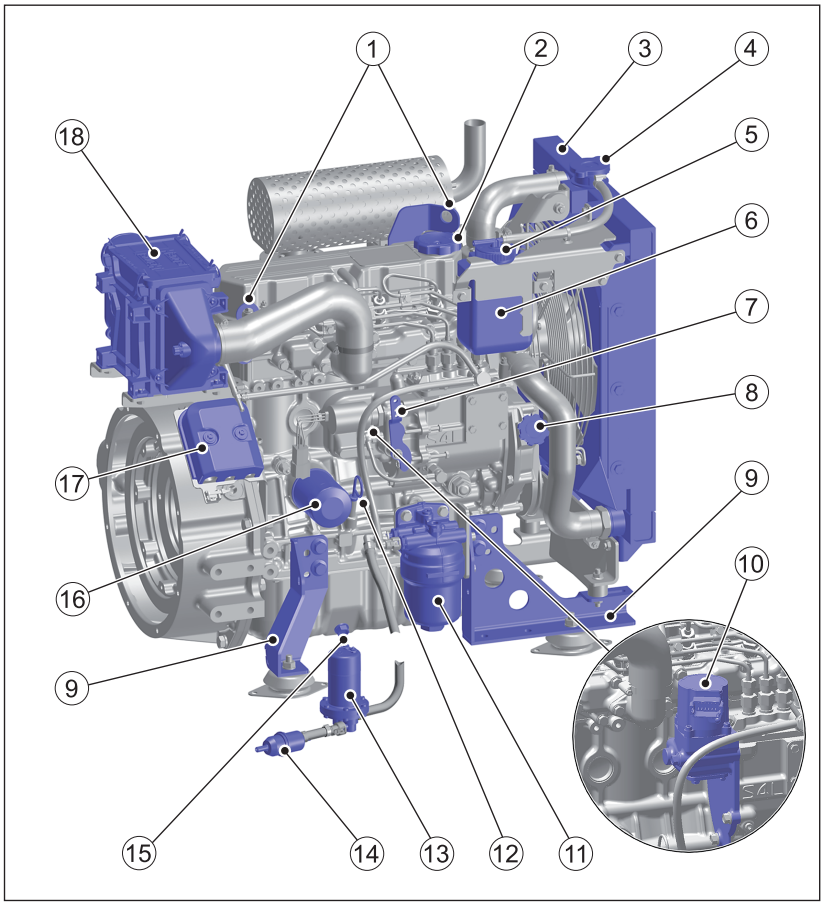
Winter fuel

Diesel fuel loses its fluidity at low temperatures, which can lead to operating problems. Use cold-resistant winter diesel fuel for outside temperatures below 0 °C.

5 Engine overview

5.1 Designation of components

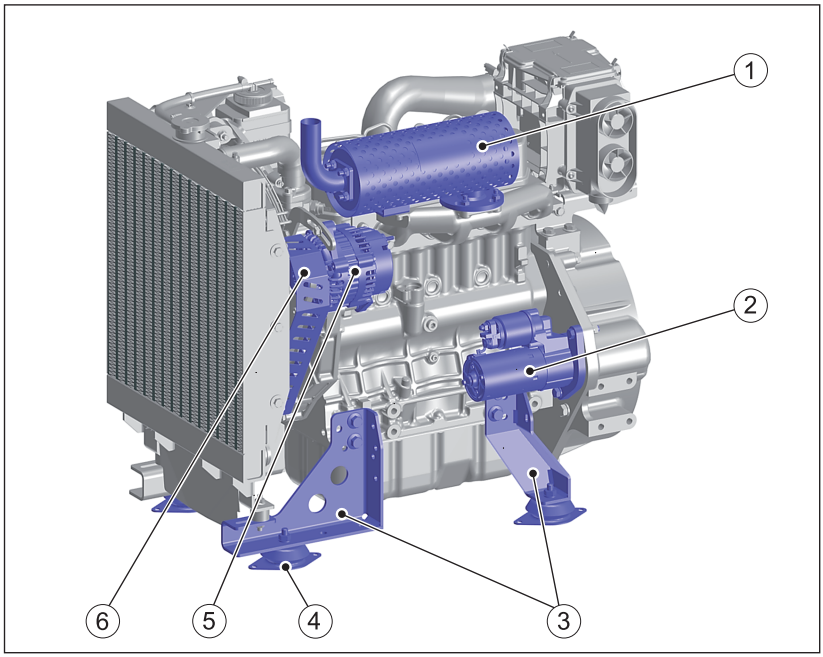
Model – OPU (Open Power Unit)
Intake side



1	Lifting eyes
2	Oil filler plug, top
3	Cooler
4	Cooler cap
5	Screw plug on the overflow container
6	Overflow container

7	Speed control lever (only for 3F30, 3F45 and 4F45)
8	Oil filler plug, bottom
9	Engine bracket
10	Electronic speed governor (only for 3F35**E**, 3F45**E** and 4F45**E**)
11	Main fuel filter
12	Dipstick
13	Electric fuel pump
14	Fuel prefilter
15	Oil drain screw
16	Oil filter
17	Relay cover
18	Air filter

Model – OPU (Open Power Unit)
Exhaust gas side



1	Muffler with contact protection
2	Starter

3	Engine bracket
4	Vibration damper
5	Three phase alternator
6	Belt guard

	NOTICE
	The Open Power Unit (OPU) is a complete system which, in addition to the engine, features all components required for operation, such as the cooling system, fuel system, electrical system, combustion air filter and muffler.

6 Transport

6.1 Transport

Safety notes

WARNING

Danger of injury from improper lifting and transport.

Danger of crushing from the engine falling or tipping.

- The machine may only be lifted using the lifting points (1).
- Before lifting the engine, check the lifting eyes for deformation and damage. Lifting with deformed or damaged lifting eyes is not permitted. Replace deformed or damaged lifting eyes before using them for lifting.
- Before lifting the engine, ensure that the fixing screws of the lifting eyes are tight.
- Only use a suitable hoist with a sufficient carrying capacity.
- Always use all lifting eyes for lifting.
- 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.

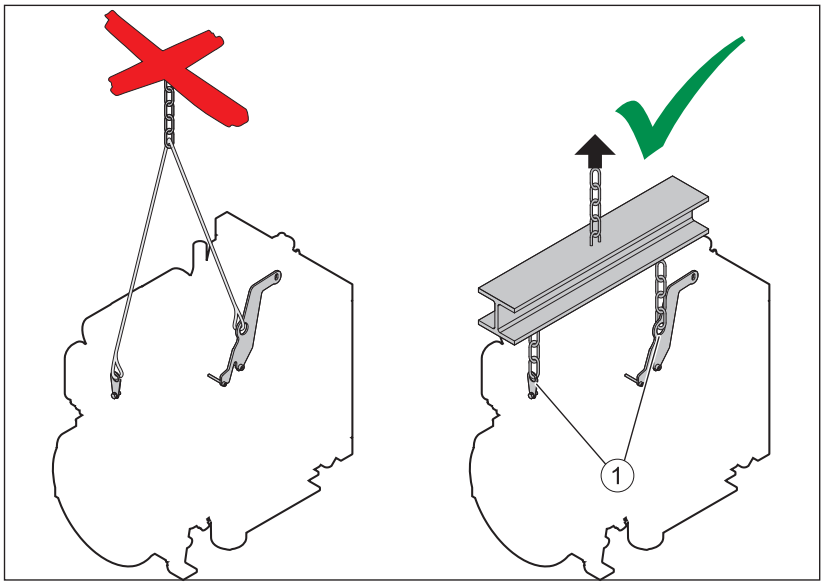
If the machine is tilted, engine oil and fuel can run out.

- Only transport the machine in an upright position.

Transport conditions

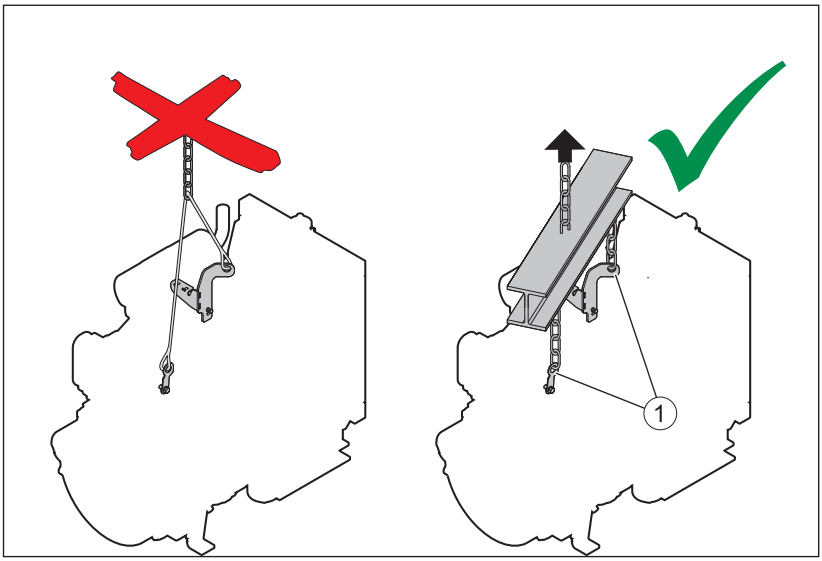
- When transporting the machine, follow the safety instructions.
- When transporting, follow the applicable safety and accident prevention regulations.
- After delivery, check the machine for completeness and transport damage.
- Only transport the machine when it is switched off and has cooled down.
- 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**.

Lifting points 3F30, 3F35



1	Lifting points

Lifting point 3F45, 3F45E, 4F45, 4F45E



1	Lifting points

7 Commissioning

7.1 Preparations for commissioning

- Check the delivered parts for completeness, damage, and other noticeable issues.
- Ensure that the setup location is adequately ventilated.

	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.

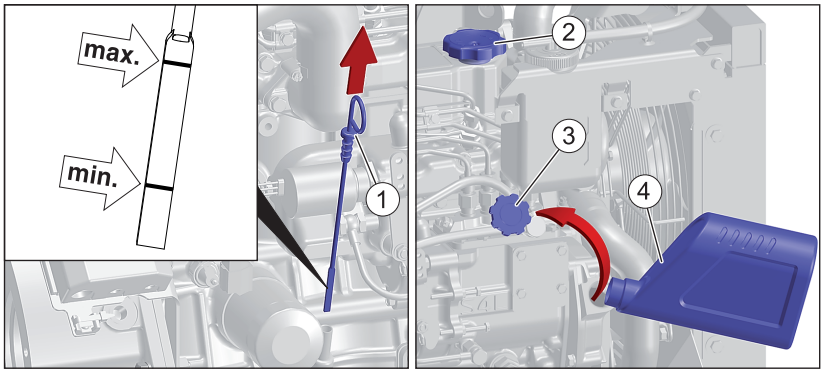
7.2 Filling engine oil (first filling)

Engines are normally delivered without an engine oil filling.

Safety note

	CAUTION
	Danger of later engine damage. ▪ Operating the engine with an oil level below the **min.** mark or above the **max.** mark can lead to engine damage. ▪ When checking the oil level, the engine must be horizontal and have been switched off for a few minutes.

Overview



1	Dipstick
2	Oil filler plug, top

3	Oil filler plug, bottom
4	Oil refilling container

Procedure

Step	Activity
1	Pull out the dipstick (1) and wipe it off with a clean towel.
2	Unscrew the oil filler plug (2) or (3).
3	Fill with engine oil. For the specification and viscosity, see section *4.2 Engine oil, page 21*. For the filling quantity, see section *4.1 Engine information and filling quantities, page 20*.
4	Reinsert the dipstick.
5	Pull out the dipstick and check the oil level.
6	If necessary, add engine oil to the max. mark.
7	Reinsert the dipstick.
8	Screw in the oil filler plug.

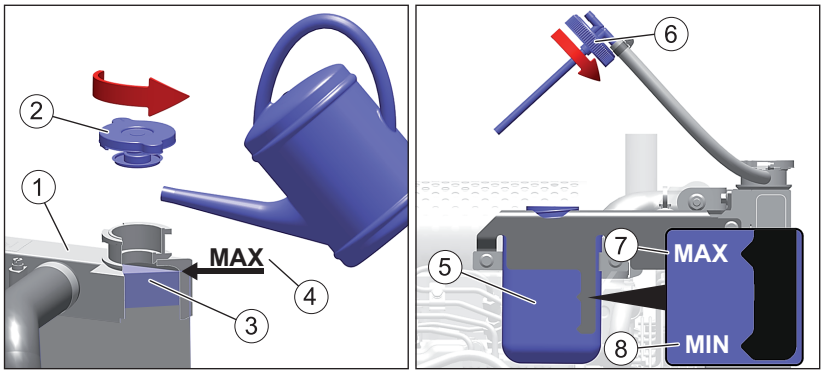
7.3 Filling the cooling system

Safety notes

	⚠ CAUTION
	**Danger of burns.** There is a danger of burns when working on a hot cooling system. The cooling system is pressurized when the engine is hot. ▪ Let the engine cool. ▪ Wear safety gloves.

	CAUTION
	Danger of later engine damage. ▪ Operating the engine with a coolant level below the **MIN.** mark can lead to engine damage. ▪ When checking the coolant level, the engine must be horizontal and switched off.

Overview



1	Cooler
2	Cooler cap
3	Coolant
4	**MAX** - Maximum coolant level in cooler
5	Overflow container
6	Screw plug on the overflow container
7	**MAX** - Maximum coolant level in overflow container
8	**MIN** - Minimum coolant level in overflow container

Procedure

Step	Activity
1	Open and remove the cooler cap (2).
2	Top up the coolant to the lower edge (4) of the filler neck. For preparation of the coolant, see section *4.3 Coolant, page 21*.
3	Tighten the cooler cap (2) all the way by hand.
4	Open and remove the screw plug (6).
5	Top up coolant to the MAX mark (7).
6	Tighten the screw plug (6) by hand.
4	Start the engine (see chapter *8 Operation and use, page 36*).
5	Warm up the engine until the coolant has reached a temperature of approx. 80 °C. Above this temperature the coolant is pumped through the entire cooling system and forces out remaining air bubbles.

Step	Activity
6	Switch off the engine and let it cool down completely (see chapter *8 Operation and use, page 36*).
7	Check the coolant level again. The coolant must be seen between the **MIN** and **MAX** mark; for a warm engine the level can also be slightly above the **MAX** mark.
8	Check the cooling system for leaks, retighten the hose clips if necessary (see section *9.2.4 Checking the cooling system, page 52*).

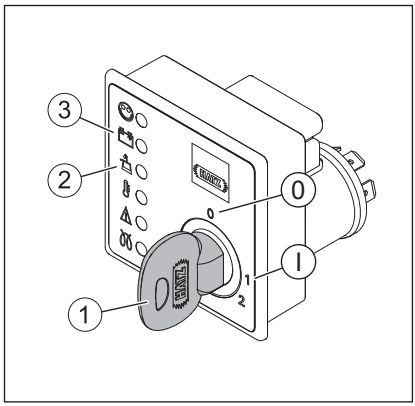
7.4 Venting the fuel system

Requirements

The fuel system must be bled in the following situations:

- At first filling of the fuel tank
- After the fuel prefilter or main fuel filter is replaced
- Engine shuts down due to empty fuel tank

Overview



1	Starting key
2	Oil pressure indicator
3	Charge control
Ignition lock	
0	Off
I	Operation

Procedure

Step	Activity
1	Insert the starting key all the way and turn to position "I". The oil pressure indicator (2) and charge control (3) light up.
2	Leave the starting key at position "I" until you hear the electric fuel feed pump switch off (usually after approx. 10 seconds).
3	Turn the starting key back to position "0". *Note:* Carry out steps 2 and 3 several times to press the air out of the fuel system.
4	Start the engine, see section *8 Operation and use, page 36*.

8 Operation and use

8.1 Safety notes

NOTICE

Comply with the safety chapter!

Follow the basic safety instructions in chapter *3 Safety, page 7*.

⚠ WARNING

Danger of injury from damage and defects on the machine.

- Do not take the machine into service if damage has been localized and identified.
- Replace defective components.

⚠ WARNING

Danger of injury from failure to follow the operating instructions and from performing unauthorized tasks on the machine.

- Define the responsibilities of the personnel taking the machine into service.
- Replace defective machine parts immediately.
- Check the installation conditions when the machine is first taken into service and after the machine has been inactive for a lengthy period.

CAUTION

Danger of engine damage from low load operation.

Operating the engine at no load or at very low load for an extended period can impair the running characteristics of the engine.

- Make sure that the engine load is at least 15 %.
- Before switching off the engine following low load operation, briefly operate it at a considerably higher load.

8.2 Performing tests

Before starting

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

Procedure

Step	Test
1	The machine is standing securely and on a level surface.
2	The installation location is adequately ventilated.
3	There is a sufficient amount of fuel in the fuel tank (see chapter *8.6 Refueling, page 44*).
4	There is a sufficient amount of engine oil in the engine housing (see chapter *8.5 Checking the oil level, page 42*).
5	There is a sufficient amount of coolant in the expansion tank (see chapter *9.2.4 Checking the cooling system, page 52*).
6	Cooler and cooler hoses are free from leaks (see chapter *9.2.4 Checking the cooling system, page 52*).
7	No persons are located in the danger zone of the engine or machine.
8	All safety equipment is in place.

8.3 Starting the engine

If possible, separate the engine from the machine being driven by uncoupling it. Always switch the machine into idle mode.

Safety notes

DANGER

Danger to life from inhaling exhaust gases.

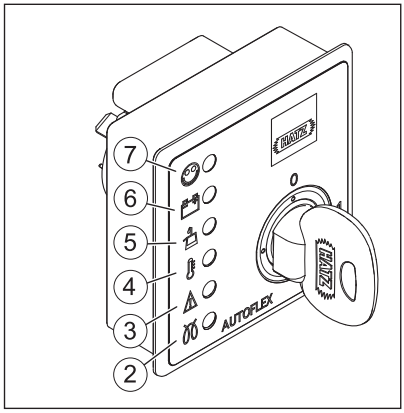
Toxic engine exhaust gases can lead to loss of consciousness, and even death, in closed-off and poorly ventilated rooms.

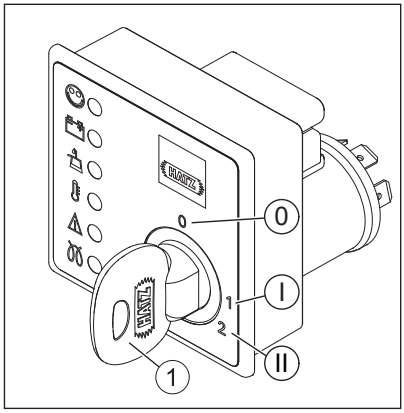
- Never operate the machine in closed-off or poorly ventilated rooms.
- Do not breathe in the exhaust gases.

	CAUTION
	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
	See also starting instructions in the documentation for the complete machine.

Overview – HATZ instrument boxes





1	Starting key
2	Pre-glow indicator (option)
3	Indicator for special customer functions (see the section "Explanation of symbols")
4	Coolant temperature indicator
5	Oil pressure indicator
6	Charge control
7	Operating indicator
Ignition lock	
0	Off
I	Operation
II	Start

Indicator lamps

The function of all indicators is checked after the starting key is turned to position "I". They light up consecutively from top to bottom. After the test, only the indicators for charge control and oil pressure are lit. If there is a fault, the applicable indicator does not go out after the engine start or it lights up again during operation. If the unit is switched off due to overspeed, all LEDs flash.

Explanation of symbols

Symbol	Meaning
	**Operating indicator** Lights up during operation when there is no engine fault.
	**Charge control** Fault in the alternator or alternator charging circuit. The battery is no longer charged. Eliminate the fault immediately.
	**Oil pressure indicator** Engine oil pressure too low. Danger of engine damage. Stop the engine immediately and check the oil level (see chapter *8.5 Checking the oil level, page 42*). Contact the HATZ service if the oil level is correct.
	**Coolant temperature indicator** Raised coolant temperature. Operate engine at reduced load. Switch off the engine if the indicator does not go off after 5 minutes. For details on troubleshooting, see chap. *10.1 Troubleshooting, page 79*.
	**Special customer functions** (e.g., electrical maintenance switch or stop switch). For further information, see the documentation for the complete machine.
	**Pre-glow indicator** Lights up at temperatures below 0 °C (depending on the setup). Start the engine after the indicator has gone out.

Procedure – starting the engine

	NOTICE
	▪ Start for max. 10 seconds. If the engine still does not start, the starting procedure can be repeated after waiting at least 60 seconds. After three unsuccessful start attempts, find the cause of the fault (see chap. *10.1 Troubleshooting, page 79*). ▪ Turn the starting key to position "0" every time you want to start the engine. ▪ The anti repeat device in the ignition lock makes it impossible for the starter to engage while the engine is running and become damaged.

Step	Activity
1	Depending on the situation, place the speed control lever in either the "1/2" or "Start" position. *NOTE:* A low speed setting will cause less exhaust smoke when starting.
2	Insert the starting key all the way and turn to position "I". Depending on the model, the following indicators light up: ▪ Pre-glow indicator (2) ▪ Oil pressure indicator (5) ▪ Charge control (6) *NOTE:* When indicator (4) lights up, the coolant temperature is impermissibly high. Do not start the engine; eliminate the cause. When the pre-glow indicator goes out, continue with step 3.
3	Turn the starting key to position "II".
4	As soon as the engine is running, release the starting key. ▪ The starting key springs back to position "I" and remains in this position during operation. ▪ The charge control (6) and oil pressure indicator (5) go out. ▪ The operating indicator (7) lights up and signals that there is no engine fault.
5	After starting the engine, allow it to warm up for 5 to 10 minutes at low speed and without load.

NOTICE

- In case of irregularities, switch off the engine immediately.
- Identify the fault and eliminate it.
- For details of troubleshooting, see chapter *10.1 Troubleshooting, page 79*.

8.4 Switching off the engine

Safety notes

CAUTION

Danger of injury from unauthorized access.

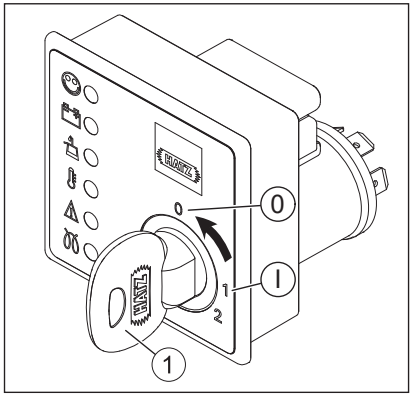
There is a danger of injury if unauthorized persons handle the machine.

- Protect the starting key against unauthorized access during breaks in operation or after completing work.

NOTICE

See also instructions in the documentation for the complete machine.

Overview – HATZ instrument boxes



1	Starting key
Ignition lock	
0	Off
I	Operation

Procedure

Step	Activity
1	Turn the starting key to position "0". The engine switches off. All indicator lamps go out. *Note:* The engine continues running for several seconds after it is switched off. Before performing any further activities, wait until all moving components have come to a complete standstill.
2	Remove the starting key.

NOTICE

Danger of exhaustive battery discharge.

- When the machine is switched off, always turn the starting key to position "0" or else the battery may become fully discharged.

8.5 Checking the oil level

Safety notes

CAUTION

Danger of burns.

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

- Wear safety gloves.

CAUTION

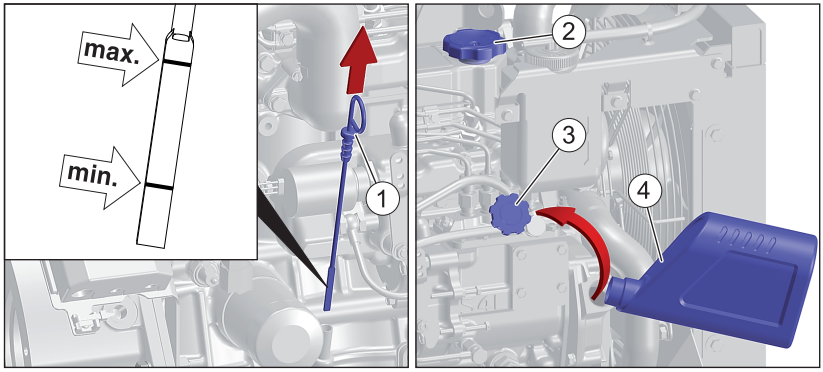
Danger of injury

Prolonged contact with engine oil can lead to irritation of the skin.

- Wear safety gloves.
- If there is contact with the skin, thoroughly wash the affected areas of the skin with soap and water.

	CAUTION
	Danger of later engine damage. ▪ Operating the engine with an oil level below the **min.** mark or above the **max.** mark can lead to engine damage. ▪ When checking the oil level, the engine must be horizontal and have been switched off for a few minutes.

Overview



1	Dipstick
2	Oil filler plug, top
3	Oil filler plug, bottom
4	Oil refilling container

Procedure — Checking oil level/adding oil

Step	Activity
1	Switch off the engine and wait several minutes for the engine oil to collect in the crankcase. The engine must be level.
2	Remove contamination on the engine in area of the dipstick (1) and the oil filler plug.
3	Pull out the dipstick and wipe it off with a clean towel.
4	Reinsert the dipstick.
5	Pull out the dipstick and check the oil level.
6	If the oil level is close to the **min.** mark, add engine oil to the **max.** mark. For the specification and viscosity, see chapter *4.2 Engine oil, page 21*.
7	Reinsert the dipstick.

8.6 Refueling

This diesel engine is intended for installation in a machine or for assembly with other machines to form a machine and does not have its own fuel tank. Follow the instructions from the manufacturer and comply with the following safety information.

Safety notes

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.

CAUTION

Danger of injury.

Repeated contact with diesel fuel can cause chapped and cracked skin.

- Wear safety gloves.
- If there is contact with the skin, thoroughly wash the affected areas of the skin with soap and water.

CAUTION

Engine damage from using low quality fuel.

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

- Only use the fuel specified in chapter *4.4 Fuel, page 24*.
- The use of fuels that do not meet specifications require approval by Motorenfabrik HATZ (main plant).

	NOTICE
	Never run the tank empty if possible, as otherwise air can enter the fuel system. This can lead to damage to the injection system. If the tank is still run empty, proceed as follows: ▪ Fill the fuel tank with diesel fuel. ▪ Bleed the fuel system (see chapter *7.4 Venting the fuel system, page 34*).

9 Maintenance

9.1 General maintenance instructions

Safety notes

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.

NOTICE

Comply with the safety chapter!

Follow the basic safety instructions in chapter *3 Safety, page 7*.

- Maintenance tasks may only be performed by trained personnel.
- Accident prevention measures must be in accordance with the local accident prevention regulations.
- Perform setting and maintenance work at the specified intervals.
- Replace defective machine parts as soon as possible.
- Always wear personal protection equipment.
- Only use fully functional tools.
- 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**.
- Closely adhere to the maintenance conditions prescribed in this manual.
- Only make changes to the machine in agreement with the manufacturer.
- Only perform maintenance work when the engine is switched off.
- Protect the starting key from unauthorized access.
- Disconnect the negative battery terminal before carrying out maintenance work.
- Adhere to legal regulations when handling and disposing of used oil, filters, coolants, and cleaning agents.
- 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.

Performance of maintenance work

The entire machine is designed to be maintenance friendly. Parts that require maintenance are easily accessible.

- Perform maintenance work faithfully at the specified intervals to prevent premature wear of the machine.
- Follow the notice and warning labels on the machine.
- Always retighten screw connections loosened during maintenance work.
- After the necessary maintenance and repair work is completed, perform a function test (test run).
- For maintenance work that is not listed and described in the maintenance documentation, please contact your nearest **HATZ service station**.

9.2 Maintenance work

Safety note

⚠ CAUTION	
	**Danger of injury from ignoring the maintenance instructions.** ▪ Only perform maintenance work when the engine is switched off. ▪ Protect the starting key from unauthorized access. ▪ Disconnect the negative battery terminal. ▪ When the maintenance work has been completed, ensure that all tools are removed from the machine.

9.2.1 Maintenance plan

NOTICE

The maintenance intervals listed below apply to standard applications. If the operating conditions differ significantly from the usual use cases, it is possible that Hatz and the manufacturer of the complete machine reached a special agreement stipulating shorter or longer maintenance intervals. Corresponding information regarding different maintenance intervals can be found in the documentation of the complete machine.

Daily checks

Maintenance interval	Activity/check	Section
Every 8–15 operating hours or every day before starting	Checking the oil level	*8.5 Checking the oil level, page 42*
	Checking the intake area of the combustion air	*9.2.2 Checking the intake area of the combustion air, page 49*
	Check the cooler fins for dirt accumulation	*9.2.3 Checking the cooler fins for dirt accumulation, page 51*
	Checking the cooling system	*9.2.4 Checking the cooling system, page 52*

Initial maintenance of new or rebuilt engines

Maintenance interval	Maintenance step/check	Section
After the first 50 operating hours:	Change the engine oil and oil filter	*9.2.5 Change the engine oil and oil filter, page 55*
	Checking the screw connections	*9.2.9 Checking the screw connections, page 66*

Maintenance

Maintenance interval	Maintenance step/check	Section
Every 250 operating hours or every 12 months	Check and clean the cooler fins[1)]	*9.2.6 Cleaning the radiator fins, page 59*
	Change the engine oil and oil filter[1)]	*9.2.5 Change the engine oil and oil filter, page 55*
	Check and adjust the belt and belt tension1)	*9.2.7 Checking the belt and belt tension, page 62*
	Drain the water separator[1)]	*9.2.10 Draining the water separator, page 66*

Maintenance interval	Maintenance step/check	Section
Every 500 operating hours or every 12 months	Change the fuel prefilter[1)]	*9.2.11 Changing the fuel prefilter, page 68*
	Replace the main fuel filter[1)]	*9.2.12 Changing the main fuel filter, page 70*
	Air filter maintenance[1)]	*9.2.13 Air filter maintenance, page 72*
	Check the anti-freeze concentration of the coolant[1)]	*9.2.4 Checking the cooling system, page 52*
	Check and adjust the tappet clearance[1)] (to be carried out by a trained specialist)	
	Check the glow plugs (to be carried out by a trained specialist)	
	Check the screw connections[1)]	*9.2.9 Checking the screw connections, page 66*
Every 2 years	Changing the coolant	*9.2.14 Changing the coolant, page 76*
Every 1500 operating hours	Clean the injection nozzles (to be carried out by a trained specialist)	
Every 3000 operating hours	Check and maintain the injection nozzles (to be carried out by a trained specialist)	

[1)] Maintenance according to the maintenance interval or after 12 months, whichever comes first.

9.2.2 Checking the intake area of the combustion air

Safety notes

CAUTION

Danger of burns.

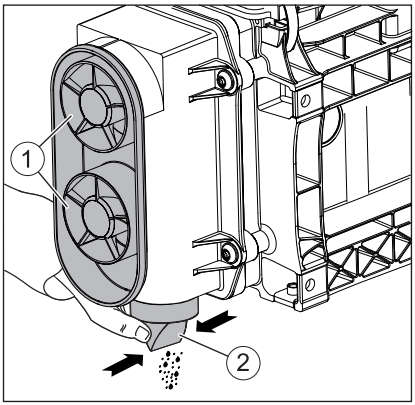
There is a danger of burns when working on a hot engine.

- Let the engine cool.
- Wear safety gloves.

	CAUTION
	Damage to the cyclone precleaner from improper cleaning. ▪ Never clean the cyclone precleaner with hard or sharp-edged tools such as spatulas or screwdrivers to avoid damage. A damaged cyclone precleaner has poor efficiency.

	NOTICE
	In case of heavy contamination, shorten the maintenance intervals accordingly (see chapter *9.2.1 Maintenance plan, page 48*).

Overview (HATZ air filter)



1	Intake opening for combustion air (cyclone precleaner)
2	Dust discharge valve

Procedure

Step	Activity
1	Check the intake opening (1) for coarse contamination such as leaves, heavy dust deposits etc., and clean if necessary. For details on cleaning, see *9.2.13 Air filter maintenance, page 72*.
2	Check that the dust discharge valve (2) is clear. Remove dust seals by pressing them together.

9.2.3 Checking the cooler fins for dirt accumulation

Safety notes

CAUTION

Danger of burns.

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

- Let the engine cool.
- Wear safety gloves.

CAUTION

Danger of injury.

When working with compressed air, foreign bodies may fly into your eyes.

- Wear safety goggles.
- Never direct the compressed air jet toward people or toward yourself.

CAUTION

Danger of engine damage from overheating.

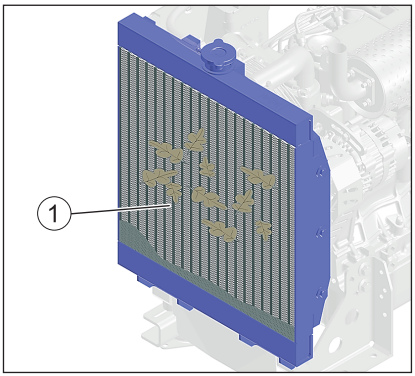
The engine temperature indicator lights up as soon as the engine becomes inadmissibly hot.

- Switch off the engine and eliminate the cause.

NOTICE

In case of heavy contamination, shorten the maintenance intervals accordingly (see chapter *9.2.1 Maintenance plan, page 48*).

Overview



1	Cooler fins

Procedure

Step	Activity
1	Check the cooler fins (1) for coarse contamination such as leaves, heavy dust deposits etc., and clean if necessary (see chapter *9.2.6 Cleaning the radiator fins, page 59*).

9.2.4 Checking the cooling system

Safety notes

CAUTION

Danger of scalding and risk of environmental damage due to hot coolant.

- Excess coolant is drained via the sealing cap of the cooler and channeled to the overflow container. After topping up the cooling system never move parts of your body or face close to the sealing cap.
- Never top up coolant above the MAX mark on the overflow container.
- Never stop escaping coolant with your bare hands.

CAUTION

Danger of burns.

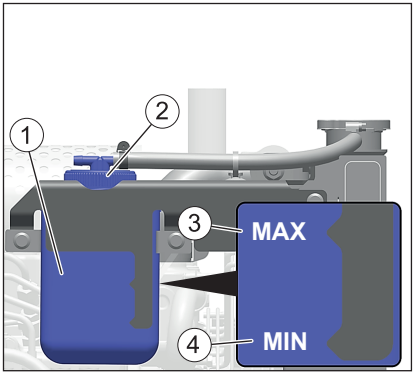
There is a danger of burns when working on a hot engine.

- Let the engine cool before maintenance.

	CAUTION
	**Danger of burns.** There is a danger of burns when working on a hot cooling system. The cooling system is pressurized when the engine is hot. ▪ Let the engine cool. ▪ Wear safety gloves.

	CAUTION
	Danger of later engine damage. ▪ Operating the engine with a coolant level below the **MIN.** mark can lead to engine damage. ▪ When checking the coolant level, the engine must be horizontal and switched off.

Overview



1	Overflow container
2	Screw plug on the overflow container
3	**MAX** - Maximum coolant level in overflow container
4	**MIN** - Minimum coolant level in overflow container

Procedure for checking the coolant level

Step	Activity
1	The coolant must be between the **MIN** and **MAX** marks on a switched-off and cooled-down engine. For a warm engine, the level can also be slightly above the **MAX** mark.

Procedure for topping up coolant

Step	Activity
1	Carefully open the screw plug (2).
2	Top up the prepared coolant to the **MAX** mark on the overflow container. For the preparation of the coolant, see section *4.3 Coolant, page 21*.
3	Tighten the sealing cap (2) by hand.

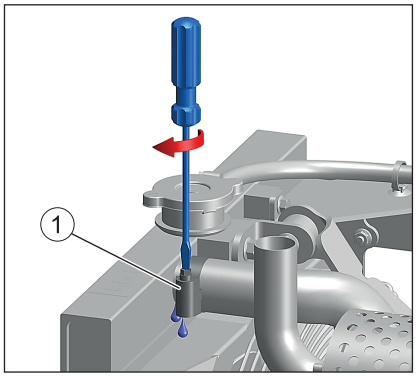
	NOTICE
	Since the corrosion and antifreeze concentration decreases over time, carry out a check with a commercially available antifreeze tester as per the maintenance schedule. If the concentration is too low, either: ▪ drain part of the coolant and bring to the required frost safety level by adding radiator protective fluid, or ▪ replace the entire filling of coolant (see section *9.2.14 Changing the coolant, page 76*).

Checking the cooling system for leaks

Coolants losses are mostly caused by leaks in the cooling system.

On a non-leaking cooling system, losses only occur when the coolant boils and this then causes coolant to be pressed out of the cooling system at the sealing cap on the overflow container. The cause of this can be contamination in the area of the cooler fins (see chapter *9.2.3 Checking the cooler fins for dirt accumulation, page 51*).

Overview



1	Hose clip

Procedure

Step	Activity
1	Check the cooling system for leaks and rectify the cause immediately - in case of doubt consult **HATZ Service** for advice.
2	When hose connections are loose, retighten the hose clips (1).

9.2.5 Change the engine oil and oil filter

This chapter contains the following subchapters:

- **Changing the oil filter**
- **Draining the engine oil**
- **Filling the engine oil**
- **Concluding the inspection work**

Safety notes

⚠ 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.

⚠ CAUTION

Danger of injury

Prolonged contact with engine oil can lead to irritation of the skin.

- Wear safety gloves.
- If there is contact with the skin, thoroughly wash the affected areas of the skin with soap and water.

CAUTION

Danger of later engine damage.

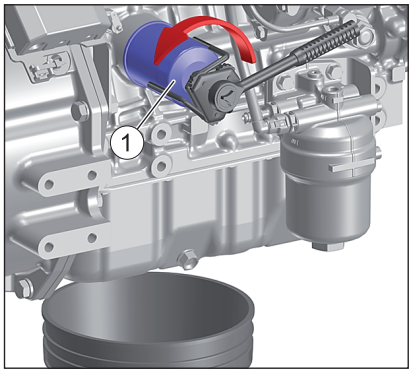
- Operating the engine with an oil level below the **min.** mark or above the **max.** mark can lead to engine damage.
- When checking the oil level, the engine must be horizontal and have been switched off for a few minutes.

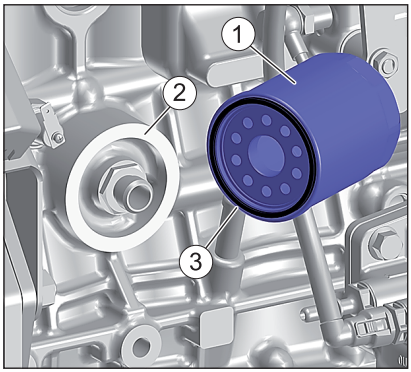
NOTICE

- The engine must be level.
- The engine must be switched off.
- Only drain engine oil while it is warm.

Changing the oil filter

Overview





1	Oil filter
2	Sealing surface
3	Sealing ring

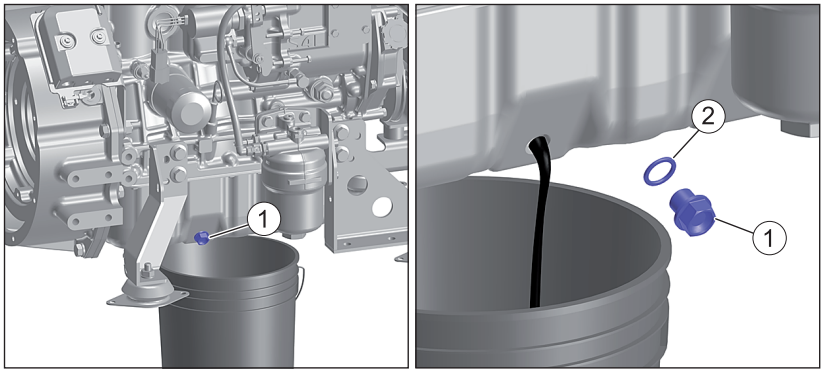
Procedure

Step	Activity
1	Keep a container ready for collecting the used oil.
2	Loosen the oil filter (1) with a strap wrench or similar and unscrew it.
3	Dispose of the old filter in accordance with local environmental regulations.
4	Thoroughly clean the sealing surface (2).

Step	Activity
5	Lightly oil the sealing lip (3) of the new oil filter.
6	Screw in the oil filter and **tighten it by hand**.

Draining the engine oil

Overview



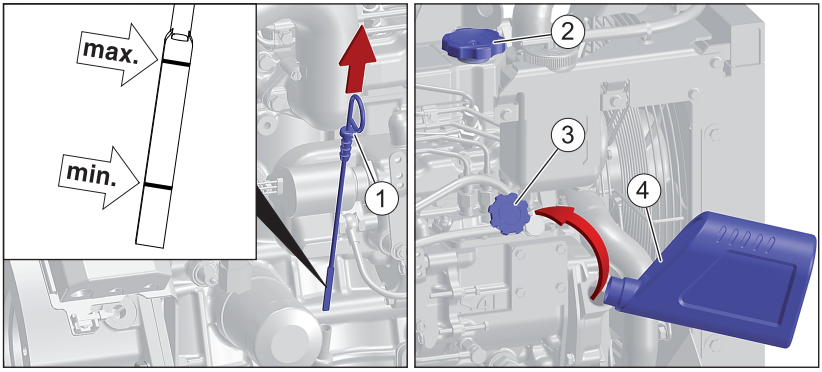
1	Oil drain screw
2	Sealing ring

Procedure

Step	Activity
1	Keep a container ready for collecting the used oil. The container must be large enough to hold the entire amount of engine oil. For the engine oil capacity, see chapter *4.1 Engine information and filling quantities, page 20*.
2	Unscrew the oil drain screw (1) and drain the used oil entirely.
3	Screw in the cleaned oil drain screw with the new sealing ring and tighten. Tightening torque: 40 Nm.

Filling the engine oil

Overview



1	Dipstick
2	Oil filler plug, top
3	Oil filler plug, bottom
4	Oil refilling container

Procedure

Step	Activity
1	Pull out the dipstick (1) and wipe it off with a clean towel.
2	Unscrew the oil filler plug (2) or (3).
3	Fill with engine oil. For the specification and viscosity, see section *4.2 Engine oil, page 21*. For the filling quantity, see section *4.1 Engine information and filling quantities, page 20*.
4	Reinsert the dipstick.
5	Pull out the dipstick and check the oil level.
6	If necessary, add engine oil to the max. mark.
7	Reinsert the dipstick.
8	Screw in the oil filler plug.

Concluding the inspection work

Step	Activity
1	Check the oil level after a short test run and correct if necessary.

Step	Activity
2	Check the oil filter for tightness and retighten by hand if necessary.

9.2.6 Cleaning the radiator fins

Safety notes

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.

CAUTION

Danger of environmental pollution due to oil and cleaning agents.

Oil and cleaning agents are hazardous to the environment.

- Do no allow them to enter the ground water, water bodies, or sewage system.
- Only clean the machine at the washing area intended for this.

CAUTION

Danger of burns.

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

- Let the engine cool.
- Wear safety gloves.

⚠ CAUTION

Danger of injury.

When working with compressed air, foreign bodies may fly into your eyes.

- Wear safety goggles.
- Never direct the compressed air jet toward people or toward yourself.

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

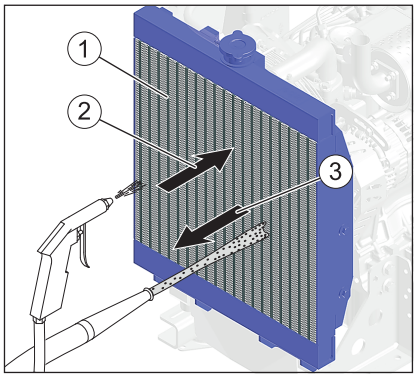
Damage to the cooler fins due to improper cleaning.

- Never clean the cooler fins with a tool such as a spatula or screwdriver. A reduction in cooler performance through bent cooler fins or cooler leaks may be the result.

NOTICE

In case of heavy contamination, shorten the maintenance intervals accordingly (see chapter *9.2.1 Maintenance plan, page 48*).

Overview



1	Cooler fins
2	Direction of flow of the cooling air with suction fan
3	Direction of flow of the cooling air with pressure fan

Procedure

Step	Activity
Cleaning in case of dry dirt contamination	
1	Clean the radiator fins either with compressed air or flush with a water jet - depending on the amount of accumulated dirt. Work first against the direction of flow of the cooling air and then in the direction of flow.
Cleaning wet or oily dirt contamination	
1	Spray the entire area with a suitable cold cleaner according to the manufacturer's instructions and then clean off with a water jet. Work first against the direction of flow of the cooling air and then in the direction of flow.
2	Identify the cause of the oiling and seal the leak.
After the cleaning	
1	Let the engine run warm until it has completely dried to prevent rust formation.

9.2.7 Checking the belt and belt tension

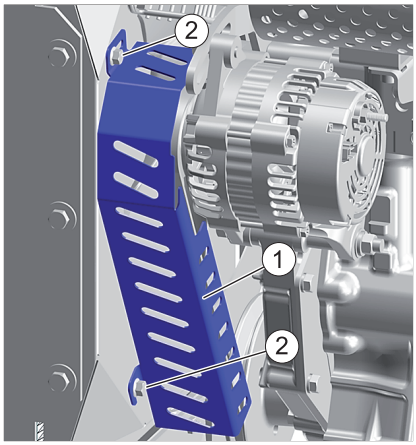
This section contains the following subsections:

- **Preparation**
- **Checking the belt for damage**
- **Checking and setting the belt tension**

Safety notes

CAUTION	
	**Danger of burns.** There is a danger of burns when working on a hot engine. ▪ Let the engine cool before maintenance.

Preparation



Step	Activity
1	Unscrew the optional belt guard (1). Unscrew the fixing screws (2) for this.

Checking the belt for damage

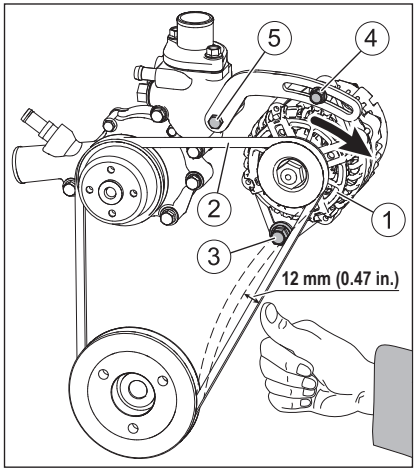
Procedure

Step	Activity
1	Check the belt for the following damage: ▪ Transverse cracks on the inside of the belt. ▪ Detachments on the surface. ▪ Hardened, polish flanks. ▪ Oily dirt contamination. If one or more of these types of damage are present, replace the belt immediately (see section *9.2.8 Changing the belt, page 64*).

Checking and setting the belt tension

NOTICE
▪ The cause of running noises of the belt is mostly likely that the pretension on the belt is too low. ▪ If the pretension is too low, this causes premature wear. ▪ If the pretension is too high, this can lead to premature wear of the generator bearing and also of the belt. ▪ Regularly check the belt tension; retension the belt if required.

Overview



1	Alternator

2	Belts
3	Lower fixing screw on the alternator
4	Upper fixing screw on the alternator
5	Fixing screw of the adjustment plate

Procedure

Step	Activity
Checking the belt tension	
1	As shown in the figure, press against the belt with your thumb and measure the distance that the belt can be pushed in. The belt tension is correct if the distance is 12 mm.
Setting the belt tension	
1	Undo the fixing screws (3, 4 and 5).
2	Turn the generator (1) in the direction of the arrow, hold it and – at the same time – tighten the fixing screws in this position.
3	Check the belt tension again.
4	If necessary, correct the belt tension.

Final steps

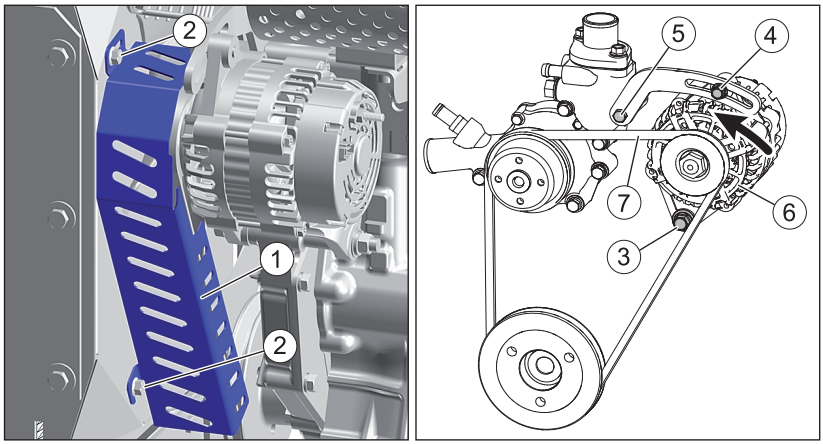
Step	Activity
1	Mount the belt guard again.

9.2.8 Changing the belt

Safety note

⚠ CAUTION	
	**Danger of burns.** There is a danger of burns when working on a hot engine. ▪ Let the engine cool before maintenance.

Overview



1	Belt guard
2	Fixing screws for belt protector
3	Lower fixing screw on the alternator
4	Upper fixing screw on the alternator
5	Fixing screw of the adjustment plate
6	Alternator
7	Belts

Procedure

Step	Activity
1	Unscrew the optional belt guard (1). Unscrew the fixing screws (2) for this.
2	Undo the fixing screws (2, 4 and 5).
3	Turn the generator (6) in the direction of the arrow to the stop.
4	Remove the loose belt (7) from the pulleys.
5	Check the pulley for perfect condition.
6	Lay the new belt over the pulleys and tighten (see section *9.2.7 Checking the belt and belt tension, page 62*).
7	Install the belt guard.

9.2.9 Checking the screw connections

Safety note

NOTICE
▪ Only retighten loose screw connections. Screw connections can be secured with thread locking adhesive or tightened to a defined torque. Retightening tight screw connections can cause damage. ▪ The adjusting screws on the injection system are secured with locking varnish and are not permitted to be tightened or adjusted. ▪ Do not retighten the screws for attaching the cylinder head.

Procedure

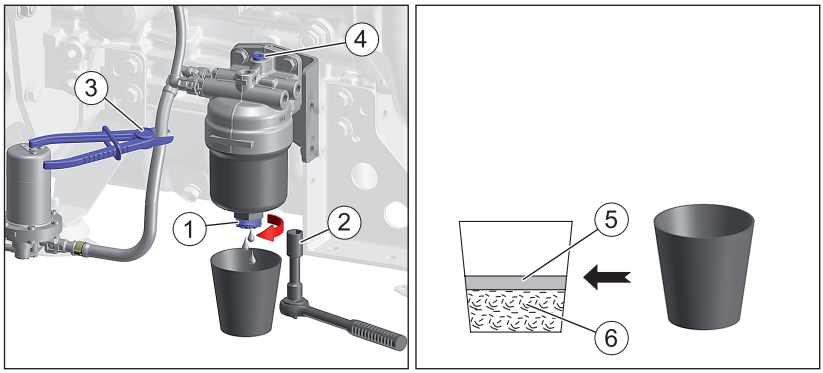
Step	Activity
1	Check the condition of all screw connections and ensure that they are tight (for exceptions, see note).
2	Tighten any lose screw connections.

9.2.10 Draining the water separator

Safety note

CAUTION
Danger of environmental damage from spilled fuel. When water is drained from the water separator, a small amount of fuel is drained as well. ▪ Collect any escaped water/fuel mixture and dispose of it according to local environmental regulations.

Overview



1	Drain screw
2	Socket wrench (13 mm)
3	Hose clip (for a fuel tank positioned low)
4	Vent screw
5	Fuel
6	Water

Procedure

Step	Activity
1	Place a suitable container under the drain screw (1).
2	Open the drain screw (1) using the socket wrench (2) and drain the water into the container.
3	If not enough liquid escapes, undo the additional vent screw (4). *NOTE:* If the fuel tank is lower than the main fuel filter, the fuel supply line must be disconnected with a hose clip (3). Otherwise fuel will run back into the fuel tank after the drain screw has been unscrewed.
4	As soon as fuel escapes, close the drain screw (1) and vent screw (4). *NOTE:* First water (6) escapes, then fuel (5). This can be seen by a clear separating line.
5	Disconnected fuel supply line is released again. Dispose of the water/fuel mixture in accordance with the local environmental regulations.

9.2.11 Changing the fuel prefilter

Safety notes

DANGER

Fire hazard from fuel

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

- Do not spill fuel.
- No open flames when working on the fuel system.
- Do not smoke.

CAUTION

Danger of burns.

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

- Let the engine cool before maintenance.

CAUTION

Danger of injury.

Repeated contact with diesel fuel can cause chapped and cracked skin.

- Wear safety gloves.
- If there is contact with the skin, thoroughly wash the affected areas of the skin with soap and water.

CAUTION

Danger of environmental damage from spilled fuel.

When the filter is removed, a small amount of fuel is drained as well.

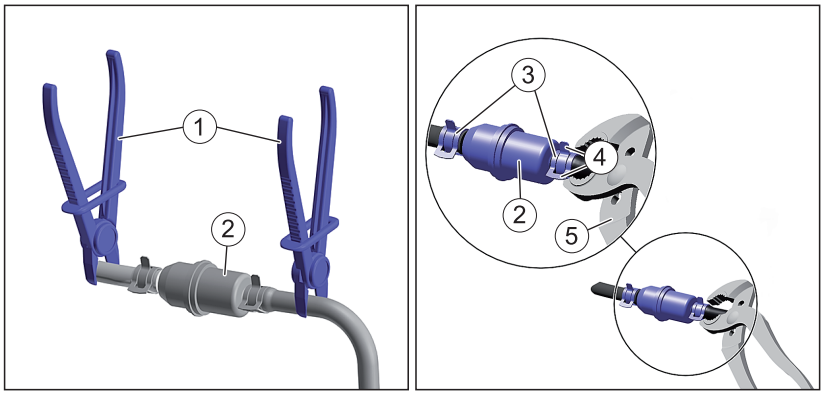
- Collect any escaping fuel and dispose of it according to local environmental regulations.

CAUTION

Dirt particles can damage the injection system.

- Maintain clean conditions to ensure dirt does not enter the fuel line.

Overview



1	Hose clip
2	Fuel prefilter
3	Hose clamp
4	Tabs on the hose clamp
5	Pliers

Procedure

Step	Activity
1	Block the fuel supply line upstream and downstream of the fuel prefilter (2) using hose clips (1).
2	Place a suitable container under the fuel prefilter to collect emerging fuel.
3	Release the hose clamps (3) and slide them to the back. To do so, squeeze the tabs (4) together with suitable pliers (5).
4	Unscrew the fuel prefilter (2) and dispose of it according to local environmental regulations.
5	Insert a new fuel prefilter. Observe the flow-through direction (arrows).
6	Slide the hose clamps to their original position.
7	Start the engine and perform a test run.
8	Check the filter and lines for tightness after a brief trial run.

9.2.12 Changing the main fuel filter

Safety notes

DANGER

Fire hazard from fuel

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

- Do not spill fuel.
- No open flames when working on the fuel system.
- Do not smoke.

CAUTION

Danger of burns.

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

- Let the engine cool before maintenance.

CAUTION

Danger of injury.

Repeated contact with diesel fuel can cause chapped and cracked skin.

- Wear safety gloves.
- If there is contact with the skin, thoroughly wash the affected areas of the skin with soap and water.

CAUTION

Danger of environmental damage from spilled fuel.

When the filter is removed, a small amount of fuel is drained as well.

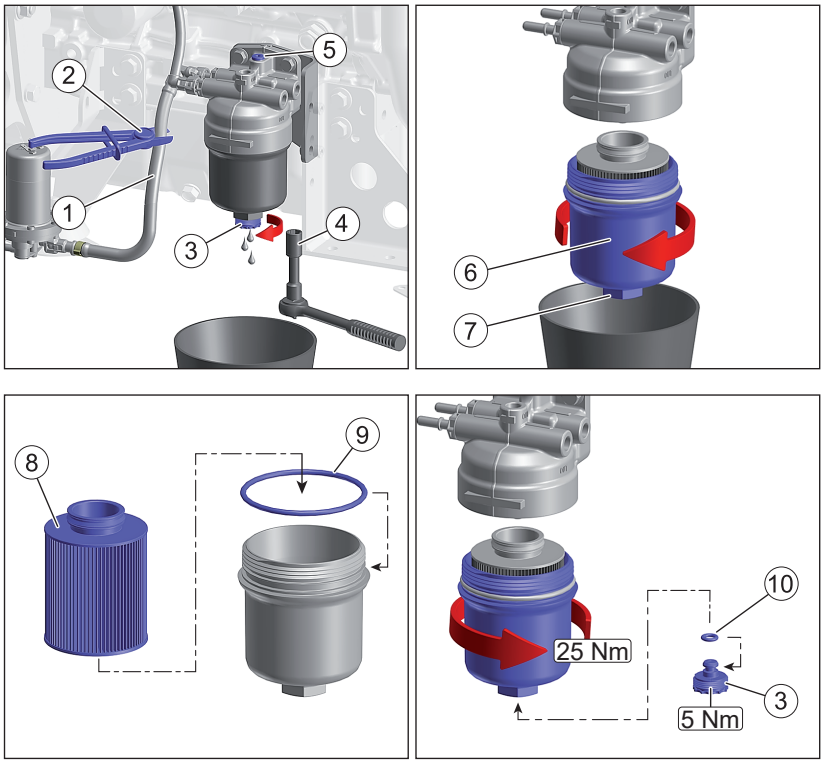
- Collect any escaping fuel and dispose of it according to local environmental regulations.

CAUTION

Dirt particles can damage the injection system.

- Maintain clean conditions to ensure dirt does not enter the fuel line.
- Only install fuel filters dry and do not prefill in order to avoid contamination.

Overview



1	Fuel feed line
2	Hose clip
3	Drain screw
4	Socket wrench (13 mm)
5	Vent screw
6	Plastic screw cap
7	Hexagon for fitting a socket or ring wrench
8	filter insert
9	Sealing ring for plastic screw cap
10	Sealing ring for drain screw

Procedure

Step	Activity
1	Block the fuel feed line (1) using the hose clip (2).
3	Place a suitable container under the filter (min. volume of 1.0 liter) to collect escaping fuel.
4	First release the drain screw (3) using the socket wrench (4), then the vent screw (5), and drain the fuel.
5	Then unscrew the drain screw (3) completely and put it aside.
6	Fit the socket wrench or ring wrench onto the hexagon (7) and unscrew the plastic screw cap (6).
7	Dispose of the filter insert (8) and sealing ring (9) in accordance with local environmental regulations.
8	Lightly oil the new sealing ring and install it.
9	Insert the new filter insert into the screw cap.
10	Screw in the screw cap and tighten it to the specified tightening torque.
11	Dispose of the sealing ring (10) in accordance with local environmental regulations.
12	Lightly oil the new sealing ring and install it.
13	Screw in the drain screw (3) and tighten it to the specified tightening torque.
	Tighten the vent screw (5). Tightening torque: 15 Nm.
15	Release the fuel feed line.
16	Bleed the fuel system (see chapter *7.4 Venting the fuel system, page 34*).
17	Start the engine and perform a test run.
18	After the test run, check the main fuel filter for leaks.

9.2.13 Air filter maintenance

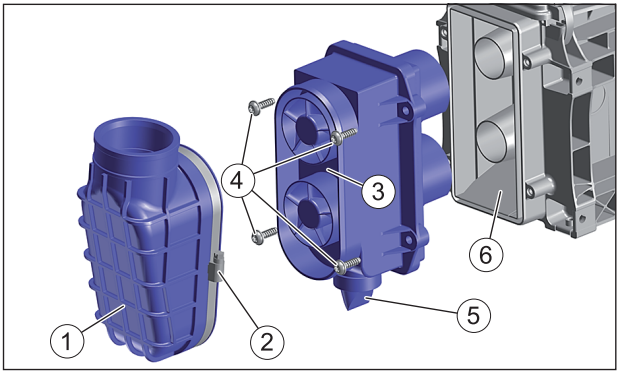
This section contains the following subsections:

- **Clean the cyclone precleaner**
- **Change the air filter cartridge**

Cleaning the cyclone precleaner

If heavily contaminated, dismantle the cyclone precleaner and clean the individual parts.

Overview



1	Add-on connecting piece (option)
2	Fastening clamp
3	Cyclone precleaner
4	Fastening screws (4 pieces)
5	Dust discharge valve
6	Housing

Procedure

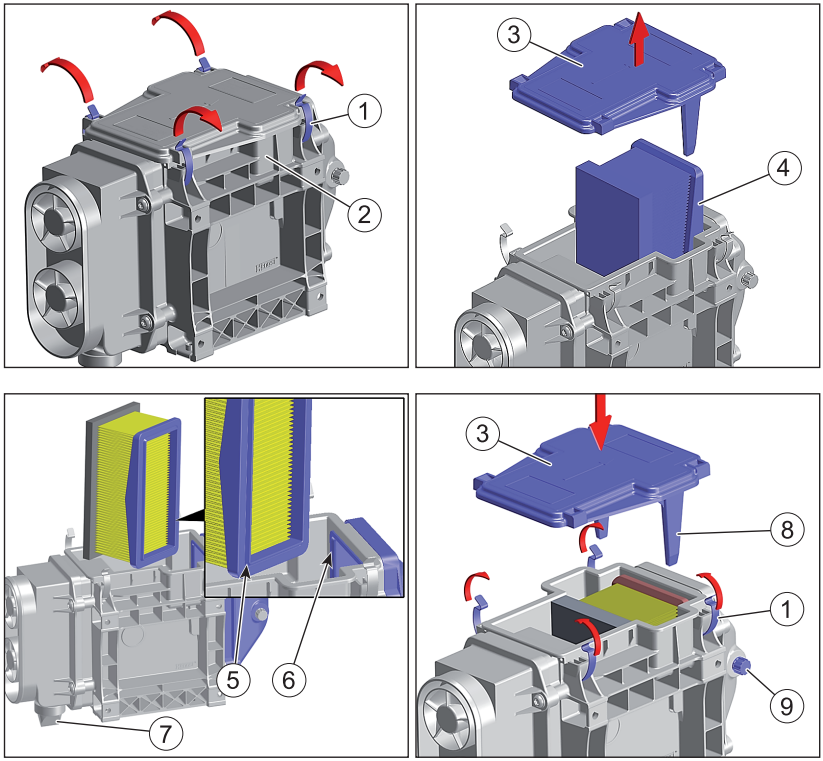
Step	Activity
1	Undo the fastening clamp (2).
2	Pull the add-on connecting piece (1) with the fastening clamp (2) off of the cyclone precleaner (3).
3	Unscrew the fixing screws (4).
4	Remove the cyclone precleaner (3).
5	Pull the dust discharge valve (5) off of the cyclone precleaner.
6	Rinse the individual parts in water or soapy water and let dry.
7	Wipe out the filter housing (6).
8	Mount the cyclone precleaner, dust discharge valve and add-on connecting piece again.

Changing the air filter cartridge

NOTICE

- Replace a soiled filter cartridge immediately, even if the maintenance interval has not been reached.
- The filter cartridge may not be washed out or beaten out.
- We also advise against blowing out the filter cartridge. This can cause tears in the filter paper and deformation of the filter. Dirt particles can be pressed even deeper into the filter paper. This can destroy the fine structure of the filter and reduce the filter effectiveness. This, in turn, leads to premature wear of the engine.
- Even minor damage in the areas of the sealing surface, filter paper, or filter cartridge makes reuse impossible.
- Never let the engine run without a filter cartridge!

Overview



1	Holding clamps (4 pieces)

2	Air filter housing
3	Air filter cover
4	Filter cartridge
5	Sealing surface on the filter cartridge
6	Sealing surface in the air filter box
7	Dust discharge valve
8	Holding tab for filter cartridge
9	Screw plug **Attention!** The screw plug must be tightened by hand. It must be present, or else the engine can draw in unfiltered air.

Procedure

Step	Activity
1	Open the holding clamps (1).
2	Remove the air filter cover (3).
2	Pull out the filter cartridge (4) and dispose of it in accordance with local environmental regulations.
3	Remove dirt adhering to the inside of the air filter housing (2), air filter cover (3) and dust discharge valve (7). *Note:* Vacuum out or wipe out the air filter housing. Do not blow out, as dust and dirt may enter the intake opening of the engine!
4	Insert a new filter cartridge into the air filter housing and apply light pressure to position it in the direction of the sealing surface (6). The frame (5) on the filter cartridge engages in the sealing surface (6).
6	Carefully mount the air filter cover on the air filter housing and lock using 4 holding clamps.

9.2.14 Changing the coolant

This section contains the following subsections:

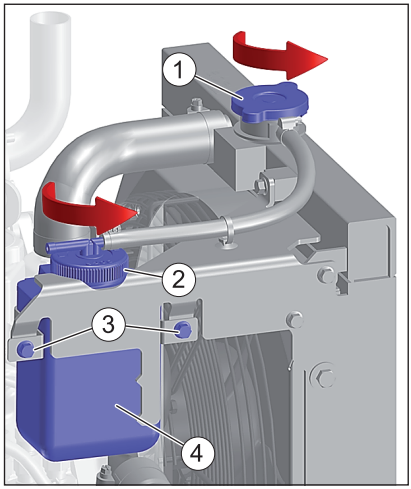
- **Draining the cooling system**
- **Rinsing the cooling system**
- **Filling the cooling system**

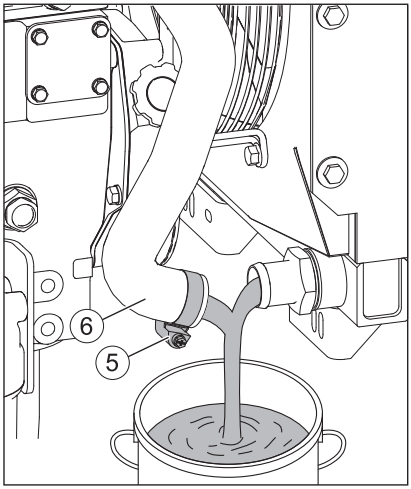
Safety notes

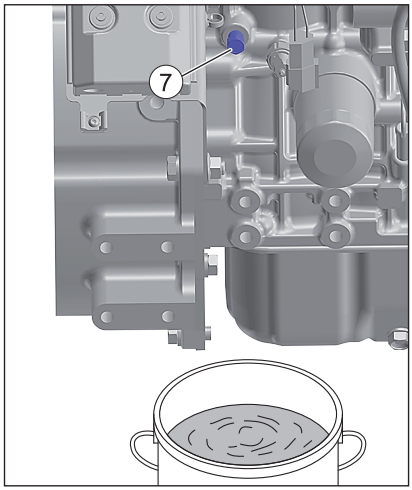
⚠ CAUTION
 **Danger of burns.** There is a danger of burns when working on a hot cooling system. The cooling system is pressurized when the engine is hot. ▪ Let the engine cool. ▪ Wear safety gloves.

⚠ CAUTION
 **Danger of environmental damage from spilled coolant.** Coolant is water-polluting. ▪ Do no allow them to enter the ground water, water bodies, or sewage system. ▪ Collect the coolant and dispose of it according to local environmental regulations.

Overview







1	Cooler cap
2	Screw plug on the overflow container
3	Fastening screws for overflow container
4	Overflow container
5	Hose clamp
6	Cooler hose
7	Drain screw on engine block

Draining the cooling system

Step	Activity
1	Provide a container to collect the used coolant. The container must be large enough to hold the entire amount of oil. For the amount of coolant, see section *4.1 Engine information and filling quantities, page 20*.
2	Screw the cooler cap (1) to the left to the point where it engages and release the pressure.
3	Continue turning the cap to the left and remove it.
4	Loosen the hose clamp (5).
5	Pull off the cooler hose (6) and drain the coolant into the container.
6	Release the screw plug (2).
	Unscrew the fastening screws (3) and remove and drain the overflow container (4) with retaining bracket.

Step	Activity
7	Mount the overflow container again.
8	Unscrew the drain plug (7) from the engine block and drain the coolant into the container.
9	Tighten the drain screw again.
10	Mount the cooler hose (6) on the cooler and secure it with the hose clamp (5).

	NOTICE
	Immediately after draining or rinsing, the coolant must be refilled to prevent the formation of corrosion in the cooling system.

Rinsing the cooling system

The cooling system only needs to be rinsed if contaminants are detected in the coolant.

Contaminants can include:

- Engine oil due to a defective cylinder head gasket (discoloration of the coolant).
- Corrosion due to used or unsuitable coolant (discoloration of the coolant).
- Foreign bodies due to:
  - Insufficient cleaning during repairs to the cooling system
  - Reuse of drained coolant

As contaminants in the coolant could be an indication of a larger problem, we recommend having the rinsing of the cooling system carried out by trained specialist personnel.

Filling the cooling system

See section *7.3 Filling the cooling system, page 32*

10 Faults

10.1 Troubleshooting

General troubleshooting notes

If the cases listed below have been worked through but the fault continues to persist, please contact your nearest **Hatz service**.

The starter does not turn or only turns slowly. Engine does not start.

Possible causes	Remedy	Section
Battery is defective and/or not loaded.	Check the battery and contact the service center if necessary.	
	Check the belt tension.	
	Check the alternator.	
Battery and/or other cable connections are incorrectly connected.	Check the cable connection between the battery, starter and starter switch.	
Cable connections are loose and/or oxidized.		
Defective starter or starter relay.	Contact HATZ Service.	

At low temperatures (engine does not start).

Possible causes	Remedy	Section
Oil is too viscous and causes a too low starter speed.	Change the engine oil and oil filter. Add engine oil with a suitable viscosity class.	*9.2.5 Change the engine oil and oil filter, page 55*
Machine is not uncoupled.	If possible, separate the engine from the machine by uncoupling it.	

The engine does not start or does not start immediately, but can be turned with the starter.

Possible causes	Remedy	Section
Hydraulic load too high (especially with multiple hydraulic pumps).	Reduce the hydraulic load – if possible.	
Insufficient compression.	Contact HATZ service.	

Possible causes	Remedy	Section
Cylinder and/or piston ring wear.	Contact HATZ service.	
Wrong fuel	Only refill with fuel approved by Hatz.	*4.4 Fuel, page 24*
Fuel supply is interrupted:		
The tank ran out of fuel during operation.	Add fuel.	*8.6 Refueling, page 44*
Electrical fuel pump is not working.	Check the cabling.	
Fuel prefilter is clogged.	Change the fuel prefilter.	*9.2.11 Changing the fuel prefilter, page 68*
Main fuel filter is clogged.	Change the main fuel filter.	*9.2.12 Changing the main fuel filter, page 70*

Engine switches off spontaneously during operation.

Possible causes	Remedy	Section
The tank ran out of fuel during operation.	Fill with fuel.	*8.6 Refueling, page 44*
Fuel prefilter or main fuel filter is clogged.	Change the fuel filter.	*9.2.11 Changing the fuel prefilter, page 68* *9.2.12 Changing the main fuel filter, page 70*
Electrical defects.	Check the wiring or contact Hatz service.	
Mechanical defects.	Contact HATZ Service.	

The engine loses power and speed.

Possible causes	Remedy	Section
The tank ran out of fuel during operation.	Add fuel.	*8.6 Refueling, page 44*

Possible causes	Remedy	Section
Fuel prefilter or main fuel filter is clogged.	Change the fuel filter.	*9.2.11 Changing the fuel prefilter, page 68* *9.2.12 Changing the main fuel filter, page 70*
Inadequate tank venting.	Ensure that the tank is sufficiently vented.	
Line connections are not leak tight.	Check the line screw connections for leak tightness.	

The engine loses power and speed, and black smoke emerges from the exhaust.

Possible causes	Remedy	Section
Dirty air filter unit.	Check the degree of contamination of the air filter and replace if necessary.	*9.2.13 Air filter maintenance, page 72*
Tappet clearance not OK.	Adjust the tappet clearance.	
Injection nozzle not OK.	Contact HATZ Service.	

Engine becomes very hot. The coolant temperature display lights up.

Possible causes	Remedy	Section
Contamination in the entire area of the cooling air guides.	Clean the cooling air area.	
Cooler fins dirty, or cooler blocked.	Clean the cooler fins, ensure air flow through cooler is not hindered.	*9.2.6 Cleaning the radiator fins, page 59* *9.2.4 Checking the cooling system, page 52*
Thermostat or water pump defective.	Contact HATZ service.	
Coolant level too low.	Check the cooling system.	*9.2.4 Checking the cooling system, page 52*

11 Storing the machine

Safety notes

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

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.

CAUTION

Danger of burns.

There is a danger of burns when working on a hot cooling system. The cooling system is pressurized when the engine is hot.

- Let the engine cool.
- Wear safety gloves.

NOTICE	
	**Comply with the safety chapter!** Follow the basic safety instructions in chapter *3 Safety, page 7*.

Storing the machine for a lengthy period

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.
2	Change the engine oil and oil filter (see chapter *9.2.5 Change the engine oil and oil filter, page 55*).
3	Replace the fuel prefilter and the main fuel filter (see section *9.2.11 Changing the fuel prefilter, page 68* and *9.2.12 Changing the main fuel filter, page 70*.
4	Let the machine cool down.
5	Check the coolant level and concentration. Refill coolant if necessary (see section *9.2.4 Checking the cooling system, page 52*). If the concentration is too low, replace the coolant (see section *9.2.14 Changing the coolant, page 76*).
6	Remove the battery 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.
7	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.
8	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

Recommissioning

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**.

12 EPA AND CARB CERTIFIED ENGINES

SUPPLEMENTAL INFORMATION
TO THE OWNER'S MANUAL FOR EPA AND CALIFORNIA
CERTIFIED NONROAD COMPRESSION IGNITION ENGINES.

Limited warranty

Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. will repair or replace parts returned to us when we judges that the parts are defective in material and/or workmanship after conducting inspection.
Mitsubishi Heavy Industries Engine & Turbocharger, Ltd.'s warranty is limited to the compensation work of repair or replacement of parts.
The warranty coverage is effective for the original purchaser only. Those to whom ownership is later transferred are not provided with the warranty.

- **Mitsubishi Heavy Industries Engine & Turbocharger, Ltd.'s makes no warranties, either expressed or implied, except as provided in this manual, including, but not limited to, warranties as to marketability, merchantability, fitness for a particular purpose or use, or against infringement of any patent.**
- **Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. will not be liable for any damages or consequential damages, including, but not limited to, damages or other costs resulting from any abuse, misuse, misapplication of the engine and devices supplied from us.**
- **Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. will not be liable for any damages or personal injuries resulting from any modification, without our written permission, of the engine and devices supplied from us.**
- **Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. will not be liable for any damages or production losses caused by the use of fuel, engine oil and/or long life coolant (LLC) that we are not recommended.**
- **The owner of the engine is responsible for the performance of the required maintenance listed in this operation manual.**
  Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. may deny the warranty coverage if the engine or part has failed due to inadequate or improper maintenance.

Emission warranty

IMPORTANT

The following warranty applies to the engines that are approved of the emission regulation of the U.S. Environmental Protection Agency.

Warranty coverage

Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. warrants to the first owner and each subsequent purchaser of a new non-road diesel engine that the emission control system of your engine:

- is designed, built and equipped so as to conform at the time of sales with all applicable regulation of the U.S. Environmental Protection Agency.If the vehicle in which the engine is installed is registered in the state of California, a separate California emission regulation also applies.
- is free from the defects in material and workmanship which will cause the engine to fail to meet these regulations within the warranty period.

Then its warranty period is

The emission warranty period is shown below.

However, if your engine warranty period is longer than the emission warranty period, the emission warranty period extends to same as the engine warranty period.

Below warranty period shall begin on the date the engine is delivered to the first owner.

If your engine is certified as	And its maximum power is	And its rated speed is	Then its warranty period is
Variable speed or constant speed	kW < 19	Any speed	1,500 hours or 2 years, whichever comes first.
Constant speed	19 ≤ kW < 37	3800 min^{-1} or more	1,500 hours or 2 years, whichever comes first.
Constant speed	19 ≤ kW < 37	Less than 3000 min^{-1}	3000 hours or 5 years, whichever comes first.
Variable speed	19 ≤ kW < 37	Any speed	3000 hours or 5 years, whichever comes first.
Variable speed or constant speed	kW ≥ 37	Any speed	3000 hours or 5 years, whichever comes first.

Warranted parts

Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. warrants the parts which will increase the emission of pollutants when they become defective.

The followings are examples.

- Inlet/Exhaust manifold
- Crankcase ventilation system
- Fuel system
- Fuel injection nozzle

LIMITED WARRANTY

Refer to Limited warranty.

California emission control warranty statement your warranty rights and obligations

IMPORTANT

The following warranty applies to the engines that are approved of the emission regulation of the California Air Resources Board (CARB).

The **California Air Resources Board (CARB)** is pleased to explain the **emission control system warranty** on you 2008 or later engine.In California, new heavy-duty off-road engines must be designed, built, and equipped to meet the State's stringent anti-smog standards.Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. must warrant the emission control system on your engine for the periods of time listed below provided there has been no abuse, neglect or improper maintenance of your engine.

Your emission control system may include parts such as the fuel-injection system and the air induction system. Also included may be hoses, belts, connectors and other emission-related assemblies.

Where a warrantable condition exists, Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. will repair your heavy-duty off-road engine at no cost to you including diagnosis, parts, and labor.

MANUFACTURER'S WARRANTY COVERAGE:

The **2008** and later heavy-duty off-road engines are warranted for the Warranty Period. If any emission-related part on your engine is defective, the part will be repaired or replaced by Mitsubishi Heavy Industries Engine & Turbocharger, Ltd.

OWNER'S WARRANTY RESPONSIBILITIES:

- As the heavy-duty off-road engine owner, you are responsible for the performance of the **required maintenance listed in your owner's manual**.Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. recommends that you retain all receipts covering maintenance on your heavy-duty off-road engine, but Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. cannot deny warranty solely for the lack of receipts or for your failure to ensure the performance of all scheduled maintenance.
- As the heavy-duty off-road engine owner, you should however be aware that Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. may deny you warranty coverage if your heavy-duty off-road engine or a part has failed due to abuse, neglect, improper maintenance or unapproved modifications.
- Your engine is designed to operate on diesel fuel only. Use of any other fuel may result in your engine no longer operating in compliance with California's emissions requirements.
- You are responsible for initiating the warranty process. The Air Rexources Board suggests that you present your heavy-duty off-road engine to a Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. dealer or distributor dealer as soon as problem exists. The warranty repairs should be completed by the dealer or distributor as expeditiously as possible.

If you have any questions regarding your warranty rights and responsibilities, you should contact Mitsubishi Engine North America at **1-630-268-0750**.

Warranty coverage

(a) The warranty period shall begin on the date the engine or equipment is delivered to an ultimate purchaser.

(b) Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. warrants to the ultimate purchaser and each subsequent purchaser of the engine registered in the state of California that the engine is:

(1) Designed, built and equipped so as to conform with all applicable regulations adopted by the Air Resources Board.

(2) Free from defects in materials and workmanship which cause the failure of a warranted part to be identical in all material respects to the parts as described in Mitsubishi Heavy Industries Engine & Turbocharger, Ltd.'s application for certification for a period of 5 years or 3,000 hours of operation, whichever occurs first. In the absence of a device to measure hours of use, the engine shall be warranted for a period of 5 years. For all engines rated less than 19kW, and for constant-speed engines rated under 37 kW with rated speeds higher than or equal to 3,000 min^{-1}, the period of 2 years or 1,500 hours of operation, whichever occurs first, shall apply. In the absence of a device to measure hours of use, the engine shall be warranted for a period of 2 years.

(c) The warranty on emission-related parts shall be interpreted as follows:

(1) Any warranted part which is not scheduled for replacement as required maintenance in the written instructions required by Subsection (e) shall be warranted for the warranty period defined in Subsection (b) (2). If any such part fails during the period of warranty coverage, it shall be repaired or replaced by Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. according to Subsection (4) below. Any such part repaired or replaced under the warranty shall be warranted for the remaining warranty period.

(2) Any warranted part which is scheduled only for regular inspection in the written instructions required by Subsection (e) shall be warranted for the warranty period defined in Subsection (b) (2). A statement in such written instructions to the effect of "repair or replace as necessary" shall not reduce the period of warranty coverage. Any such part repaired or replaced under the warranty shall be warranted for the remaining warranty period.

(3) Any warranted part which is scheduled for replacement as required maintenance in the written instructions required in Subsection (e) shall be warranted for the period of time prior to the first scheduled replacement point for that part.If the part fails prior to the first scheduled replacement, the part shall be repaired or replaced by Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. according to Subsection (4) below. Any such part repaired or replaced under warranty shall be warranted for the remainder of the period prior to the first scheduled replacement point for the part.

(4) Repair or replacement of any warranted part under the warranty provisions shall be performed at no charge to the owner at a warranty station.

(5) Notwithstanding the provisions of Subsection (4) above, warranty services or repairs shall be provided at all Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. distribution centers that are franchised to service the subject engines.

(6) The owner shall not be charged for diagnostic labor that leads to the determination that a warranted part is in fact defective, provided that such diagnostic work is performed at a warranty station.

(7) Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. shall be liable for damages to other engine components proximately caused by failure under warranty of any warranted part.

(8) Throughout the engine's warranty period defined in Subsection (b) (2), Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. shall maintain a supply of warranted parts sufficient to meet the expected demand for such parts.

(9) Any replacement part may be used in the performance of any maintenance or repairs and must be provided without charge to the owner. Such use shall not reduce the warranty obligations of Mitsubishi Heavy Industries Engine & Turbocharger, Ltd..

(10) Add-on or modified parts that are not exempted by the Air Resources Board may not be used. The use of any non-exempted add-on or modified parts shall be grounds for disallowing a warranty claim. Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. shall not be liable to warrant failures of warranted parts caused by the use of a non-exempted add-on or modified part.

(11) The Air Resources Board may request and, in such case, Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. shall provide, any documents which describe that Mitsubishi Heavy Industries Engine & Turbocharger, Ltd.'s warranty procedures or policies.

(d) Warranted parts list.

(1) Fuel metering system
- (A) Fuel injection system.
- (B) Air/fuel ratio feedback and control system.
- (C) Cold start enrichment system.

(2) Air induction system
- (A) Controlled hot air intake system.
- (B) Intake manifold.
- (C) Heat riser valve and assembly.
- (D) Turbocharger/supercharger systems.
- (E) Charged air cooling systems.

(3) Exhaust gas recirculation (EGR) system
- (A) EGR valve body, and carburetor spacer if applicable.
- (B) EGR rate feedback and control system.

(4) Air injection system
- (A) Air pump or pulse valve.
- (B) Valves affecting distribution of flow.
- (C) Distribution manifold.

(5) Catalyst or thermal reactor system
- (A) Catalytic converter.
- (B) Thermal reactor.
- (C) Exhaust manifold.

(6) Particulate controls
- (A) Traps, filters, precipitators, and any other devices used to capture particulate emissions.
- (B) Regenerators, oxidizers, fuel additive devices, and any other device used to regenerate or aid in the regeneration of the particulate control device.
- (C) Control device enclosures and manifolding.
- (D) Smoke puff limiters.

(7) Advances oxides of nitrogen (NOx) controls
- (A) NOx absorbers.
- (B) Lean NOx catalysts.
- (C) Selective catalyst reduction.
- (D) Reductant (urea/fuel) containers/dispensing systems.

(8) Positive crankcase ventilation (PCV) system
- (A) PCV valve.
- (B) Oil filler cap.

(9) Miscellaneous items used in above systems

(A) Vacuum, temperature, and time sensitive valves and switches.

(B) Electronic control units, sensors, solenoids, and wiring harnesses.

(C) Hoses, belts, connectors, assemblies, clamps, fittings, tubing, sealing gaskets or devices, and mounting hardware.

(D) Pulleys, belts and idlers.

(E) Emission control information labels.

(F) Any other part with the primary purpose of reducing emissions or that can increase emission during failure without significantly degrading engine performance.

(e) Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. shall furnish with each new engine written instructions for the maintenance and use of the engine by the owner.

LIMITED WARRANTY:

Refer to "Limited warranty".

Important information

- To avoid the potential hazard, accident prevention activities must be planned methodically and conducted continually by considering all aspect of engine operation, maintenance and inspection.All related personnel, including managers and supervisors, should actively participate, recognize their roles and organize themselves and their work to ensure a safe environment.
- The foremost safety objective is to prevent accidents which may result in injury or death, or equipment damage.
- Always observe laws or regulations of the local or federal/national government.
- Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. cannot foresee all potential dangers of the engine, potential danger resulting from human error and other causes, or danger caused by a specific environment in which the engine is used. Since there are many actions that cannot be performed or must not be performed, it is impossible to indicate every caution in this manual or on warning labels. As such, it is extremely important to follow directions in this manual and also to take general safety measures when operating, maintaining and inspecting the engine.
- When the engine is used by individuals whose native language is not English, the customer is requested to provide thorough safety guidance to the operators.Also add safety, caution and operating signs that describe the original warning label statements in the native language of the operators.
- The engine must be operated, maintained and inspected only by qualified persons who have thorough knowledge of engines and their dangers and who also have received risk avoidance training.
- To prevent an accident, do not attempt to carry out any operation other than those described in this manual, and do not use the engine for any unapproved purpose.
- When the ownership of the engine is transferred, be sure to provide this manual with the engine to the new owner. Also inform Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. of the name and address of the new owner of the engine.
- This manual is copyrighted and all rights are reserved.No part of this manual, including illustrations and technical references, may be photocopied, translated, or reproduced in any electronic medium or machine readable form without prior written consent from Mitsubishi Heavy Industries Engine & Turbocharger, Ltd.
- The contents in this manual are subject to change at any time without notice for improvement of the engine.
- Pictures or illustrations of the product in this manual may differ from those of product you have. Please note that, depending on specifications, items described in this manual may differ from those on your engine in shape, or may not be installed on your engine.
- Please contact a dealer of Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. if you need more information or if you have any questions.
- If you lost or damaged this manual, obtain a new copy at a dealer of Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. as soon as possible.
- Mitsubishi Heavy Industries Engine & Turbocharger, Ltd. recommends the engine owner to install an hour meter on the engine due to monitor correct running intervals and to perform the maintenance at the appropriate timing.

- Make sure that all warning/caution/emission labels are legible. Clean or replace the labels when the description and/or illustration are not clear to read.
  - Illegible labels fail to alert people, which may cause personal injury, environmental pollution, and damage to the engine.
  - For cleaning the labels, use a cloth and soapy water. DO NOT USE CLEANING SOLVENTS, GASOLINE, OR OTHER CHEMICALS THAT MAY ERASE THE PRINT OR CAUSE PEELING OFF OF THE LABEL. If the labels are damaged, replace them with new ones.
  - When replacing a part that has a label attached, attach the new label to the new part so that it is in the same state as before replacement.
  - New labels are available at your MHIET dealer, MHIET group company, or MHIET.

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

Motorenfabrik Hatz GmbH & Co. KG
Ernst-Hatz-Str. 16
94099 Ruhstorf a. d. Rott
Deutschland
Tel. +49 8531 319-0
Fax. +49 8531 319-418
marketing@hatz.com
www.hatz.com

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