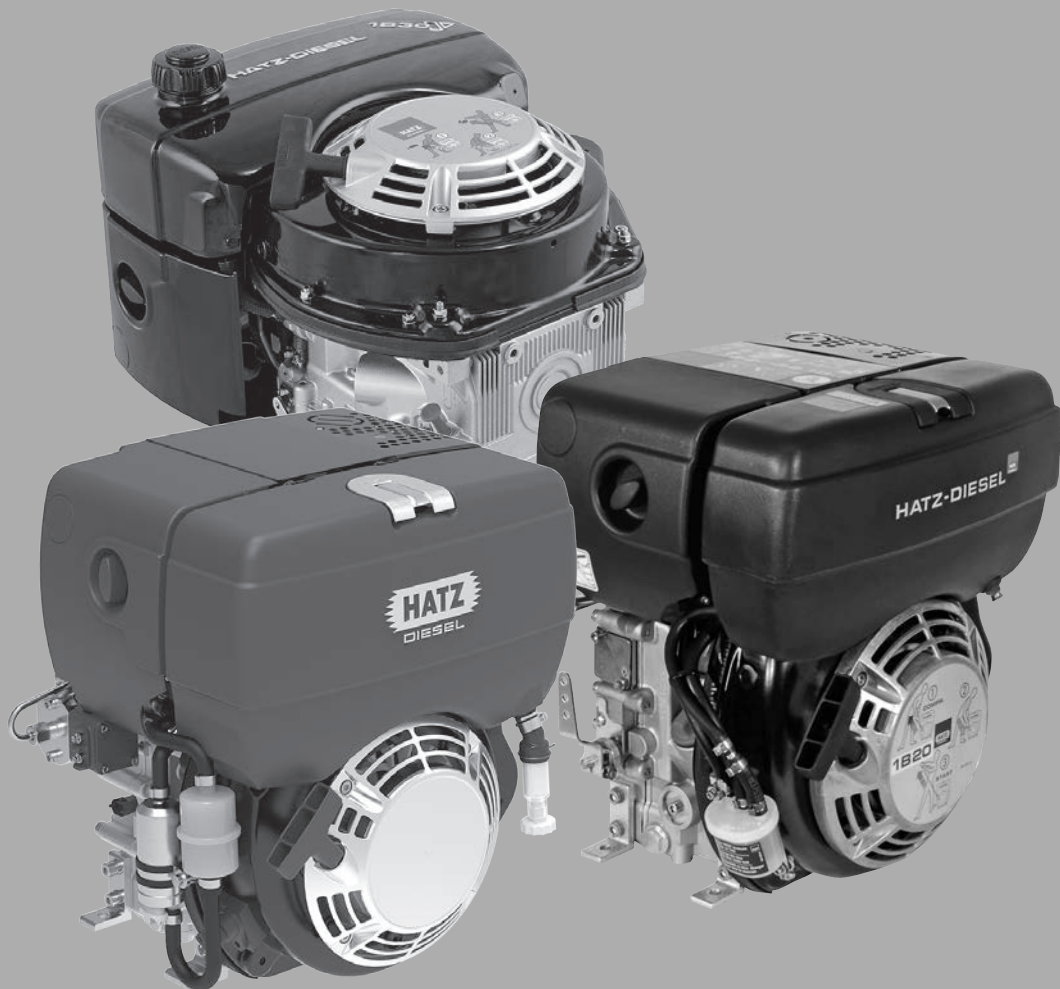


CREATING POWER SOLUTIONS.



1B.. | 1B..V | 1B..E

ASSEMBLY INSTRUCTIONS

Hatz Diesel

www.hatz-diesel.com

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1 Notices

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Original manual

This manual has been translated into multiple languages.

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

2 General information

General information

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

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

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

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

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

Have service work performed by qualified technicians only. We recommend that you work with one of the more than 500 HATZ service centers.

Trained specialists there will repair your engine with original HATZ spare parts and with HATZ tools.

The global HATZ service network is at your disposal to advise you and supply you with spare parts. For your nearest Hatz service center, please look at www.hatz-diesel.com on the Internet.

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

Modifications without prior approval by HATZ will invalidate the warranty. Installation must only be carried out by qualified technicians in accordance with these Assembly Instructions, all safety-related measures and statutory regulations.

After the installation of the engine, the machine manufacturer is responsible for ensuring that all relevant statutory directives and regulations are fulfilled.

The operator must become familiar with the manual for diesel engine prior to commissioning in order to avoid danger to personnel and potential material damage.

Motorenfabrik HATZ GmbH & Co. KG takes no responsibility for injury to personnel or damage to the machine arising from non-observance of the assembly instructions or manual for diesel engine.

Damage resulting from non-observance of the assembly instructions or the manual for diesel engine will forfeit any warranty on the part of Motorenfabrik HATZ GmbH & Co. KG and responsibility shall be transferred to the machine manufacturer/user.

Machine

This manual describes the following machine.

Machine name	HATZ diesel engine
Type number	1B20, 1B30, 1B30E, 1B30V, 1B30VE, 1B40, 1B50, 1B50E

3 Safety

3.1 General information

Introduction

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

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

Read this chapter carefully before beginning work.

3.1.1 Intended use

Intended use

The machine described in this manual fulfills the following functions:

- Diesel engine intended for installation in a machine or for assembly with other machines to form a machine. See chapter *17 Declaration of incorporation, page 115*.

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.
- 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.
- Installation of the device on movable supports (e.g. vehicles, trailers) without HATZ approval.
- Improper operation at variance with DIN ISO 3046 -1 and DIN ISO 8528 (climate, load, safety).

Residual risks

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

These residual risks will be pointed out in chapter *3.2.2 Machine-specific safety instructions for operation, page 13* and in chapter *3.2.3 Machine-specific safety instructions for maintenance work, page 14* as well as in the further contents of the manual, directly in front of the descriptions or operating instructions concerned.

3.1.2 Machine user or machine manufacturer obligations

Machine manufacturer obligations

These assembly instructions contain important information on how to safely assemble the engine.

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. Running the machine while identified defects exist is not permitted. The operator must also ensure that all persons who work on the machine are familiar with the contents of this manual.

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.

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 flammable substances!
	Warning of explosive substances!
	Warning of toxic engine exhaust!
	Warning of corrosive substances!



Symbol	Meaning
	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	
	<p>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.</p> <ul style="list-style-type: none"> ▪ 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. ▪ 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 8.

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: <ul style="list-style-type: none"> ▪ 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 clothing. 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 (see chapter "Labels" 3.2.5 *Labels*, page 16).

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	
	<p>Danger to life and danger of injury due to failure to follow the warnings on the machine and in this manual.</p> <ul style="list-style-type: none"> ▪ Heed the warnings on the machine and in this manual.

 WARNING	
	Danger of injury and danger of incorrect operation due to inadequate personnel qualifications. <ul style="list-style-type: none"> ▪ 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. <ul style="list-style-type: none"> ▪ 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. <p>Lifting the machine to transport it or to move it to another location can lead to injuries (of the back, for example).</p> <ul style="list-style-type: none"> ▪ Only lift the machine with a hoist (see chapter 7.1 <i>Transport</i>, page 46).

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 **these Assembly Instructions** 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.

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. <ul style="list-style-type: none"> ▪ Never operate the machine in closed-off or poorly ventilated rooms. ▪ Do not breathe in the exhaust gases.
	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. <ul style="list-style-type: none"> ▪ Keep inflammable materials away from the exhaust gas system. ▪ Do not operate the engine (exhaust flow or hot exhaust gas system) in the direct vicinity of combustible materials.
 DANGER	
 	Fire hazard from fuel. Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries. <ul style="list-style-type: none"> ▪ Only refuel when the engine is switched off and has cooled down. ▪ Never refuel in the vicinity of open flames or sparks that can cause ignition. ▪ Do not smoke. ▪ Do not spill fuel.

3.2.3 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.
- Check the safety equipment regularly to ensure it is in good condition and functioning properly.
- Check connections, cables and fasteners regularly to ensure they are in good condition.

Maintenance work

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










Replacing parts

- When replacing defective components, we recommend that you use **Hatz original spare parts** (see chapter Customer service).
- 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	
	<p>Danger of explosion from flammable cleaning agents.</p> <p>Cleaning with benzene is an explosion hazard. It is highly flammable, can become electrostatically charged, and can generate an explosive gas/air mixture.</p> <ul style="list-style-type: none"> ▪ Use halogen-free, cold cleaners with a high flash point for cleaning. ▪ Comply with manufacturer's instructions.
 WARNING	
 	<p>Danger of injury from compressed air and dust particles.</p> <p>Eye injuries can occur when cleaning with compressed air.</p> <ul style="list-style-type: none"> ▪ Wear safety goggles.
 CAUTION	
	<p>Danger of injury from ignoring the maintenance instructions.</p> <ul style="list-style-type: none"> ▪ 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	
	<p>Danger of burns.</p> <p>There is a danger of burns when working on a hot engine.</p> <ul style="list-style-type: none"> ▪ Let the engine cool before maintenance.


3.2.4 Electrical equipment

Safety notes

 DANGER	
	<p>Danger to life, danger of injury or danger of property damage due to incorrect use of batteries.</p> <ul style="list-style-type: none"> ▪ 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	
	<p>Danger of explosion from flammable substances.</p> <p>There is a danger of explosion from flammable gases.</p> <ul style="list-style-type: none"> ▪ 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 pull out the starting key during operation.
- 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 of the alternator. For 1B30E, 1B50E, also disconnect the plug-in connection to the engine control unit.

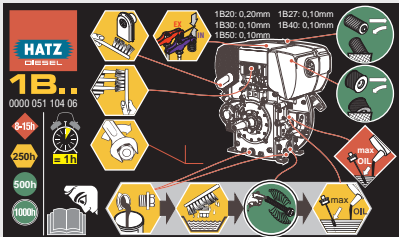





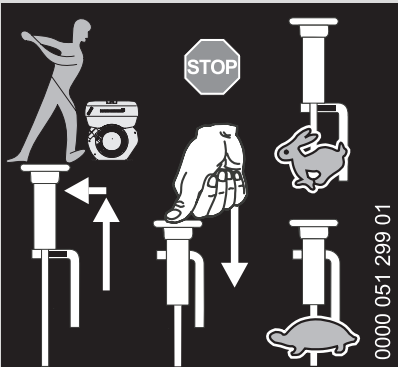


NOTICE

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

3.2.5 Labels

Warning labels and information signs on the engine



Label	Meaning
	Maintenance instructions (see Diesel Engine Manual)
 	Start the engine with the recoil start (see Diesel Engine Manual)

Label	Meaning
	<p>CAUTION! Danger of injury from faulty starter rope.</p> <p>A chafed starter rope can rip and cause injuries.</p> <ul style="list-style-type: none">▪ Before using the starter rope, check for abrasion; replace the rope if necessary.
	<p>Speed adjustment with connecting rod (additional equipment)</p>
	<p>Refuel with diesel fuel only. Specification, see the Diesel Engine Manual.</p>
	<p>The engine may only be operated with fuel that is "EXTREMELY LOW IN SULFUR OR SULFUR-FREE".</p> <p>The fuel label is located close to the fuel cap. If there is no fuel tank installed on the engine, the label must be applied permanently close to the fuel filler opening.</p>

Warning label (sticker) EU, US market and Canada

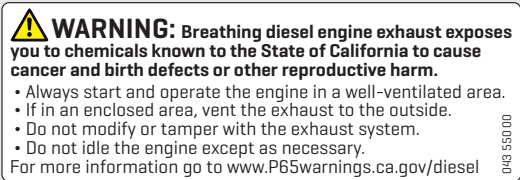
Each sticker on the engine was changed to ISO labels (pictograms) to meet the specifications of the European market on the basis of the Machinery Directive.

If an engine is sold to and operated on the US market or in Canada, the following additional label (see below) must be applied to it.

Label	Meaning
	<p>"CAUTION"</p>
<p>Recoil start version - Standard</p> 	<p>Recoil start version - Noise protection package</p> 

If a warning label on the engine is concealed (e.g. by a cover, encapsulation, etc.), the machine must be checked to determine whether the danger still prevails. If the danger has been eliminated, the additional warning label can be omitted. If the danger persists, a new warning label must be applied by the machine manufacturer. Thus, the machine manufacturer is responsible for the correct application of the warning labels on the engine and on the machine.

Warning label (sticker) CARB

Label	Meaning
	<p>CALIFORNIA Proposition 65 Warning. For more information, see www.P65warnings.ca.gov/diesel (warning label is supplied unattached by Hatz)</p>

The warning label must be applied by the machine manufacturer before commissioning in a location on the engine (machine) that is easily legible by the user. If the engine is installed in a capsule or housing, the label must be immediately visible when the housing is opened.

4 General information about the engine

4.1 Engine selection

Ideally, the engine is selected when the operating conditions have been analyzed and taken into account.

Not only are the operating conditions defined by the direct installation in the machine, but also by boundary conditions such as temperature, altitude, etc., and the planned starting method.

Generally speaking we recommend defining an engine according to the following flow chart:

Selection of:	Criteria for the selection process:
Speed	Speed level dependent on: <ul style="list-style-type: none"> ▪ Operating hours per year ▪ Noise ▪ Free mass forces/torques/vibrations ▪ Flexible/rigid attachment ▪ Geographic area of use of the driven machine
Power setting	Power calculation including: <ul style="list-style-type: none"> ▪ Temperature ▪ Height above sea level ▪ Efficiency of the driven machine (see section 4.4.1 <i>Power consumption of the machine</i>, page 25) ▪ Safety reserve (see section 4.4.3 <i>Safety reserve</i>, page 27) ▪ Load profile, power classes of the standard
Engine variations	Selection of the engine, taking into account: <ul style="list-style-type: none"> ▪ Standard, power class ▪ Exhaust gas standard ▪ Speed/Power ▪ Weight/Volume ▪ Starting method, starting temperature ▪ Power take off ▪ Permissible load on power take off points ▪ Flange capability ▪ Flexible/rigid attachment ▪ Dataset (e.g. speed parameter)
Additional equipment	<ul style="list-style-type: none"> ▪ Adaptation to the machine and its environment

The most important points for the correction selection of the engine can be worked out using the **"Engine selection checklist"**. To do so, please contact the respective HATZ subsidiary. Based on this generally held view of the engine selection, the details can be found in the following sections.

4.2 Choice of speed

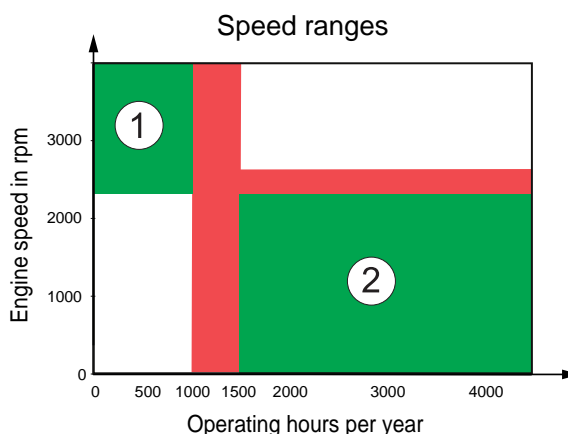
General information (noise, service life, ...)

Specify the operating speed at the beginning of the equipment specification since this variable has significant influence on all the essential operating parameters of your machine. It is important to pay attention to a balanced compromise of efficiency for the following parameters:

- Service life
- Fuel consumption
- Weight
- Noise
- Vibrations
- Power requirement
- Torque requirement
- Dimensions
- Exhaust gas quality

The right engine speed selection is important when selecting the engine since it significantly influences the behavior of the engine. When defining the right engine speed, the number of operating hours is decisive.

The number of operating hours is assigned to the so-called speed ranges:



4.2.1 Speed range 1

Speed range 1 begins at above 2300 rpm and extends to the maximum speed of the engine.

For engines in speed range 1, the number of operating hours is normally less than 1000 h/year, although this limit can certainly occasionally be at 1200 h/year, for example.

Engines for construction machinery, and industrial or commercially operated engines, are generally situated in speed range 1.

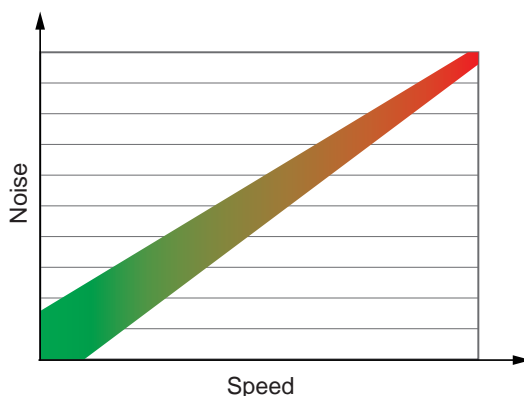
Example:

In a year with 240 working day, a commercially used machine is operated on approx. 70% of days and is operated about 60% of the time in an 8-hour working day. This yields an annual number of operating hours of approx. 800 h. Under these circumstances, the engine can normally easily be operated up to the maximum permissible speed range, although the speed of 3600 rpm only appears reasonable in combination with 60 Hz generating sets and should not necessarily be used with other drives.

The engine speed has a significant influence on the following properties:

The noise behavior

The engine emits less noise at low speeds.



The vibration level of the engine

The vibration level is improved by a reduction in speed because the mass forces and mass torques are significantly less at lower speeds. A better vibration level means less structure-borne excitation, and hence a quieter machine.

Maintenance deficits

Generally, lower speed increases the service life. However, this only applies if the maintenance intervals are strictly adhered to.

If no other variables require a higher speed (e.g. building up torque), the lowest possible speed should be chosen.

4.2.2 Speed range 2

when the number of operating hours is greater than 1500 h/year, a 5-year operating period of the machine accumulates an considerable total number of operating hours; this is true, for example, for irrigation pumps or generating sets, which reach a runtime of approx. 1800 h/year by operating as little as 5 hours daily, or 9000 hours in 5 years.

For these types of drives, speeds from speed range 2 must be selected, i.e. for more than 1500 operating hours/year, the selected speed selection must be from 2300 rpm to a maximum of 2600 rpm. This speed selection also makes sense for third-world countries where service and maintenance options may not be reliable.

The noise behavior and vibration level of the engine also apply in speed range 2.

4.3 Power class selection

The lower setting of HATZ diesel engines is made in accordance with the power classes of the international standard of engines for work machinery ISO 3046-1:

The standard reference conditions for ISO 3046-1 are:

- Air pressure: 100 kPa (at approx. 100 m height above sea level),
- Intake air temperature: 298 K (25 °C)
- Relative humidity: 30%

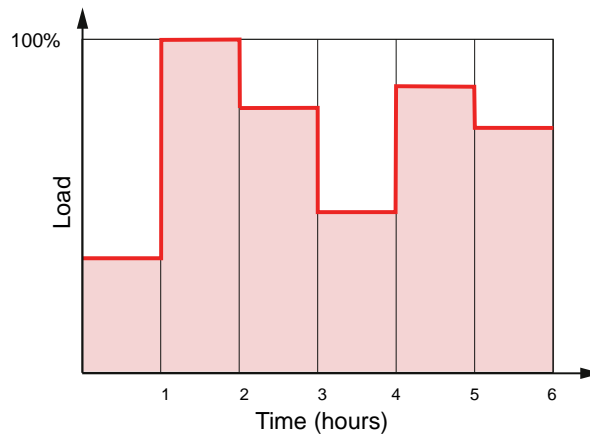
Power class ISO 3046-1:

1	Blocked power for intermittent operation = blocked ISO effective power	IFN
2	Blocked power for highly intermittent operation = blocked ISO effective power	IFNSI
3	Continuous power output, 10% overload capacity = ISO standard power output, 10% overload capacity	ICXN
4	Continuous power output, no overload capacity = blocked ISO standard power output	ICFN

4.3.1 Power class IFN

This power setting cannot be exceeded, and **corresponds to normal machinery use for alternating load at predominantly constant speed.**

The maximum value of the blocked ISO net power can be removed for a duration of up to one hour within 6 hours of alternating load.



Typical uses are with machines such as:

- Compressors,
- Trench cutting machines,
- Earth-moving equipment with hydrostatics such as caterpillars, loaders, etc.,
- Fire-fighting pumps,
- Vibratory plate compactors and vibratory rollers.

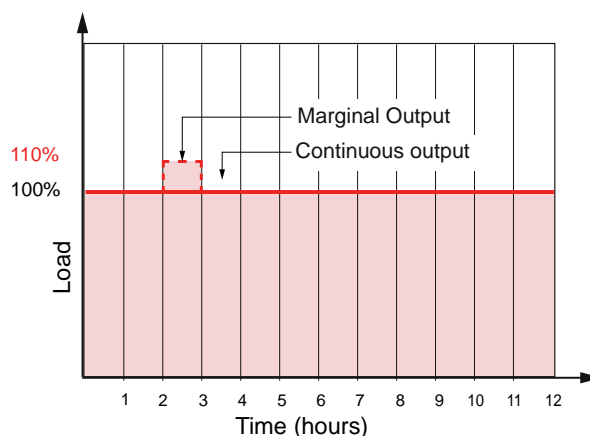


4.3.2 Power class IFNsi

Employed **when full power is only required briefly**, although the speed is largely constant, such as in refrigerators, welding machinery, forklift trucks, mobile cranes, etc.

4.3.3 Power class ICXN

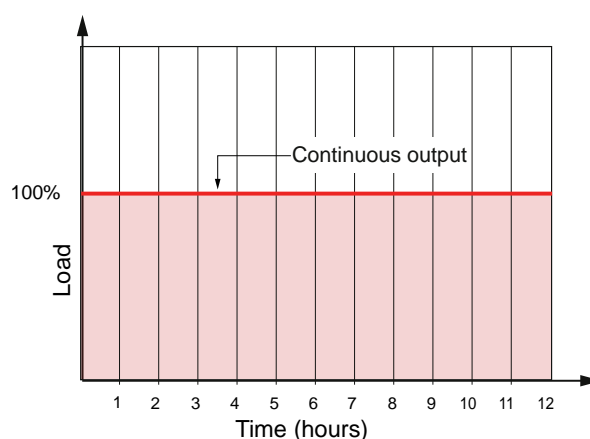
The **ICXN** is used for machines with **constant load consumption at a constant engine speed** such as power generation sets for a basic load or for ship drives. A one-hour overload operation is possible within a 12-hour period.



The engine setting takes this overpower capability into account. The magnitude of the overpower is selected depending on the purpose of the engine – normally it is set to an overpower of 10%.

4.3.4 Power class ICFN

The ICFN must not be exceeded. **It is the continuous effective power that the engine – interrupted only by maintenance work – is able to output continuously at a constant engine speed.**



This power setting is used, for example, for irrigation pumps and for machines that can be run on the torque rise curve for hours (e.g. joint cutters at maximum feed).



If there is no ICFN setting for Hatz diesel engines, please contact **Motorenfabrik Hatz Ruhstorf** beforehand.

4.4 Power calculation

After the power class is specified, the necessary engine power is determined:

An undersized engine (overload) leads to high wear and high probability of failure. An oversized engine (permanent low load) leads to high specific fuel consumption, deposits in the engine, etc. The power calculation is essential for this reason.

In the power calculation the following are determined:

- | | |
|---|---|
| 1 | The size of the net power requirement of the driven machine. |
| 2 | The size to set the safety reserves. |
| 3 | The load capacity of the engine due to the elevation at the place of use. |

4.4.1 Power consumption of the machine

The net power consumption of the driven machine (PG) is obtained from the output of the machine, taking into account the efficiency of the machine and the force-transmitting elements.

Examples:	Efficiency
Gear drives	Approx. 95%
Belt drives	Approx. 85 – 95%
Hydrostatic systems (pump, lines, engine)	Approx. 60 – 70%
Generators	
→ 2 kW	Approx. 70%
→ 20 kW	Approx. 85%
Non-self-priming centrifugal pump	Approx. 60 – 65%
Self-priming, centrifugal pump	Approx. 45 – 50%

In the case of centrifugal pumps, it must still be taken into account that the pump input power is increased 33 % when the speed is only increased by 10 %. And conversely the pump input power also falls when the speed is reduced.

Simple formulae for calculating the net power requirement for:

▪ Water pumps

$$P(kW) = \frac{Q(m^3/h) \times H(m)}{367 \times \eta(\%/100)}$$

Example:

A non-self-priming centrifugal pump with $\eta = 60\%$ pumps 75 m³ of water per hour at a pressure of 3 bar (1 bar = 6.5 m water column at a water density of 1000 g/dm³). The net power requirement of the pump is:

$$P = \frac{75 \times (3 \times 6,5)}{367 \times 60/100} = 6,6kW$$

- **Hydraulic pumps**

$$P(kW) = \frac{Q(l/min) \times p(bar)}{600 \times \eta(\%/100)}$$

Example:

A gear pump pumps 20 liters per minute at a pressure of 140 bar. The efficiency of the overall system is 70 %. The net power requirement is:

$$P = \frac{20 \times 140}{600 \times 70/100} = 45,7kW$$

- **Generating set**

$$P(kW) = \frac{kVA \times \cos \varphi}{\eta(\%/100)}$$

Example:

A generator with 6 kVA at full load has an efficiency of 82% and is

- connected to inductive consumers with a $\cos \varphi$ of 0.8. The net power requirement is:

$$P = \frac{6 \times 0,8}{82/100} = 5,8kW$$

- connected to ohmic consumers with a $\cos \varphi$ of 1.0. The net power requirement is:

$$P = \frac{6 \times 1,0}{82/100} = 7,3kW$$

4.4.2 Power requirement of auxiliary take-off systems

The power calculation must also take power-consuming auxiliary take-off systems into account, such as alternators. Especially in engines with a low power output, it must be taken into account that the power consumption of an alternator corresponds to about twice the output electric power. For the individual engine families, the power requirements for the alternator are as follows:

Engine family	Power requirement of alternator at n = 3000 rpm	
	Unloaded approx.	Loaded approx.
1b 1B30E/1B50E	30 W	50 W [14V/1A]
	30 W	
	300 W	600 W [14V/15A]

Engine family	Power loss of unloaded alternator	
	Speed range rpm	Power loss kW
1B20/1B30/1B40 Standard Lima 200 W 1B30E/1B50E	3300 – 3600	0.3
	2500 – 3250	0.2
	1500 – 2450	0.1

The power calculation must take the power requirements described above and from similar ancillary components into account.

4.4.3 Margin of safety (factor fs)

The vast majority of assumptions to determine the power requirements are theoretical in nature, and therefore a margin of safety is necessary. In addition, the power requirement of the machine can change during operation and increase, e.g. due to wear. For both reasons, a margin of safety is necessary.

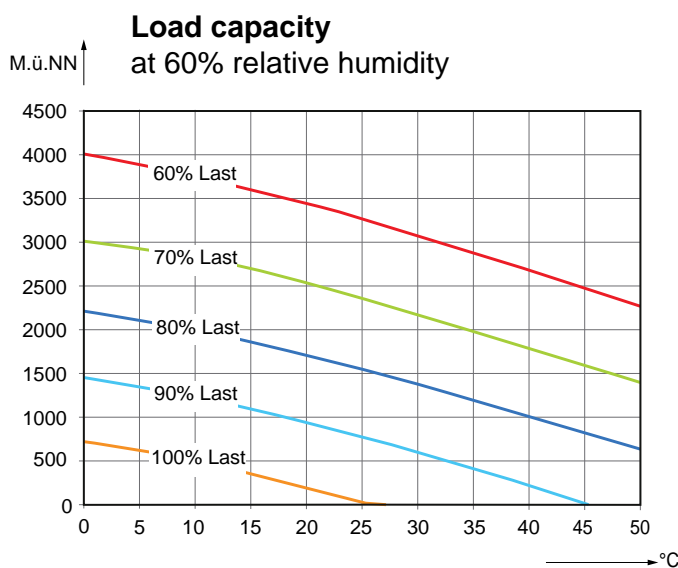
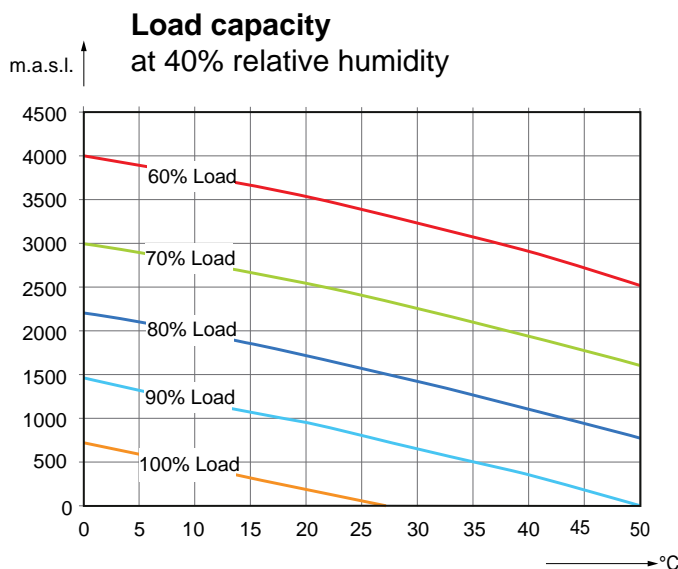
It is generally recommended that a safety margin between 5 and 10% is assumed for uncertainties in the calculation. This results in the safety factor fs:

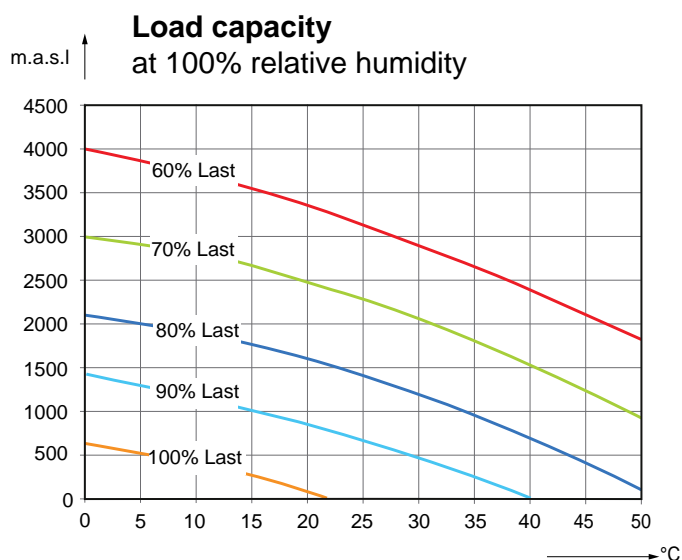
Safety			
%	5	10	15
fs	1.05	1.1	1.15

4.4.4 Climate at the place of use (divisor K)

The engine is mostly not used at the standard reference point of the performance standard ISO 3046-1

(+ 25 °C, 100 m above sea level, 30 % rel. humidity), but in places with higher altitude (for more information, see also *11 General limits of use, page 100*) and higher temperatures, usually also with higher relative humidity. Also temperature increases caused by sunlight under a cowling must be considered. The capacity of the engine due to climatic conditions that differ from the standard reference point can be read on the following graphic:





Limits on the capacity of diesel engines

($\eta_{\text{mech. 80\%}}$) in accordance with ISO 3046–1 depending on temperature, installation height and relative humidity.

Example:

With 60 % relative humidity at a temperature of + 35 °C and an altitude of 1200 m, the capacity of the engine is 80 %. The climate divisor K is therefore = 0.8.

4.4.5 Required engine power

With the aid of the number specified earlier for the

- power consumption of the machine (PG)
- the power of the auxiliary take offs (PN)
- the power margin for safety (factor fs)
- the power margin for the climate at the place of use (divisor K)

the power requirement on the engine can now be specified:

$$P \text{ (kW)} = \frac{(PG + PN) \times fs}{K}$$

As an example for the determination of the engine power size, the aforementioned 12 kVA generating set with ohmic load is used for which the following data apply:

Power requirement of the generator	PG	6 kW
Power requirement for auxiliary take-off systems	PN	1 kW
Margin of safety 5%	fs	1.05
Climate	0% relative humidity, 35 °C, 1,200 m above sea level	K = 0.8

$$P = \frac{(6 + 1) \times 1,05}{0,8} = 7,3kW$$

An engine that can provide an output of 7.3 kW at the reference point of the standard must be selected, according to calculations.

Where a series-produced machine (e.g. soil compactor) is exported and used worldwide, it is advisable to choose a climate divisor of approx 0,8.

Operation can then be at the fairly common altitude of 2000 m at + 30 °C and 60 % relative humidity or at an altitude, for example, of 100 m at +40 °C and 100 % relative humidity.

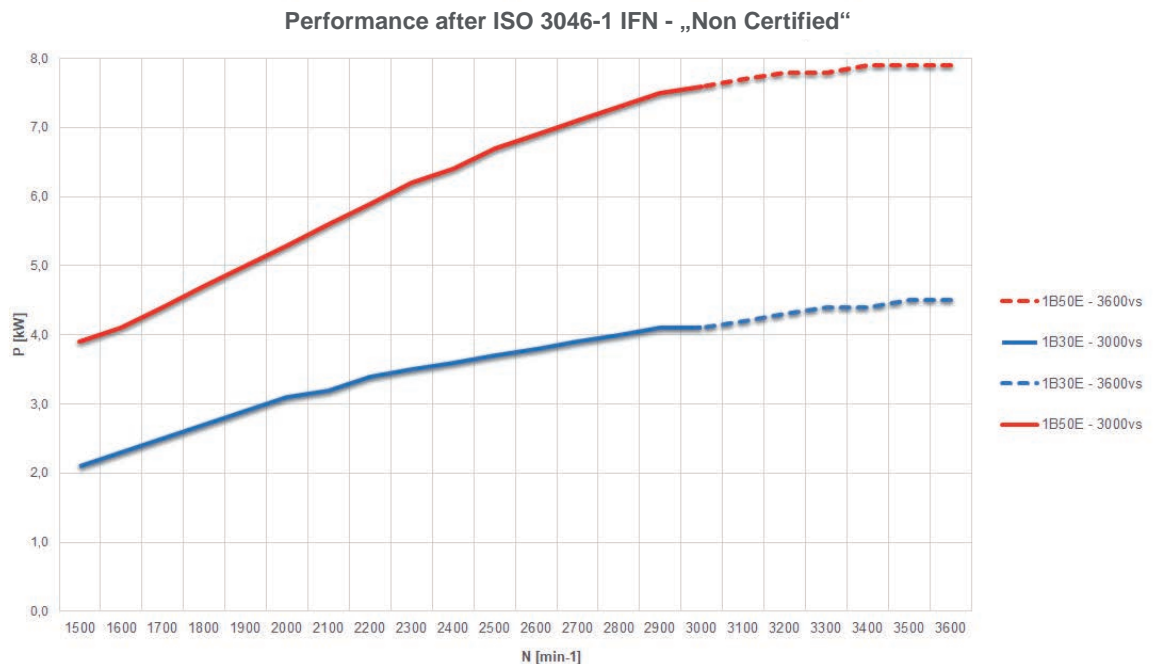
When calculating the climate margin, do not only bear in mind the overseas territories in Africa, South East Asia or South America, but also the high altitudes in Europe (Alps), in warm areas of Europe and also the high altitudes and warm zones in North America.

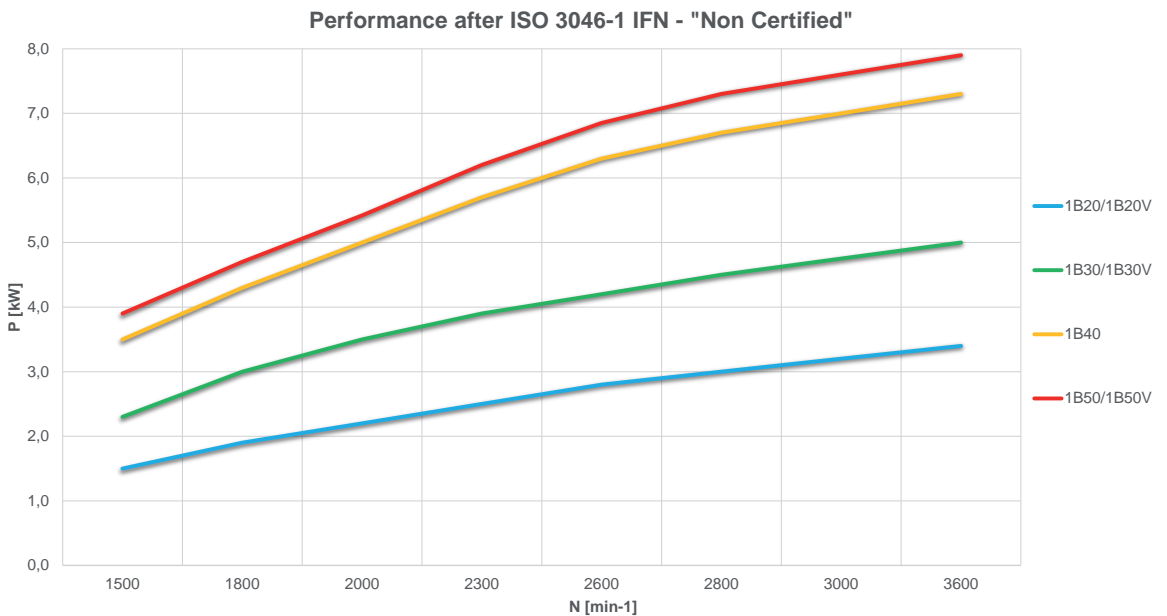
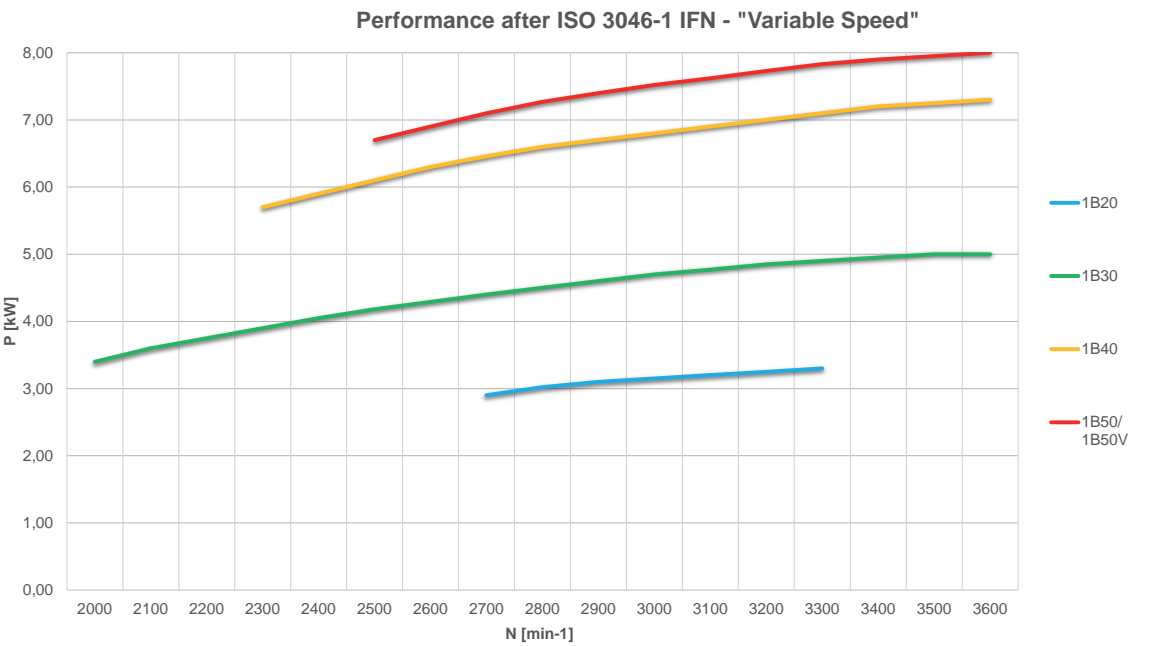
4.5 Selection of the engine type

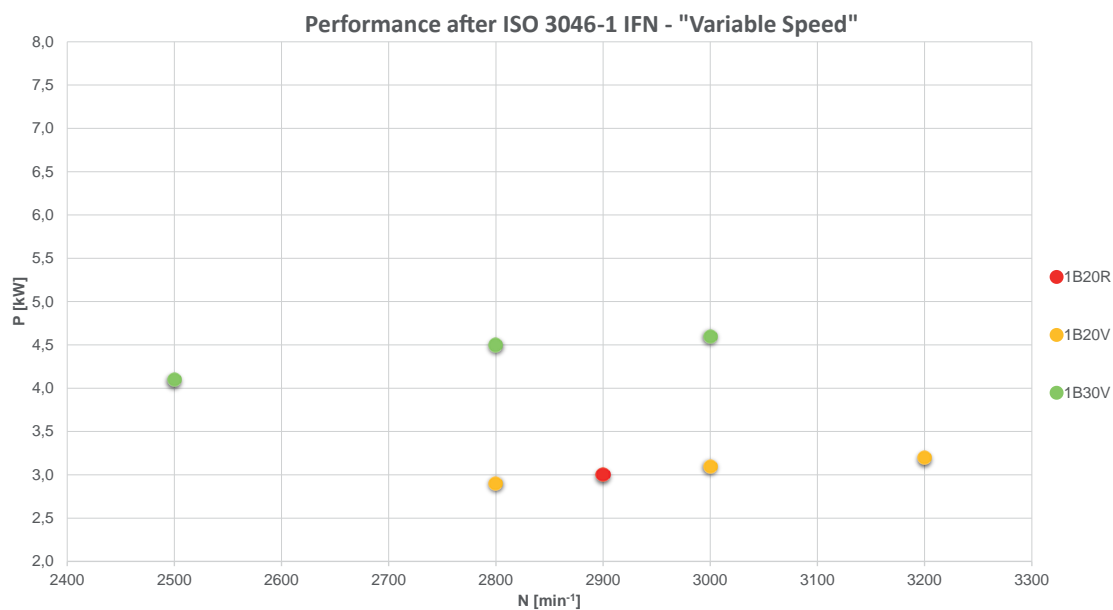
After the power calculation has been performed and the required engine power size and speed range have been identified, the fitting Hatz diesel engine can now be found using the following selection tables.

The specified power values are points of reference and are in no way the upper limits but can be changed upward if the load type permits, such as in welding current generators, vehicles with mechanical gears, etc.

On the other hand, lower power values may be required for a **continuous full load**.







*1B20R only available with n=2900 rpm

*1B20V only available with n=2800 rpm / n=3000 rpm / n=3200 rpm

*1B30V only available with n=2500 rpm / n=2800 rpm / n=3000 rpm



4.6 Engine speed setting and accuracy

4.6.1 Setting for mechanically controlled engines - 1B20, 1B30, 1B40, 1B50

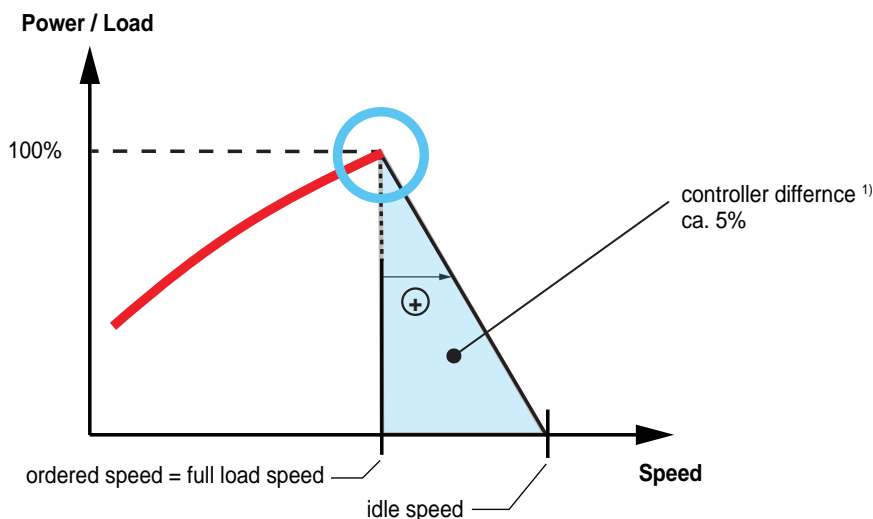
The ordered engine speed is the full load speed. The idle speed is then above the ordered speed by the "control difference". The setting of the upper idle speed can be acceptable for generating sets if the generating set is intended to run close to the rated frequency at the rated load.

The speed specification in the order confirmation and on the type plate is, for example:

1500 / 300¹⁾

2300 / 240

3000 / 180



¹ The controller differential range is not valid for 1B30E, 1B30VE, 1B50E due to the electronic speed control.

If the ordered engines are intended to power generating sets, then speed governors are installed for the "generator speeds" 1500 rpm, 1800 rpm and 3000 rpm that do not exceed a speed difference between zero load and full load of approx. 5 %.

The speed governors for generating sets are in compliance with the specifications of DIN ISO 8528, performance class G1 for 1-cylinder engines

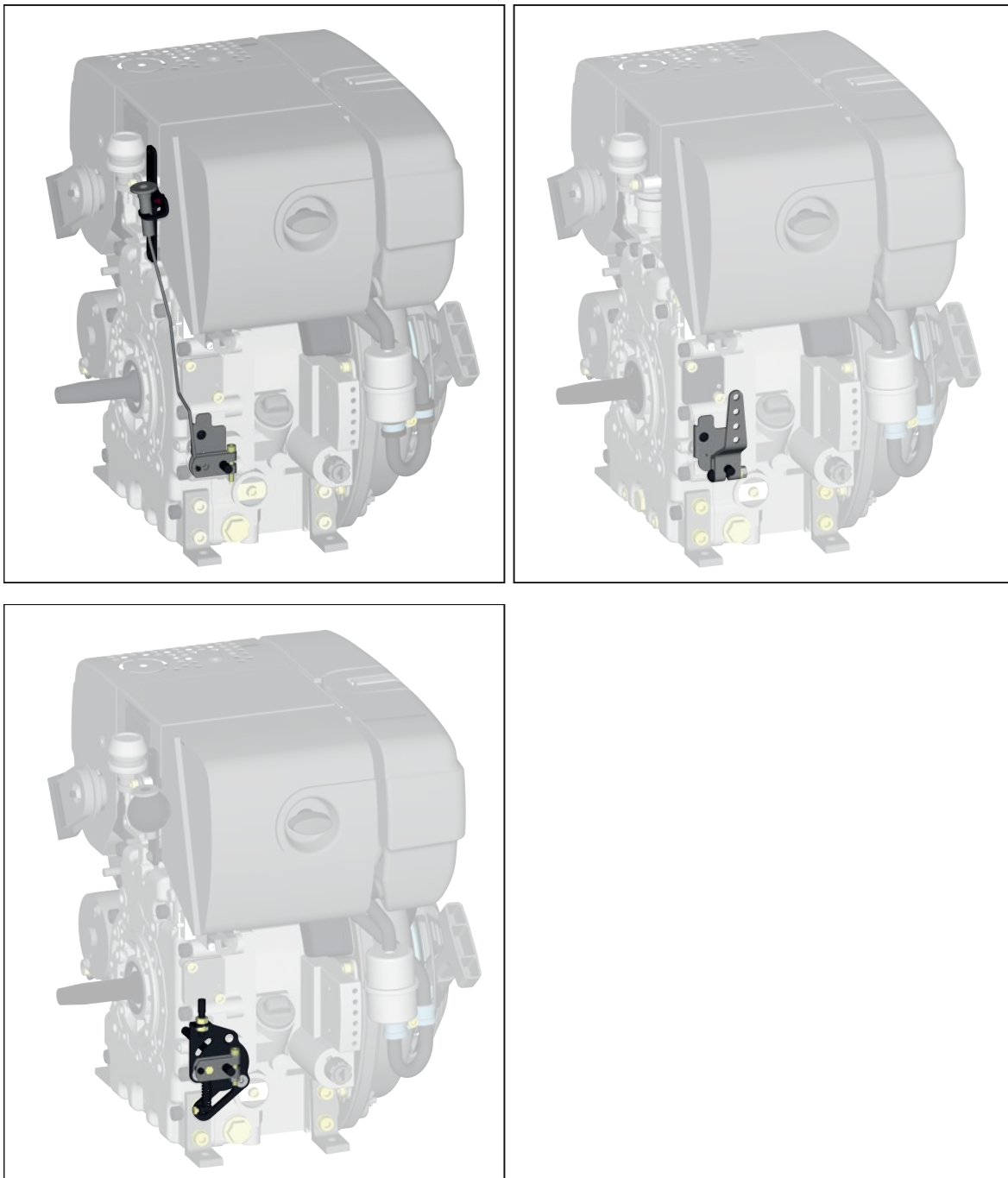
- Static speed change (droop) d_s 5 %
- Speed oscillation width n for 1-cylinder engines 2.5 %

This control equipment must be requested when the engine is ordered.

Increased requirements for the speed variation can be met in different engines using an electronic speed control.

The standard equipment of 1-cylinder diesel engines 1B20, 1B30, 1B40, 1B50 includes a speed adjustment that enables the speed to be adjusted continuously between the maximum speed and stop.

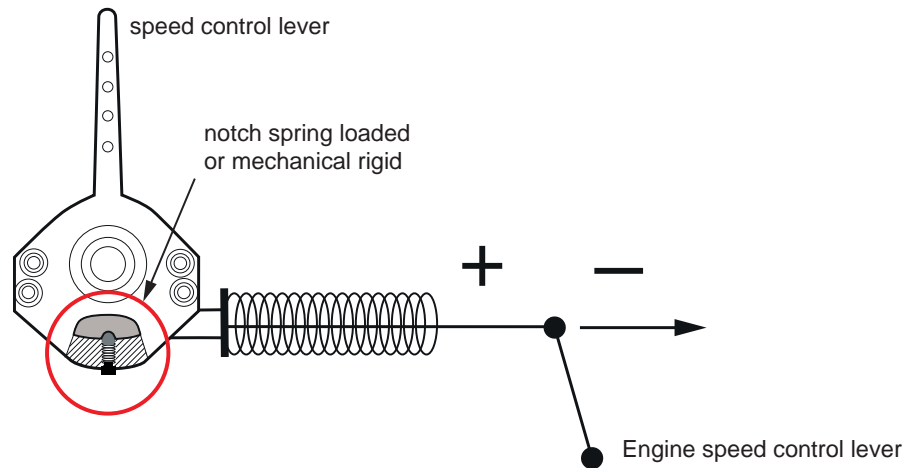
The speed control lever can be actuated from a distance via a Bowden cable.



When using a centrifugal clutch, an adjustable speed control lever is essential so that the clutch cannot be operated in the slipping range.

Adjustable speed control levers either can be located directly on the engine or, as already mentioned, can be executed as adjustable Bowden cable actuation levers, such as:

The speed control lever on the engine is kept all the way at the lower idle with a spring. The Bowden cable moves the speed control lever against the spring force into the position of the operating speed.



The Bowden cable lever is locked in the position of the operating speed (by a flap, a ball with spring force, etc.).

When the lock is released, the spring pulls the speed control lever to the lower idle position and the centrifugal clutch immediately leaves the dangerous slip range.

The adjustable Bowden cable levers enhance the operating comfort of the machine because they can be mounted at the control panel.

The speed control lever is not permitted to be modified, especially not lengthened or provided with a larger mass.

4.6.2 Setting for electronically controlled engines - 1B30E, 1B30VE, 1B50E

The engines 1B30E, 1B30VE and 1B50E features an electronic control unit (ECU). The speed is controlled via the ECU, unlike in the mechanical engine.

The speed control for the generating set engines is in compliance with the specifications of **DIN ISO 8528, execution class G1** in 1-cylinder engines.

Compulsory criteria re EPA/CARB-certified engines

Based on the different requirements within the US exhaust legislation for non-road diesel engines, the operation of EPA-certified Hatz engines has to be restricted to an individually limited speed and torque range within the engine characteristic zone.

Thus, the following EPA certificate can be offered for this application:

a) For constant speed (e.g. generators).

- ⇒ for 1B30E with 3000, 3100 rpm
- ⇒ for 1B50E with 1800, 3000, 3600 rpm

a) for variable speed

- ⇒ for 1B30E with 3000, 3100, 3600 rpm
- ⇒ for 1B50E with 2400, 3000, 3600 rpm

Under standard ambient conditions, the machine must not be loaded with more than 90% of the engine power. Installation test and installation release of the machine is mandatory. Export to the US or Canada is not allowed without approval from HATZ.

NOTICE



For further information, please contact the appropriate HATZ subsidiary or the headquarters at Ruhstorf.

5 Technical data

5.1 Engine information and filling quantities 1B20, 1B30, 1B30E 1B40, 1B50, 1B50E

Type		1B20	1B30 1B30E	1B40	1B50 1B50E
Type		Air-cooled, four stroke diesel engine			
Combustion system		Direct injection			
Number of cylinders		1	1	1	1
Bore/Stroke	mm	69 / 65	80 / 69	88 / 76	93 / 76
Displacement	cm ³	243	347	462	517
Tank capacity	Ltr.	3	5	5	5
Engine oil capacity					
Without oil sump	Approx. ltr.	0.9 ¹⁾	1.1 ¹⁾	1.5 ¹⁾	1.5 ¹⁾
With oil sump	Approx. ltr.	2.6 ¹⁾	2.8 ¹⁾	3.2 ¹⁾	3.2 ¹⁾
Difference between "max" and "min" marking					
Without oil sump	Approx. ltr.	0.5 ¹⁾	0.5 ¹⁾	0.8 ¹⁾	0.8 ¹⁾
With oil sump	Approx. ltr.	1.6 ¹⁾	1.8 ¹⁾	2.2 ¹⁾	2.2 ¹⁾
Engine oil consumption (after running-in period)	Max.	1 % of fuel consumption, pertaining to full load			
Engine oil pressure at oil temperature of 100 °C	Approx.	2.5 bar at 3000 rpm			
Sense of rotation on power take-off side		Left			
Tappet clearance at 10–30 °C inlet/outlet	mm	0.20	0.10	0.10	0.10
Max. perm. inclination during continuous operation in direction		Flywheel low 25° ²⁾ Other directions 35° ²⁾			
Weight (incl. fuel tank, air filter, silencer and electric start)	Approx. kg	33	40 ³⁾	55	57 ⁴⁾
Battery capacity	Max.	12 V – 55 Ah / 420 A (EN) / 450 A (SAE) 24 V – 44 Ah / 360 A (EN) / 400 A (SAE)			

¹⁾ These specifications are approximate values. The max. mark on the dipstick is decisive in any case.

²⁾ Exceeding these limit values causes engine damage.

³⁾ 1B30E: 41 kg

⁴⁾ 1B50E: 58 kg

Engine specifications

Model	Description
R	for rammer operation (1B20R only)
T	Normal counter balance (1B40T, 1B50T and 1B50ET only)
U	Additional counter balance (1B40U, 1B50U and 1B50EU only)

5.2 Engine information and filling quantities 1B30V, 1B30VE

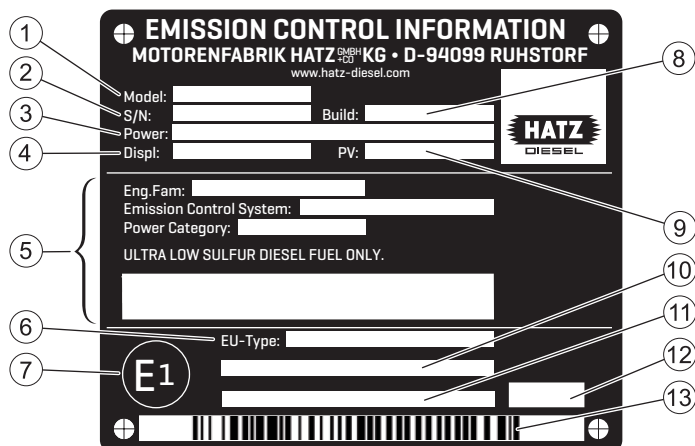
Type		1B30V	1B30VE
Type		Air-cooled, four stroke diesel engine	
Combustion system		Direct injection	
Number of cylinders		1	1
Bore/Stroke	mm	80 / 69	80 / 69
Displacement	cm ³	347	347
Engine oil capacity	Approx. ltr.	1.1 ¹⁾	1.1 ¹⁾
Difference between the "max." and "min." mark	Approx. ltr.	0.5 ¹⁾	0.5 ¹⁾
Engine oil consumption (after running-in period)	Max.	1 % of fuel consumption, pertaining to full load	
Engine oil pressure at oil temperature of 100 °C	Approx.	2.5 bar at 3000 rpm	
Sense of rotation on power take-off side (control side)		Left	
Sense of rotation (flywheel side)		Right	
Tappet clearance at 10 – 30 °C inlet/outlet	mm	0.10	0.10
Permissible inclination	Max.	25° ²⁾	25° ²⁾
Weight	Approx. kg	42	43
Battery capacity	Max.	12 V – 55 Ah / 420 A (EN) / 450 A (SAE)	
		24 V – 44 Ah / 360 A (EN) / 400 A (SAE)	
Model V : crankshaft with vertical arrangement, normal counter balance			

¹⁾ These specifications are approximate values. The max. mark on the dipstick is decisive in any case.

²⁾ The values apply to continuous operation in any direction.

Exceeding these limit values causes engine damage.

5.3 Engine type plate

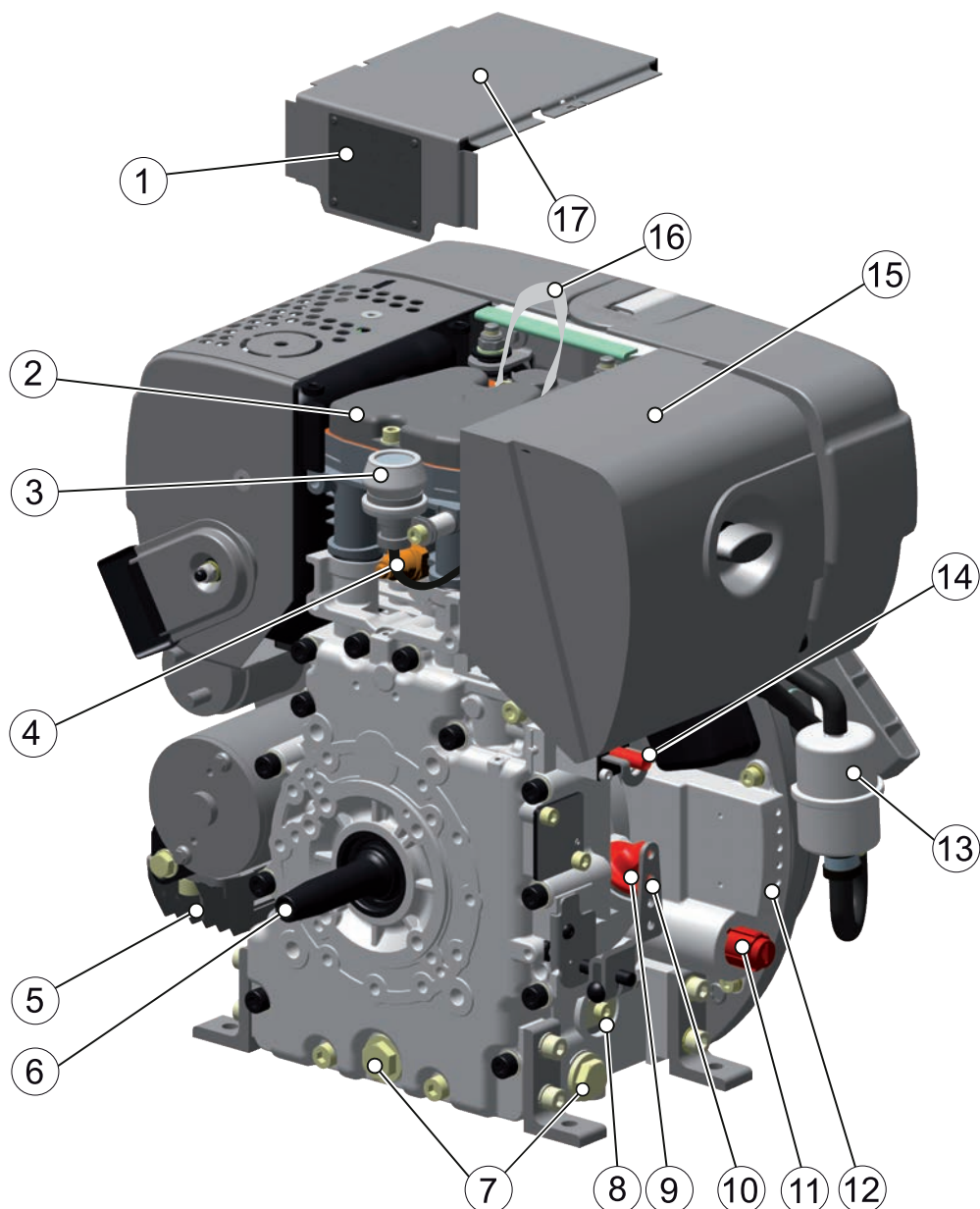


1	Model designation of the engine
2	Engine serial number
3	Engine power (kW) at rated speed (rpm)
4	Displacement (liters)
5	Information for US emission certification (EPA/CARB)
6	EU type approval number
7	EU country of origin (Germany)
8	Model year (month/year)
9	Test specification for special settings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

6 Engine overview

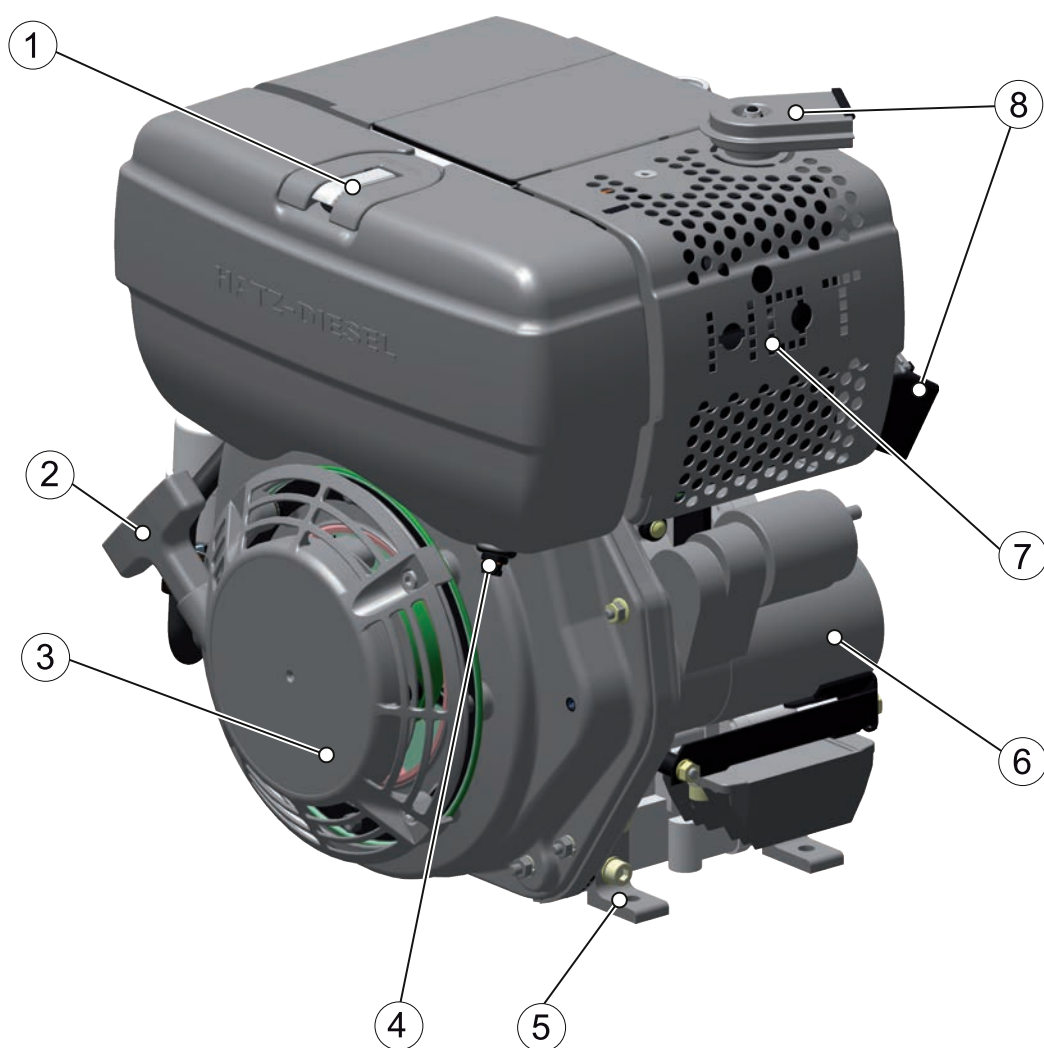
6.1 Designation of components

Intake side – 1B20, 1B30, 1B40, 1B50



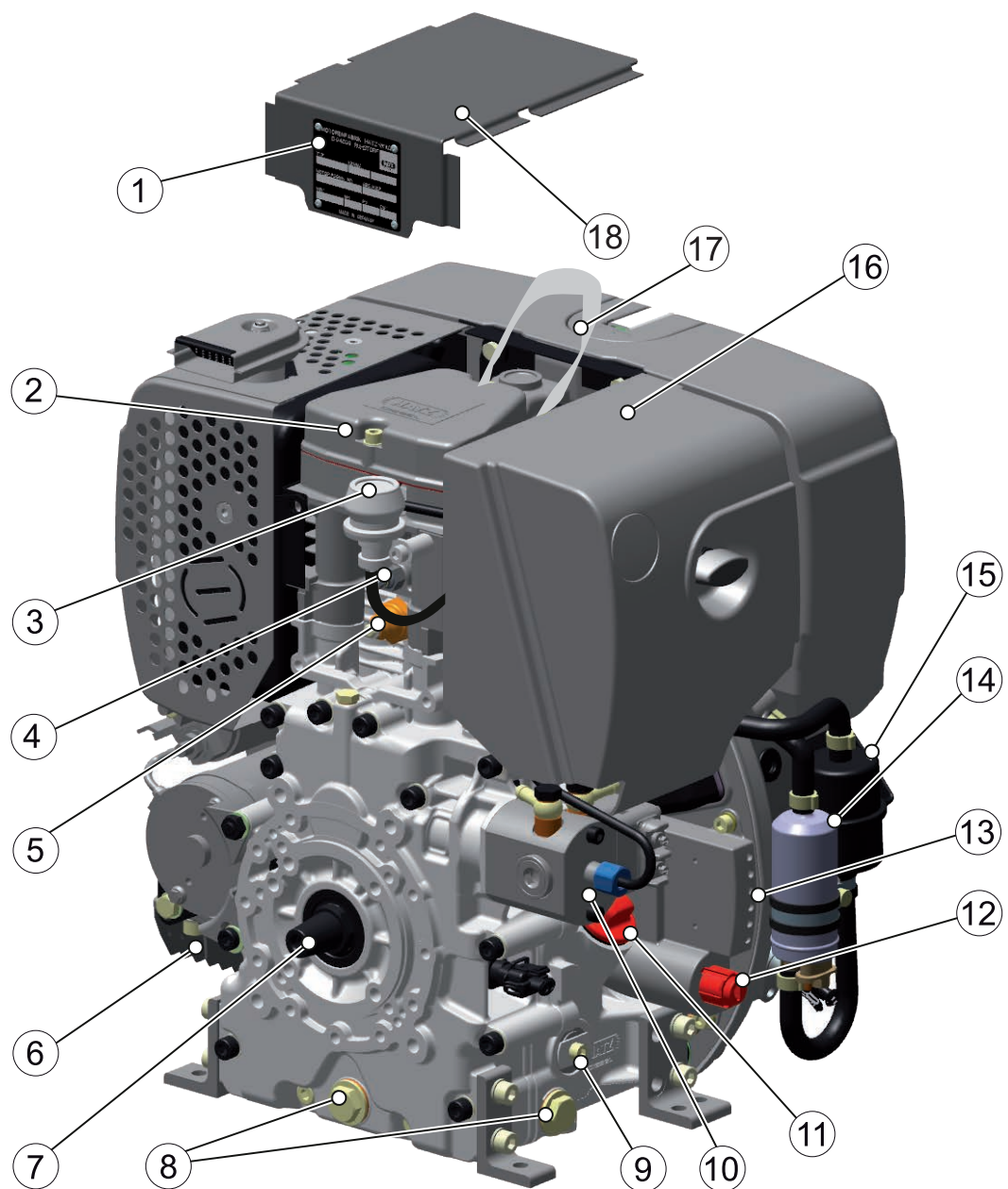
1	Type plate	10	Speed control lever
2	Cylinder head cover	11	Ignition lock ¹⁾
3	Air filter maintenance indicator (option)	12	Indicators ¹⁾
4	Oil pressure switch ¹⁾	13	Fuel filter
5	Voltage controller	14	Stop pin (option)
6	Crankshaft – power take off	15	Dry air filter
7	Oil drain screw (front and side)	16	Lifting eye
8	Screw cap for oil filter	17	Sound protection hood
9	Oil filler opening and dipstick		

¹⁾ Only in model with electrical equipment.

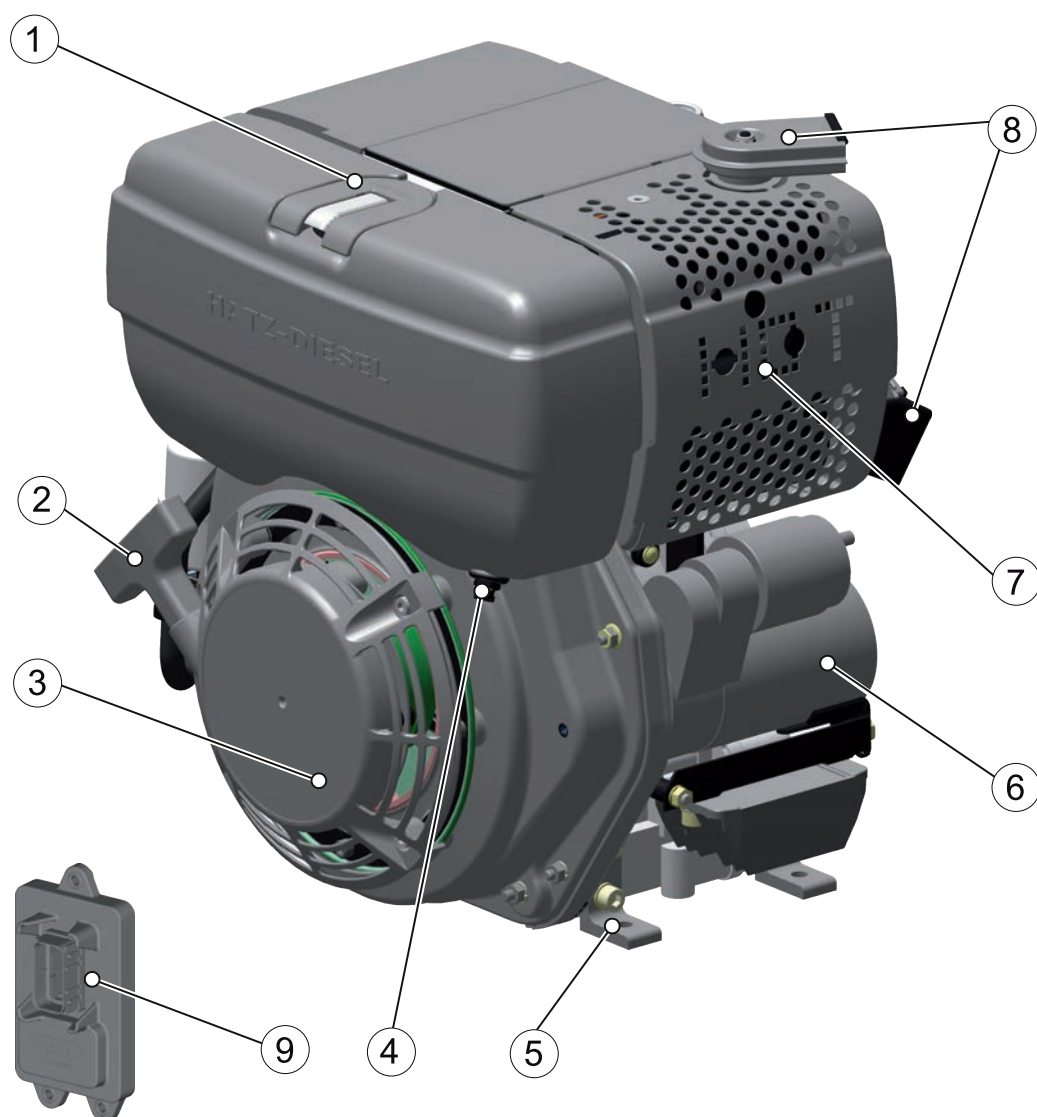
Exhaust side – 1B20, 1B30, 1B40, 1B50

1	Fuel cap
2	Recoil start
3	Intake opening for cooling and combustion air
4	Water separator
5	Engine bracket
6	Starter
7	Silencer with contact protection
8	Exhaust gas manifold with exhaust screen (standard: lateral)

Intake side – 1B30E, 1B50E

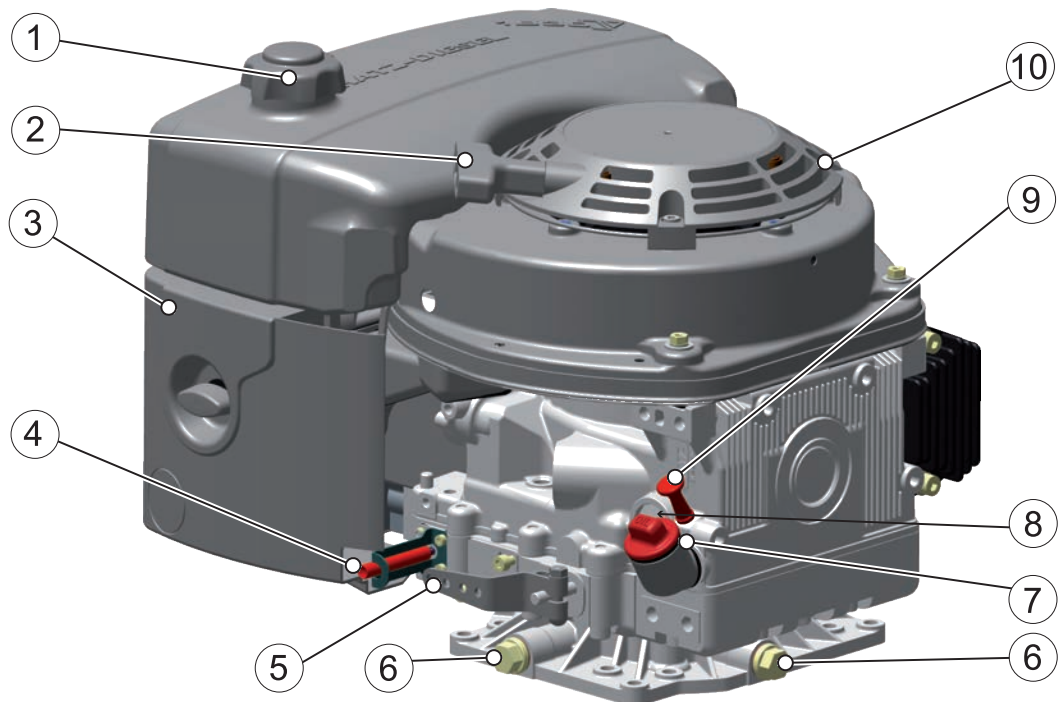


1	Type plate	10	High-pressure pump with solenoid valve
2	Cylinder head cover	11	Oil filling opening and dipstick
3	Air filter maintenance indicator (option)	12	Ignition lock
4	Temperature switch (option)	13	Indicator lamps
5	Oil pressure switch	14	Electric fuel pump
6	Voltage controller	15	Main fuel filter
7	Crankshaft – power take off	16	Dry air filter
8	Oil drain screw (front and side)	17	Lifting eye
9	Screw cap for oil filter	18	Sound protection hood

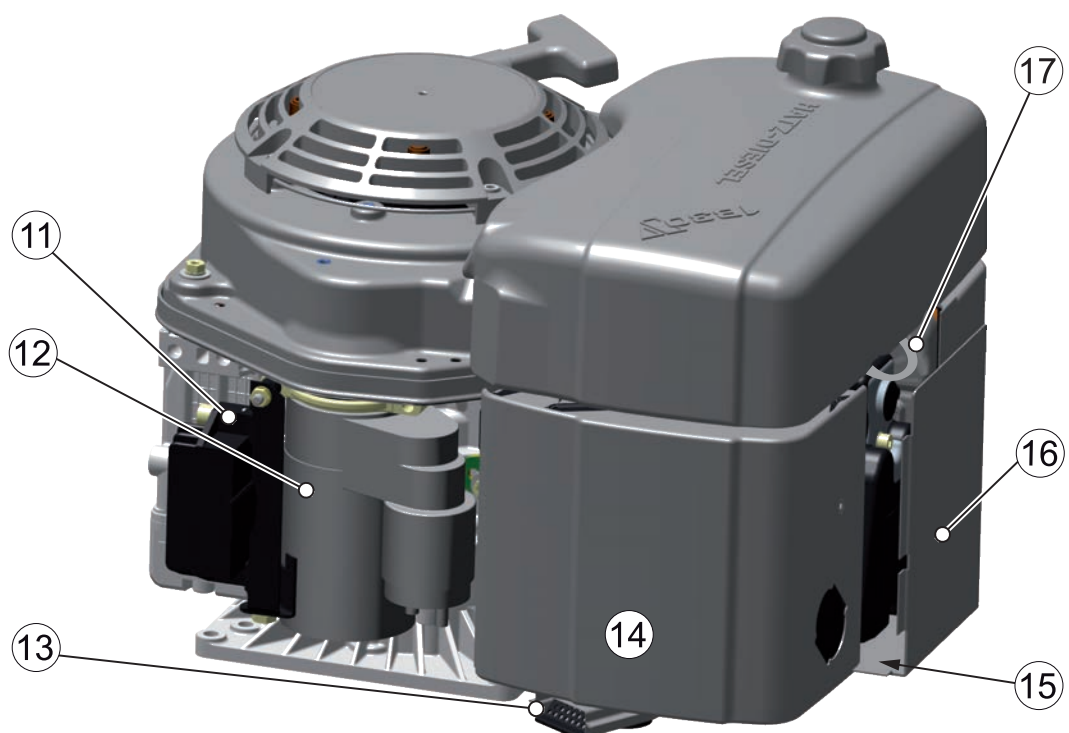
Exhaust side – 1B30E, 1B50E

1	Fuel cap
2	Recoil start
3	Intake opening for cooling and combustion air
4	Water separator
5	Engine bracket
6	Starter
7	Silencer with contact protection
8	Exhaust gas manifold with exhaust screen (standard: lateral)
9	Engine control unit

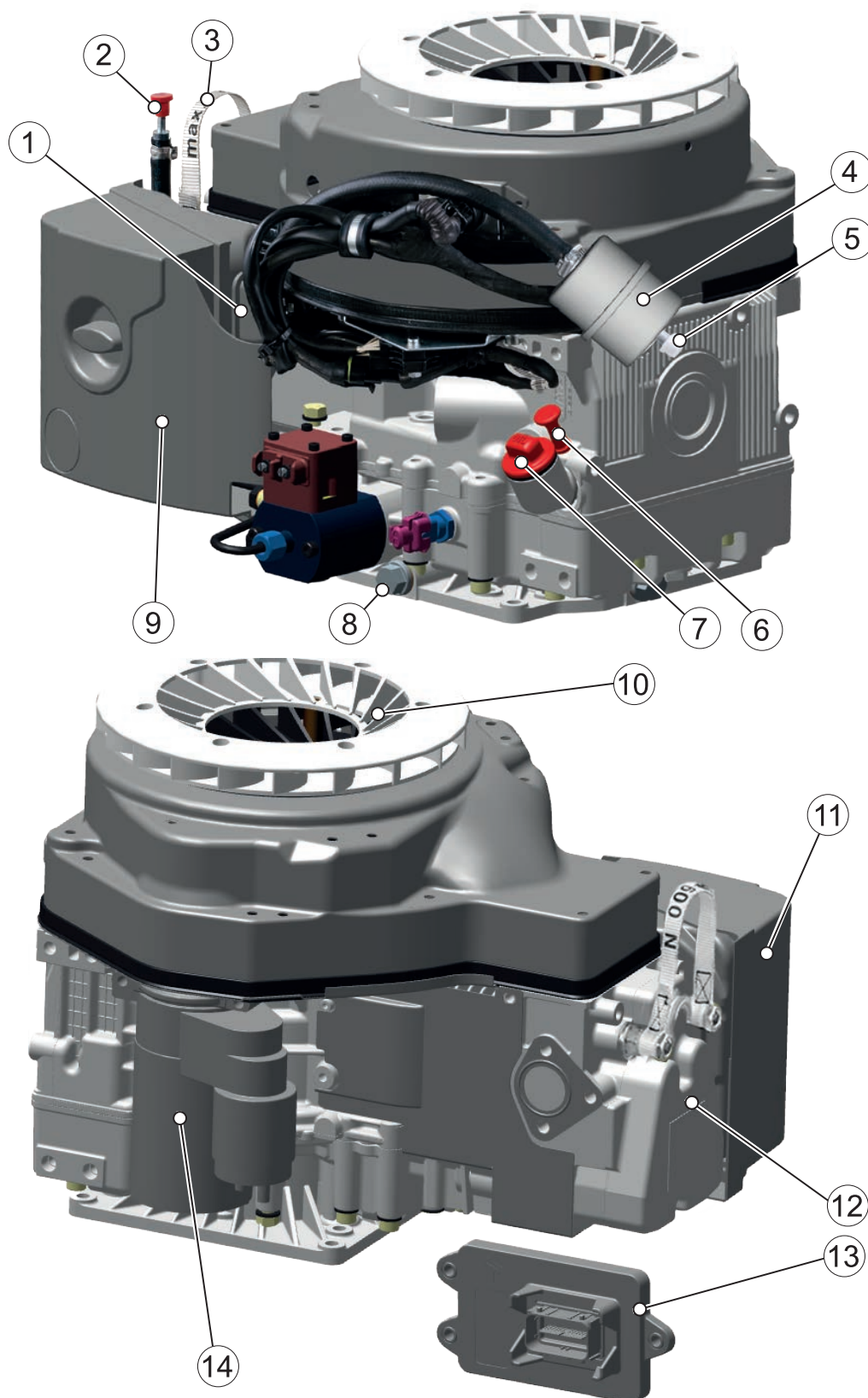
Intake side/exhaust side – 1B30V



1	Fuel cap	10	Intake opening for cooling and combustion air
2	Recoil start	11	Voltage controller
3	Dry air filter	12	Starter
4	Stop pin (option)	13	Exhaust gas manifold with exhaust screen
5	Speed control lever	14	Silencer with contact protection
6	Oil drain screws	15	Type plate
7	Oil filler plug	16	Sound protection hood
8	Screw cap for oil filter	17	Lifting eye
9	Dipstick		



Intake side/exhaust side – 1B30VE










1	Intake opening for combustion air
2	Fuel return
3	Lifting eye

4	Fuel filter
5	Fuel feed
6	Dipstick
7	Oil filler plug
8	Oil drain screw
9	Dry air filter
10	Intake opening for cooling air
11	Type plate
12	Cylinder head cover
13	Engine control unit
14	Starter

7 Transport and packaging

7.1 Transport

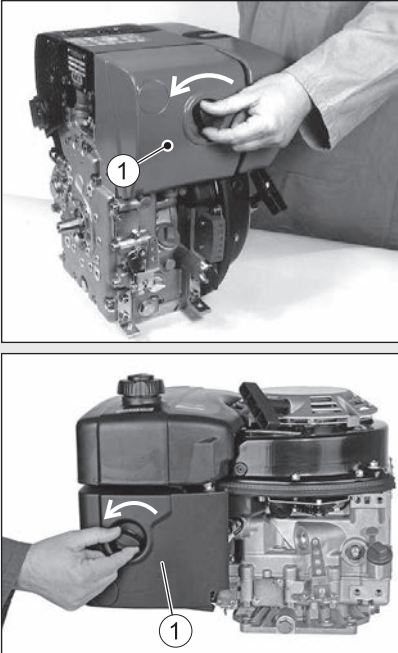
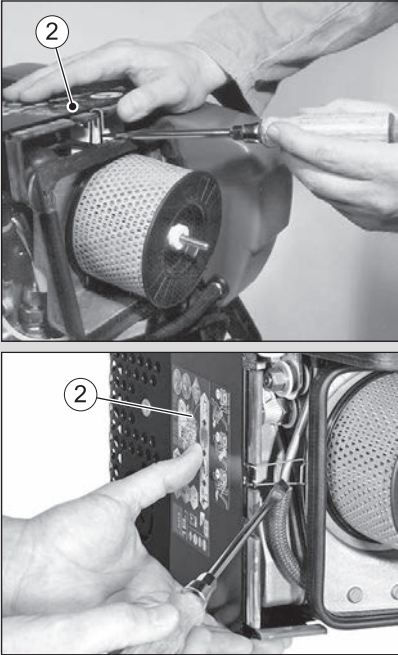
Safety notes

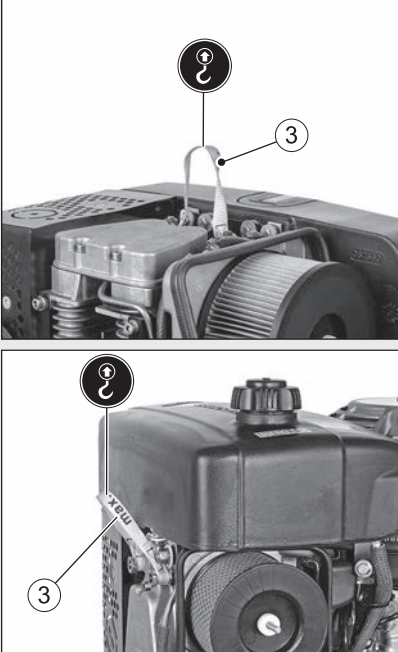
 WARNING	
	Danger of injury from improper lifting and transport.
	Danger of crushing from the engine falling or tipping.
	<ul style="list-style-type: none"> ▪ Only use the lifting eye already mounted on the machine for lifting. ▪ Before lifting the engine, check the lifting eye for damage. Lifting with a damaged lifting eye is not permitted. Replace a damaged lifting eye before using it for lifting. ▪ Only use a suitable hoist with a sufficient carrying capacity. ▪ Do not remain under suspended loads.
 CAUTION	
	Only use the lifting eye for transporting the engine.
	Do not use for lifting the entire machine.
 CAUTION	
	Danger of injury from overloading the body.
	Lifting the machine to transport it or to move it to another location can lead to injuries (of the back, for example).
	<ul style="list-style-type: none"> ▪ 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.
	<ul style="list-style-type: none"> ▪ 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 1 "Notices", page 6 or www.hatz-diesel.com.

Access to the lifting eye

Step	Activity	Figure
1	Unscrew the air filter cover (1).	
2	Remove the sound protection hood (2).	

Step	Activity	Figure
3	Attach the hoist securely to the lifting eye (3).	
4	After completion of transportation, refit the sound protection hood and cover for the air filter.	

7.2 Temporary stoppage

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

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

Step	Activity
3	Check the engine oil level.
4	Battery (if present) as per machine operating instructions.

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

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

7.3 Packaging

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

8 Installation instructions

8.1 Machine manufacturer obligations

It is forbidden to start the engine before it is fully installed. Modifications without prior approval by HATZ will invalidate the warranty. Installation must only be carried out by qualified technicians in accordance with these Assembly Instructions, all safety-related measures and statutory regulations. After the installation of the engine, the machine manufacturer is responsible for ensuring that all relevant statutory directives and regulations, including functional safety, are fulfilled.

Motorenfabrik HATZ GmbH & Co. KG takes no responsibility for injury to personnel or damage to the machine arising from non-observance of the assembly instructions or manual for diesel engine. Damage resulting from non-observance of the assembly instructions or the manual for diesel engine will forfeit any warranty on the part of Motorenfabrik HATZ GmbH & Co. KG and responsibility shall be transferred to the machine manufacturer/user.

8.2 Installation notes – general information

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

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

- Parts of the exhaust gas system and the engine surface become hot during operation and may not be touched until they cool down after the engine is switched off.
- Incorrect cable connections and incorrect operation of the electrical equipment can lead to sparking and must be avoided.
- After the engine is installed in the machine, rotating parts must be protected against contact. Protective devices from HATZ (e.g. belt protection) are available for this.
- Any improper modification of the engine will result in a loss of liability coverage for resulting damage.
- If the engine is speed limited via the CAN bus, care must be taken that the maximum machine speed is not exceeded.

8.3 Engine support/installation

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

Generally, flexible mounting of the engine should be aimed at.

In addition, the engine should be uniformly loaded; see *8.7.3 Uniform bearing load, page 60*.

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

8.4 Rigid engine support on frame

Rigid fastening can only be allowed up to an engine speed of approx. 2300 to 2600 rpm. At higher speeds, the free mass forces are so large that a flexible support is recommended. (Exceptions prove the rule)

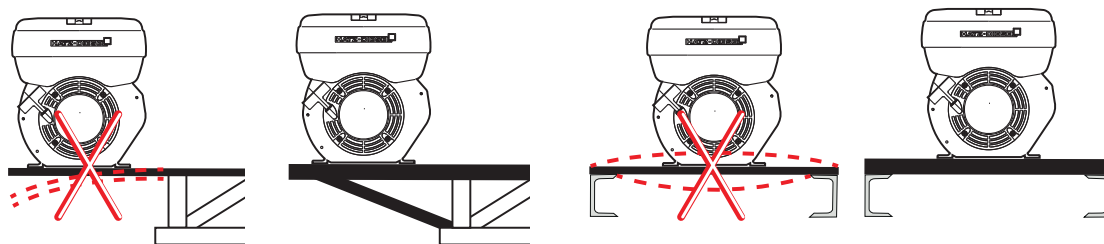
Important prerequisites for each engine fastening:

The frame or rack must be sufficiently stiff and sturdy since frame parts that are not stiff acts as springs and must be stabilized by additional struts.

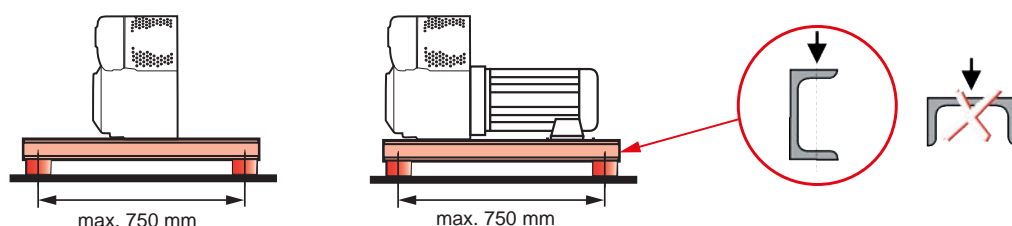
The following dimensions of the frame parts are sufficiently stiff for a rigid engine fastening (up to max. approx. 2300 to 2600 rpm):

For 1-cylinder engines, a U 80 U profile as per DIN 1026-1, rolled, should be used.

These frame parts should be as short as possible so they cannot act as springs. The maximum recommended permissible length is 750 mm.



If frame parts are longer than 750 mm for structural reasons (e.g. engines with multistage pumps), these must be bolted down again after a maximum distance of 750 mm.

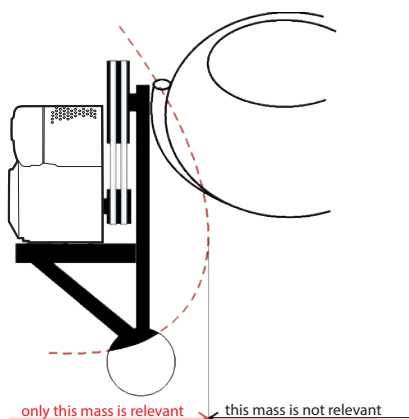


The dimensions recommended above for the rolled U profile only apply for vertically erected U profiles. The necessary stiffness is only achieved in this position.

A further prerequisite for the rigid setup of an engine is a sufficiently large machine mass/frame mass directly below or in the vicinity of the engine.

- For engine speeds of 1500 to 2000 rpm, the frame mass should be roughly as heavy as the engine mass.
- For engine speeds of 2000 to 2600 rpm, the frame mass should be roughly twice as heavy as the engine mass.

Primarily, however, only the frame/machine masses in the direct vicinity of the engine count and not masses located farther away.

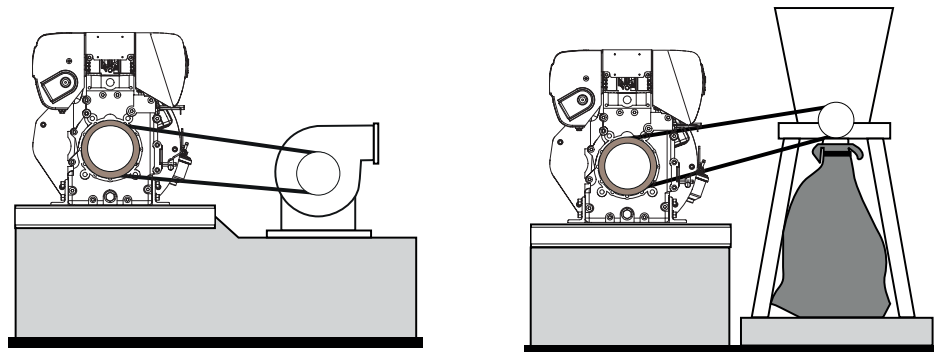


Only sufficiently large masses in the direct vicinity of the engine can prevent strong vibrations and possible material breakage.

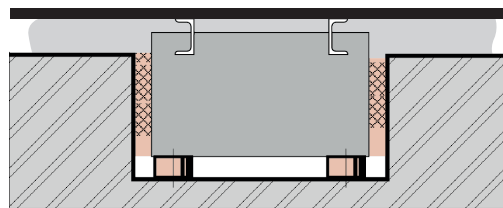
8.5 Rigid engine support on foundation

Speed recommendation: Max. 2300 rpm, although it would be better to operate it at a lower engine speed.

For stationary use, the engine is fastened to a concrete foundation. The driven machine, e.g. pump, mill, etc., is driven by a flexible drive element such as a belt.



To isolate vibrations and structure-borne noise from buildings, concrete foundations should be separated from the buildings by means of springy mats or similar in case of high speeds – i.e. they should be flexible and thus insulated against structure-borne noise.



Building of the foundation must be commissioned with a construction company that provides a guarantee that the foundation is properly constructed. The foundation block is seated on ground with a sufficient load-bearing capacity. If ground with a sufficient load-bearing capacity is not reached at the defined depth, the bottom of the foundation must be enlarged until it corresponds to the load-bearing capacity of the ground. The entire foundation must be poured continuously without interruption.

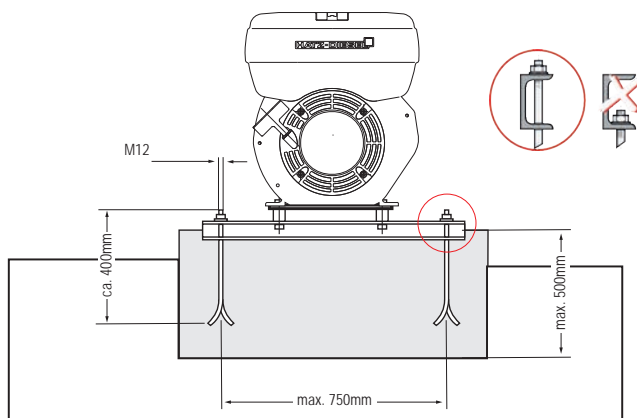
NOTICE



The engine may only be operated and the belt only tensioned after the concrete is fully hardened (7–10 days depending on the temperature).

Rails (rolled U profiles) are required under the engine brackets to securely fasten the engine to the concrete foundation. The rails are arranged under the engine brackets transverse to the crankshaft axis so that the belt tension and the torque are adequately resisted.

The clearance for the anchor screws must not exceed 750 mm to avoid impairing the stiffness – yet the clearance must not be much less than 750 mm, either, or else the belt tension and torque will not be adequately resisted.



The anchor bolts used for fastening must be approx. 400 mm long. A size M12 cross section is recommended. The anchor bolts must be screwed through the U profile (see figure); this ensures a level washer and nut contact surface and the necessary bolt preload.

The anchor bolts must be cast in the concrete block; other fastening types (e.g. dowels) have not proven effective. The U profile rails are securely fastened by inserting the rails in the still liquid concrete with the engine and anchor bolts or casting the rails and anchor bolts in concrete.

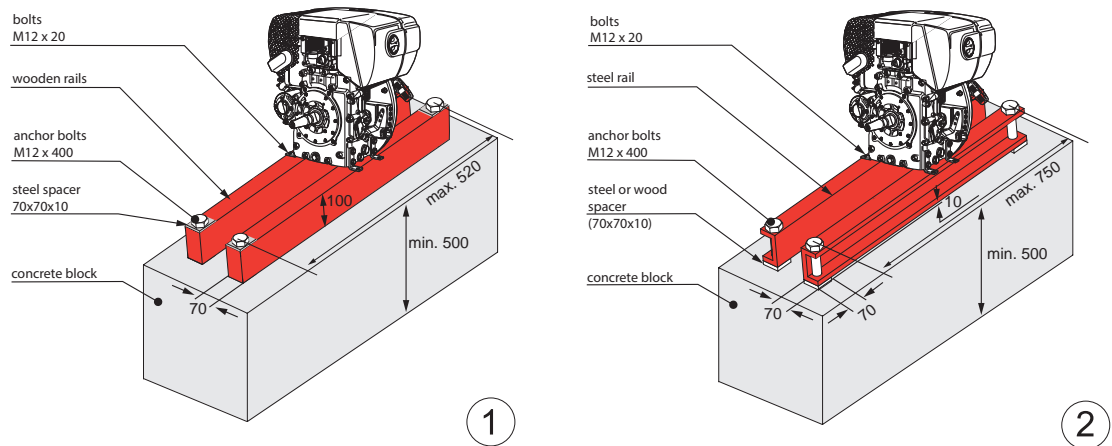
Summary:

- Select a U profile
- Position the U profile vertically
- Arrange the rails transverse to the crank shaft axis
- Distance between anchor bolts max. 750 mm
- Screw the anchor bolts through the U profile
- Anchor bolts M12 x 400
- Cast the rails and anchor bolts in the concrete block
- Let the concrete harden
- Retighten the nuts of the anchor bolts after a short period of operation and continue to monitor them.

If a hardened concrete foundation is used that was previously created, the following points apply:

Under the steel rails, the tips of the concrete surface will brake away, the bolt connections lose the preload needed for the holding the bolts, and the anchor bolts will break a short while later.

Recommendations for finished concrete foundations



For figure 1: Rails made of hardwood

Wood adapts well to unevenness and rough concrete surface, and the concrete tips press into the wood. To ensure that the nuts do not dig into the wood excessively, steel shims (70x70x10 mm) are used on the wooden rails.

For figure 2: Rails made of steel

When using a steel rail, a shim of steel or hardwood should be placed under the rail (approx. 70x70x10 mm).

The fastening nuts must be tightened more often during the initial operating hours. After a certain time, the concrete tips break away and a level and supporting concrete surface results.

In both cases, it is important to monitor the screw connections and retighten the nuts if necessary.

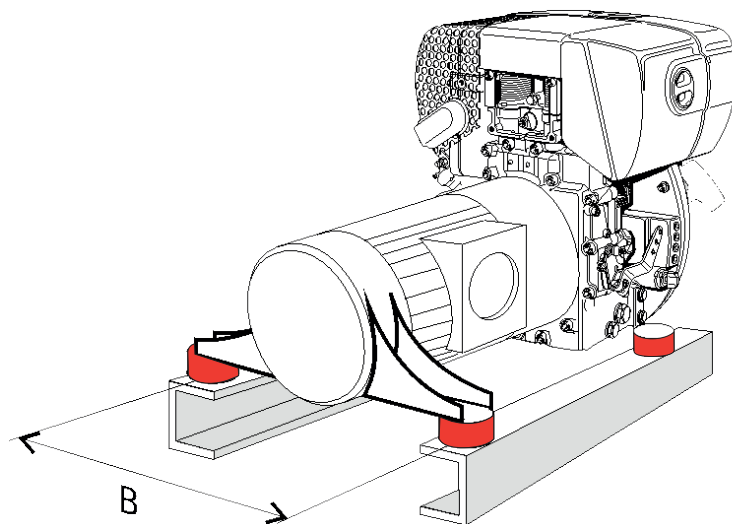
8.6 Flexible engine mounting

A flexible engine mounting is recommended.

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

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

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

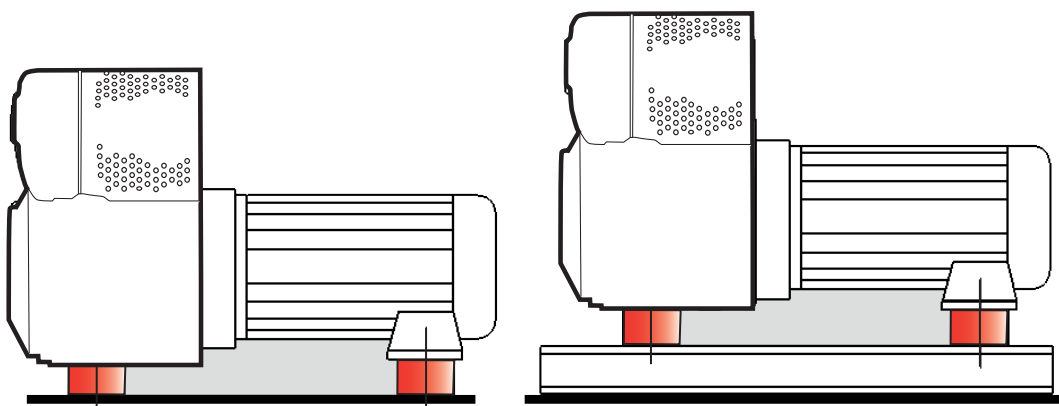


Depending on the type of machine with a flexible mounting, a decision must be made between a

- a) **flange-mounted** force sensor and
- b) **non-flange-mounted** force sensor.

a) Flexible mounting - flange-mounted force sensor

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



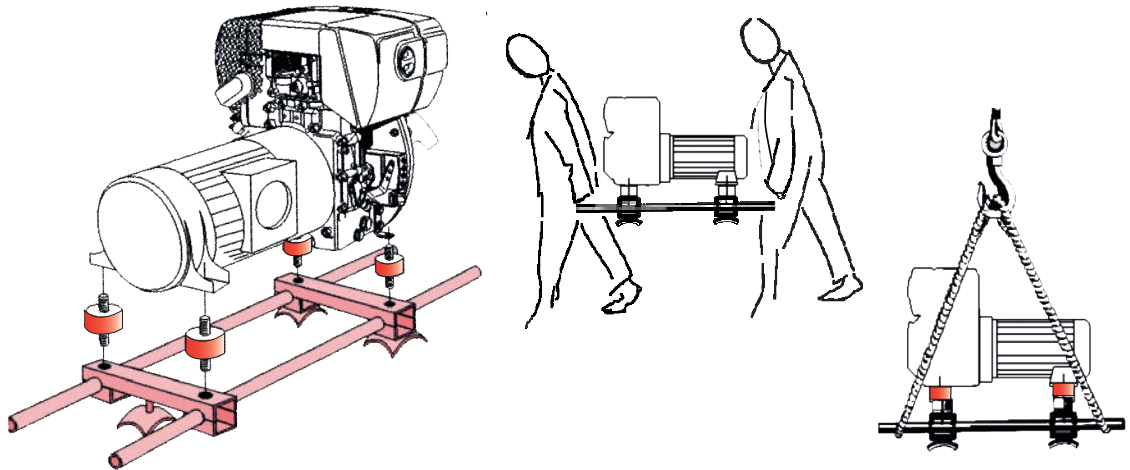
A U 80 profile (vertical) is adequate for the frame parts of a flexibly supported and flange-mounted force sensor. Because the flange-mounted force sensor is rigid within itself and is cushioned by the rubber buffers.

To stabilize the flexibly supported machine during the starting and coasting phases, stable rubber buffers must be used under the machine part with low vibration (e.g. generator). The following rubber buffers have proven useful, see 8.7.2 *Flexible mounting*, page 59.

HATZ – Universal frame

A frame under the flange-mounted systems is usually used for transport purposes. For all mobile systems with 1-cylinder engines, HATZ offers universal frames with the following advantages:

- The frame can be used for all electrical systems, pump systems, hydraulic systems, etc.
- The engine crossbeam has fastening holes for all 1-cylinder engines.
- Holes are drilled into the crossbeam under the system as needed.
- The longitudinal distance of the cross beams is universally adjustable.
- The crossbeams are simple 1" water pipes and can be provided by the customer.
- The system is mounted on rubber buffers.
- The frame is firmly positioned on three 3 feet, which is why the system can also be operated on uneven ground.



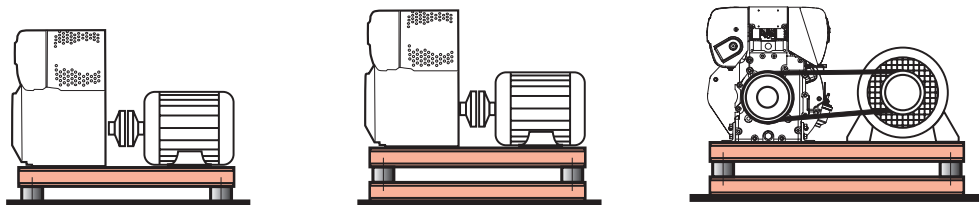
b) Flexible mounting for non-flange-mounted force sensors

For a non-flange-mounted force sensor, a frame is used on which the engine and the driven machine are rigidly screwed in place.

The following recommendation applies to the frame dimension of a non-flange-mounted system:

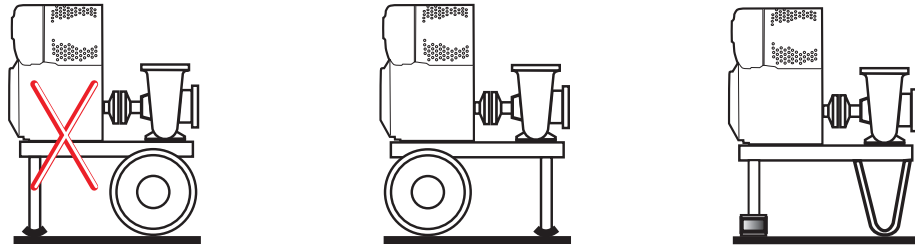
- For the top frame, on which a 1-cylinder engine is mounted:
 - U 80, vertical
- For the spring-loaded subframe:
 - U 80, vertical, for all numbers of cylinders

Examples for a non-flange-mounted and open design is shown in the following figure.





When systems are mounted on a single-axle trailer with rubber tires, the engine must be mounted over the axle.

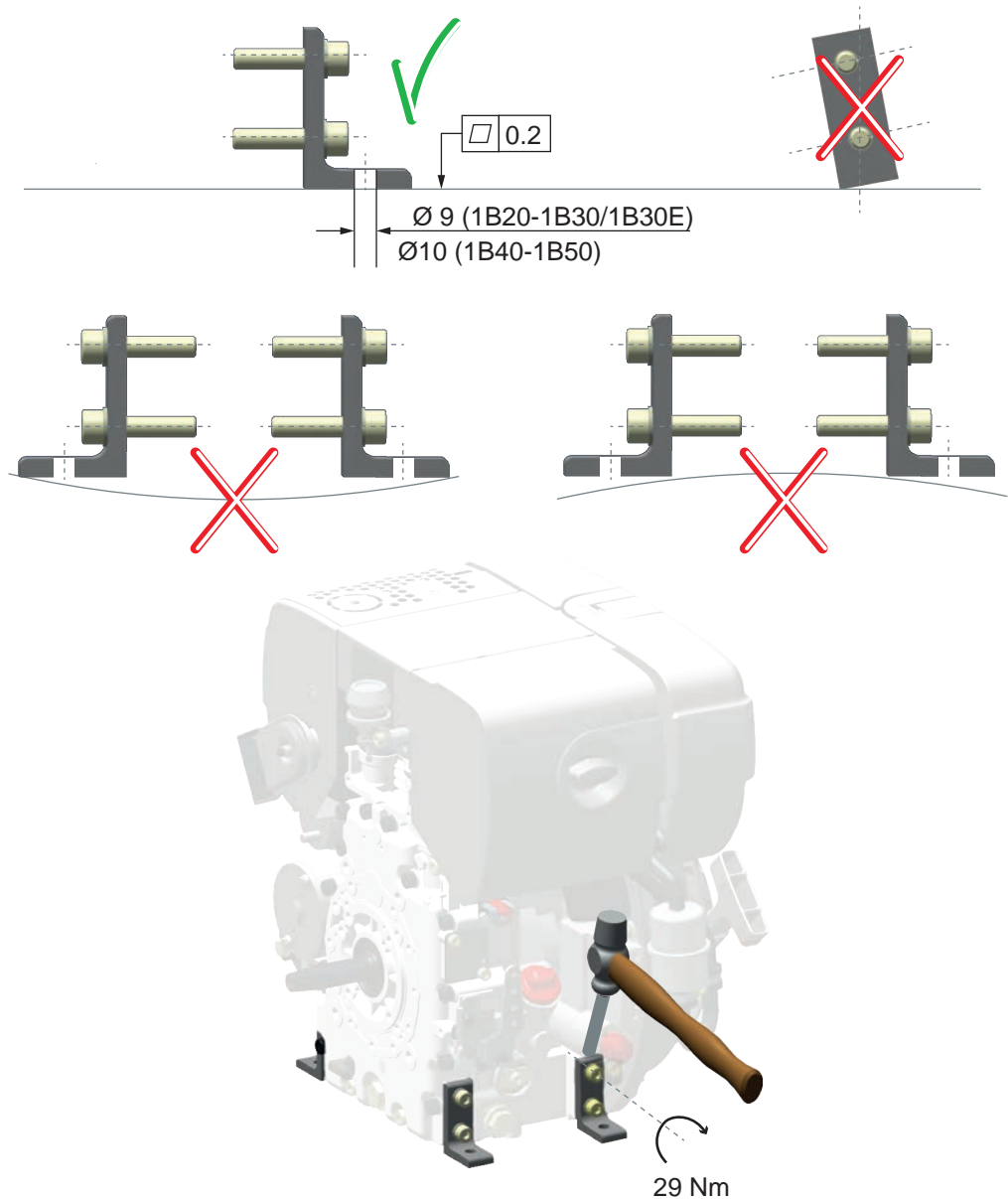
The rubber wheel provides a flexible mount and achieves an isolating effect. If there are no rubber tires, we recommend placing a rubber element under the support of the trailer and mounting the engine on top of this rubber element.



8.7 Stress-free fastening of the engine

8.7.1 Rigid setup

 CAUTION	
	<p>Danger of injury and danger of engine damage if the engine is not mounted without stress</p> <ul style="list-style-type: none"> If the engine fastening is rigid, the engine brackets/base plate must be set up in a stress-free manner (flatness tolerance of the contact surface must be 0.2 mm). Non-observance can lead to a risk of injury, breaking of the engine brackets/base plate, and thus engine damage.

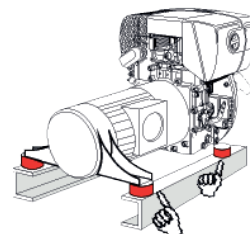
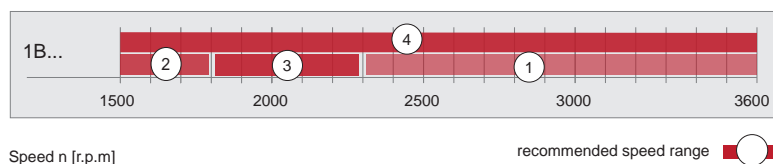


In order for the engine to also be installed absolutely free of stress, one of the 4 identical engine brackets must be adjusted/aligned to the contact surface.

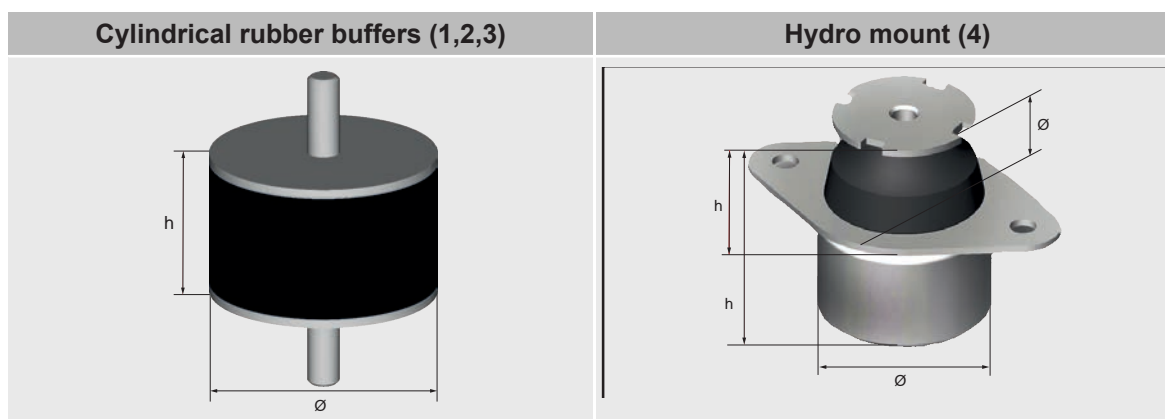
8.7.2 Flexible mounting

Recommendation for cylindrical rubber buffer for flexible mounting of stationary systems with vertical installation and use of four anti-vibration pads per system. See also chapter 8.6 *Flexible engine mounting*, page 55.

The support surface for the fixing of the engine must comply with a flatness tolerance of max. 1 mm.



No.	Material no.	Vibration damper	Ø [mm]	h [mm]	Hardness [Shore A]
1	502 867 xx	Cylindrical rubber buffer	40	40	40
2	502 859 xx	Cylindrical rubber buffer	50	45	55
3	502 678 xx	Cylindrical rubber buffer	50	45	40
4	401 484 xx	Hydro mount V250	46/56	26.5/62.5	40



NOTICE

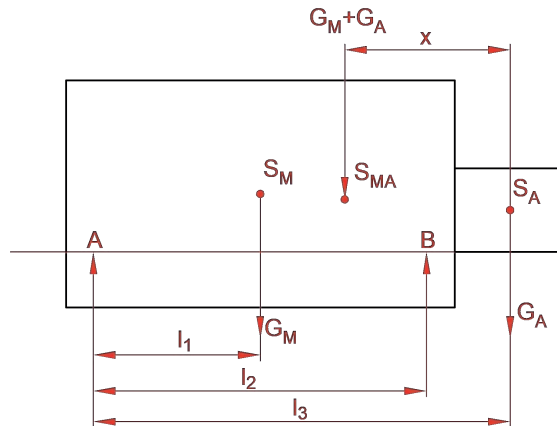


Depending on the application, the device manufacturer must define and set up the installation of the engine together with the appropriate vibration dampers.

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

8.7.3 Uniform bearing load

When using bearing elements, ensure the bearing load is uniform. Of the total weight, no more than 60 % should rest on A or B; if you have any questions, contact Motorenfabrik Hatz, Ruhstorf. Determination of bearing forces (if centers of gravity of the engine, attachments such as hydraulic pump, generator, and their intrinsic weights are known)



$$A = \frac{G_M \times (l_2 - l_1) - G_A \times (l_3 - l_2)}{l_2} \text{ [N]}$$

$$B = \frac{(G_M \times l_1) + (G_A \times l_3)}{l_2} \text{ [N]}$$

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

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

$$x = \frac{l_2 - l_1}{1 + \frac{(G_A)}{(G_M)}} \text{ [m]}$$

8.8 Installation of engines under a cowling

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

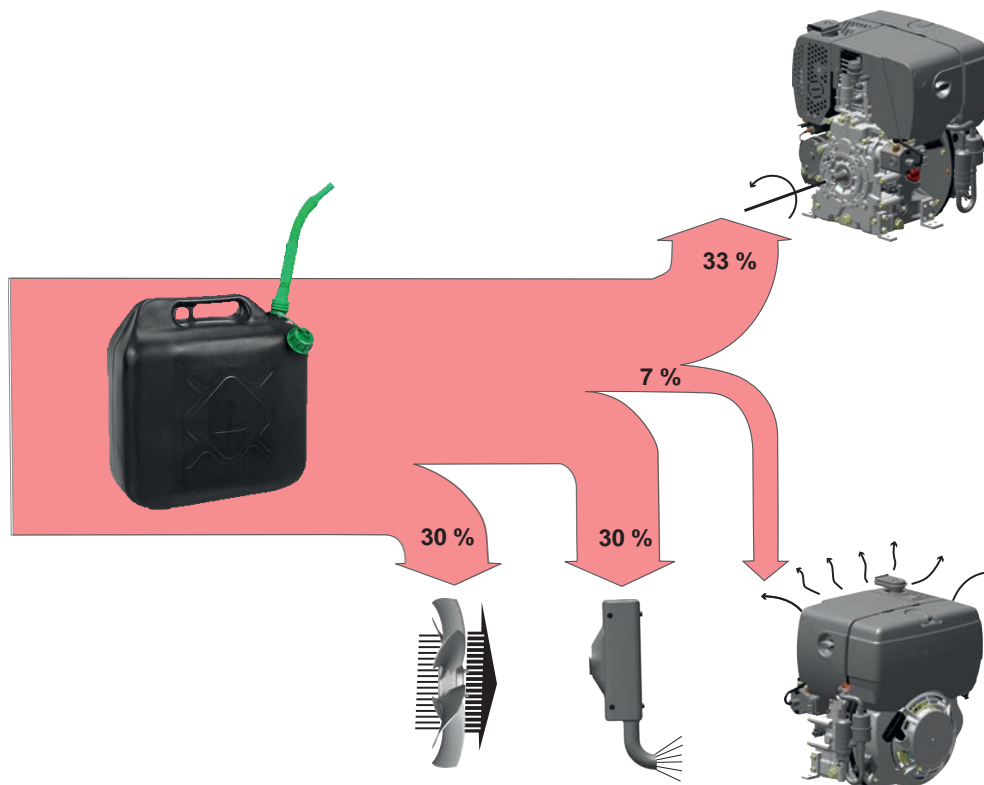
The energy balance looks something like this:

Approx. 33% of the engine power available for effective work

Approx. 30% contained in the exhaust gas

Approx. 30% contained in the cooling air or cooling water

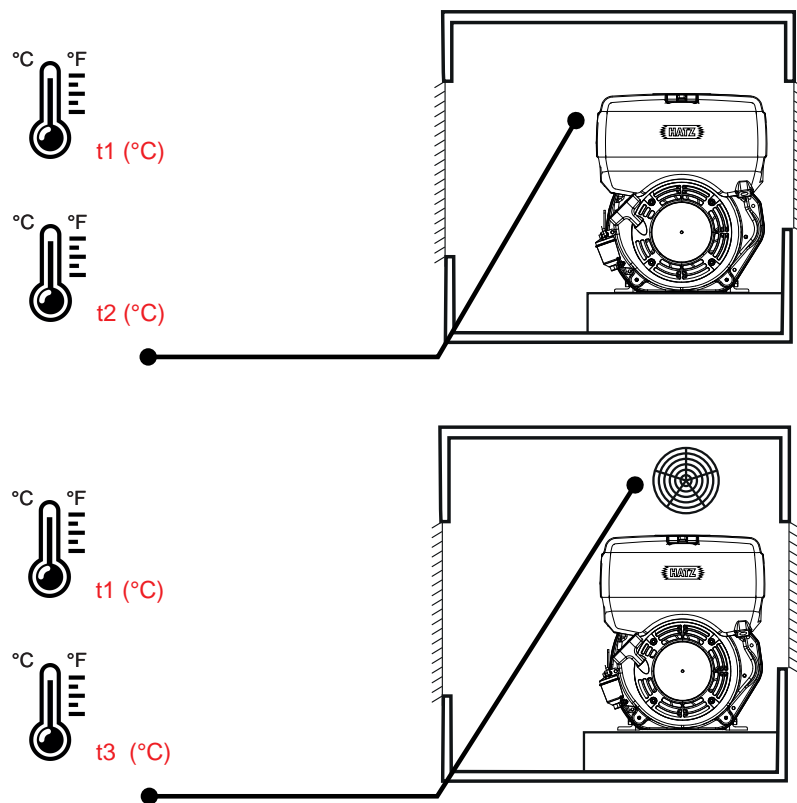
The remainder (approx. 7%) is radiated from the engine surface



To successfully enclose a system, it is necessary to dissipate the radiated heat of the engine, the exhaust pipe and the applied machines from the engine compartment again. For each engine installation, the temperature outside of trim panel t1 and the operating temperature in front of the air filter and the cooler fan must be measured.

The temperature difference between measuring points t2 – t1 and t3 – t1 is a measure of how well the engine was installed. If there is a temperature increase, either the radiation heat is not being adequately dissipated and/or there is a short circuit between the heated cooling exhaust air and the cooling supply air.

A **temperature difference** of at most 8 to 10 °C is only acceptable if the higher temperature level is taken into account in the **power calculation** or force ventilation using an auxiliary fan prevents the temperature increase.



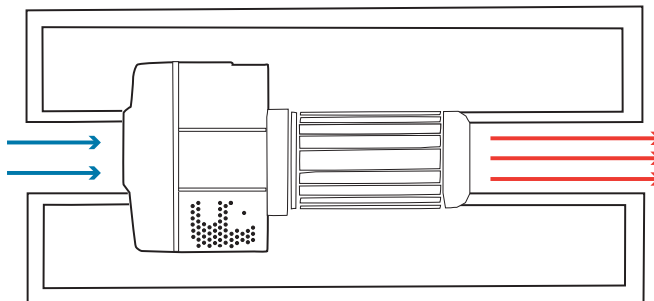
A temperature increase, of course, overrides the normally applicable temperature limits. This means that at a temperature increase between the outside air and the intake air of 8 to 10 °C, the engine can no longer be operated up to the ambient temperature of +45 °C but now only up to approx. 35 – 40 °C.

It is therefore recommended to install the engine in such a way that higher temperatures do not occur in the first place or only rise slightly.

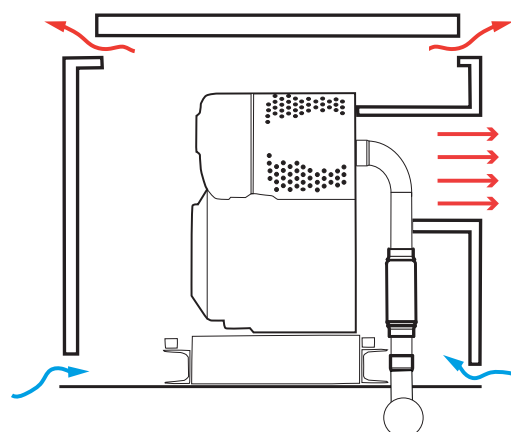
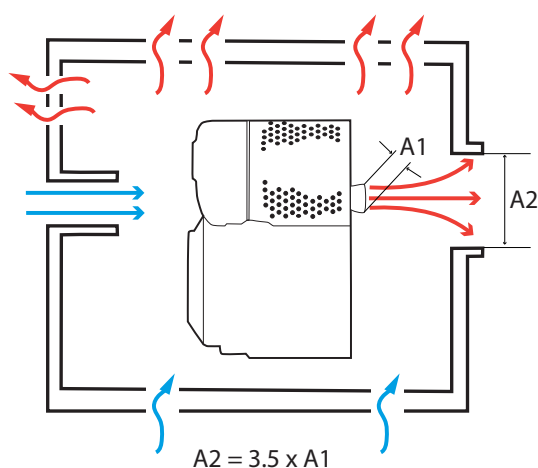
Installation recommendation:

- **Engine installation in the vicinity of the supply air or exhaust air openings**

The cooling air intake and combustion air openings of the engine must overlap with the measured cutouts in the trim panel. The heated cooling exhaust air must be able to flow out over the shortest distance and across a very large unobstructed area.



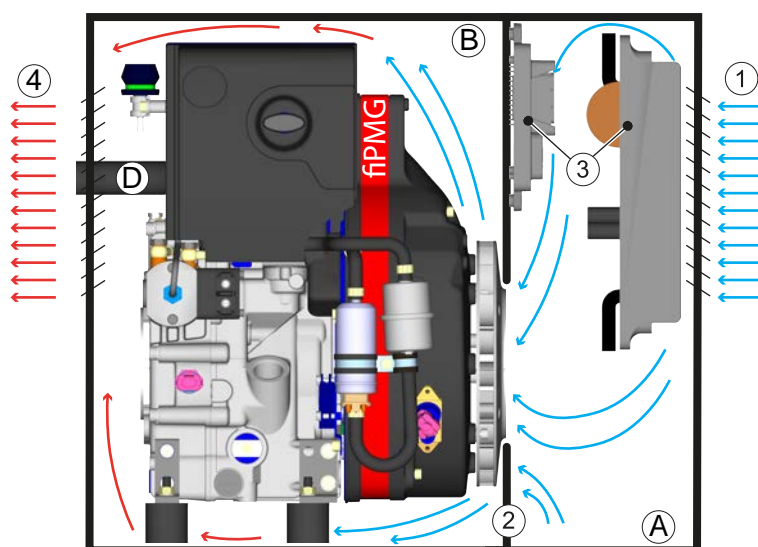
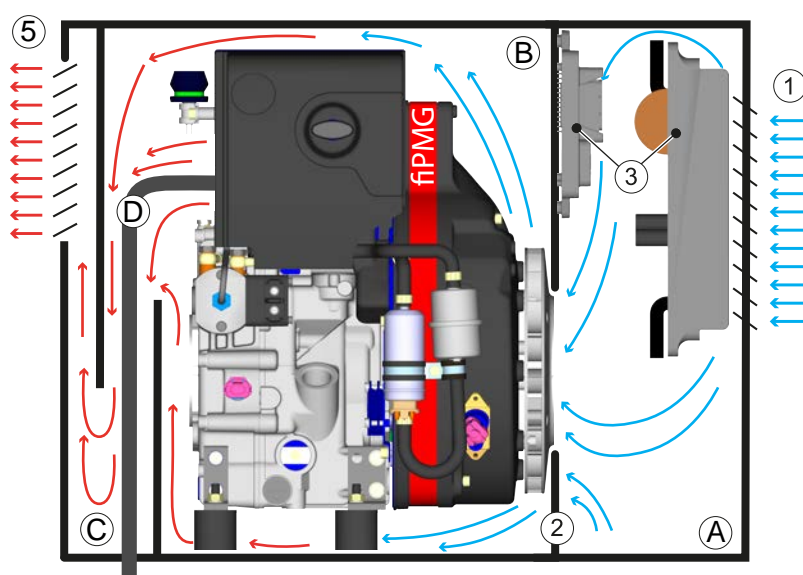
The opening area in the trim panel must be approx. three to five times as large as the discharge area at the cylinders and cylinder heads. The opening in the trim panel should have guide plates.



The openings for the radiation heat must be arranged in such a way that a chimney draft occurs that carries away the heat energy. Exhaust dampers must be installed outside of the trim panel and the exhaust gas line must be routed along the shortest possible path out of the trim panel. The radiation heat of the driven machinery, such as hydraulic pumps, must be able to escape as well.

Installation recommendation: housing for fiPMG:

The inverter and control unit are supplied as loose parts with the engine.

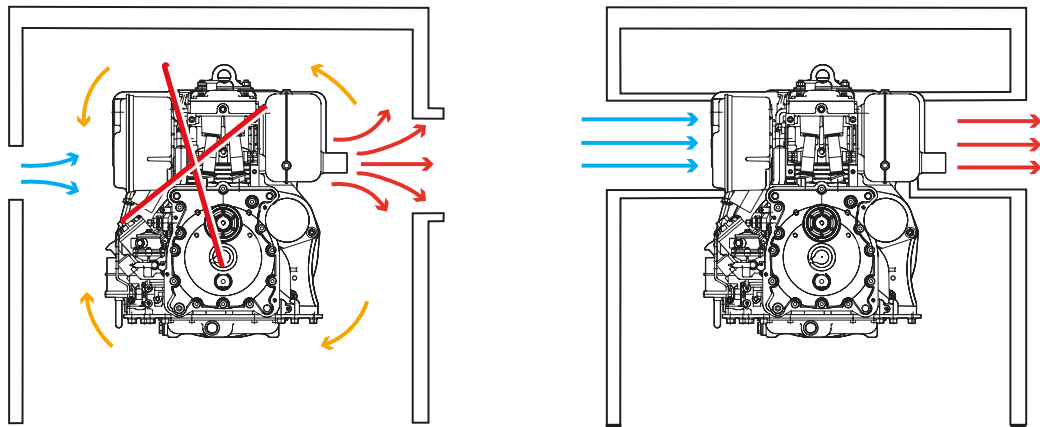
**Installation recommendation: housing for fiPMG for noise reduction:**

1	Fresh air supply: the cooling and combustion air are drawn in.
2	Separating plate between the cooling air space (A) and the space holding the heat (B) from the engine.
3	The inverter and control unit* must be mounted in the fresh air supply space. Note: The inverter switches off automatically if overheated to an excessive degree.
4	The engine must be installed in such a way that the heat generated by the engine can be discharged to the outside as quickly as possible. The exhaust gas line (D) must be routed out of the trim panel along the shortest possible path.
5	The exhaust heat of the engine is conveyed out into the open through a labyrinthine air shaft, which additionally reduces noise.

*Connection diagrams and wiring diagrams can be obtained by entering the serial number on the Hatz engine, which is located on the delivery slip or on the type plate directly on the engine.

▪ **Engine installation far from the supply air or exhaust air openings.**

If the engine is installed far from the supply air and exhaust air openings, a guide shaft must be installed that discharges the collected cooling energy. This prevents mixing with the freely drawn-in cooling and combustion air, and it prevents an increase in the intake air temperature.



If a **fresh air supply line is necessary upstream of the air filter**, this must take place through a hose that can withstand the intake pulsation, such as a hose with a wire insert. The air filter should therefore always remain installed on the engine to prevent any leaks on the clean air side.

NOTICE



If **noise reduction canopies** are used, a closed supply air guidance and a closed exhaust air guidance are necessary. In addition, the radiation heat must be dissipated by an auxiliary blower.

The intake openings must be protected by rain caps or similar to prevent the ingress of rain or washing water. If a supply line is present for the cooling air, the combustion air can be branched off from this cooling duct.

A ready-made noise reduction canopy is available for the engine in the form of the "**Silent Packs**" from **HATZ**. If you wish to install engines in noise reduction canopies yourself, please contact **Hatz Ruhstorf**.

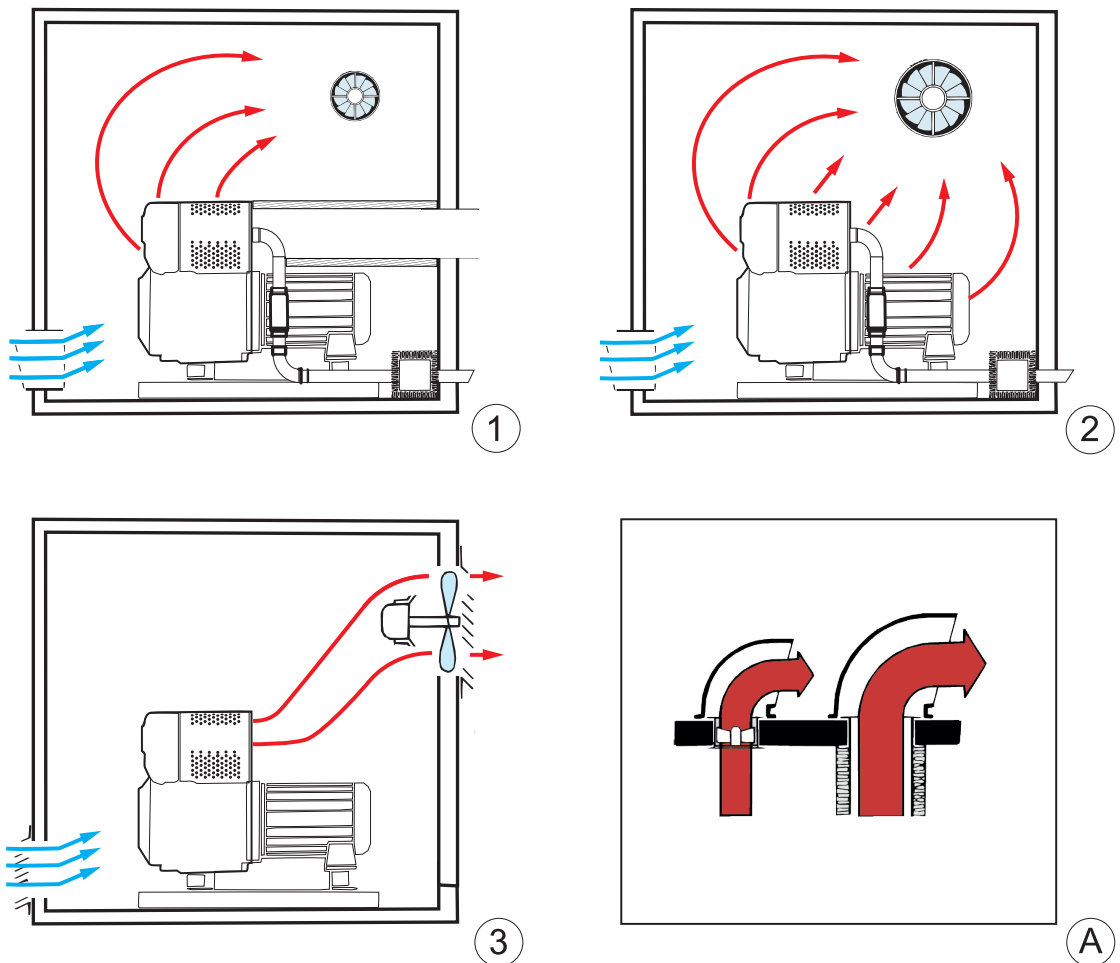
Supply air and exhaust air openings have **grids** for optical and safety reasons. The air resistance of these grids must be taken into account. Grids made of "flattened metal" have proven to be effective here.

To discharge the exhaust heat generated by the engine and the driven machine, the space must be provided with a fan that can transport away the generated heat.

The following systems have proven to be effective:

1. A relatively **small fan** for transporting away engine radiation heat and heat from the driven machine. The heated engine exhaust air is collected in an insulated air outlet duct and conducted to the outside along the shortest possible path..
2. A **large exhaust air fan** is installed that not only conveys the engine radiation heat and the excess heat from the driven machine but also the heated exhaust air from the engine into the open.
3. The arrangement of the supply and exhaust air openings must always be chosen in such a way that **air flows through the space diagonally**, ensuring that the surface of the machinery can dissipate enough heat. This means that the **supply air opening** is always **close to the floor** and the opening for the extract air fan is diagonally opposite from it directly under the top cover. The **exhaust gas line** is routed to the outside over the shortest possible distance and is **heat insulated**. Details on the dimensions of the space fans, supply air cross sections, exhaust air lines

and air outlet ducts are described in the section **Exhaust gas**. The numerical values presented there are based on a temperature increase in the machine room of +10 °C over the external temperature.



Details on the dimensions of the space fans, supply air cross sections and exhaust air lines are described in the section *8.12 Exhaust gas system, page 78* and of air outlet ducts in section *8.9 Installing the engines in enclosed spaces, page 67*. The numerical values presented there are based on a temperature increase in the machine room of +10 °C over the external temperature.

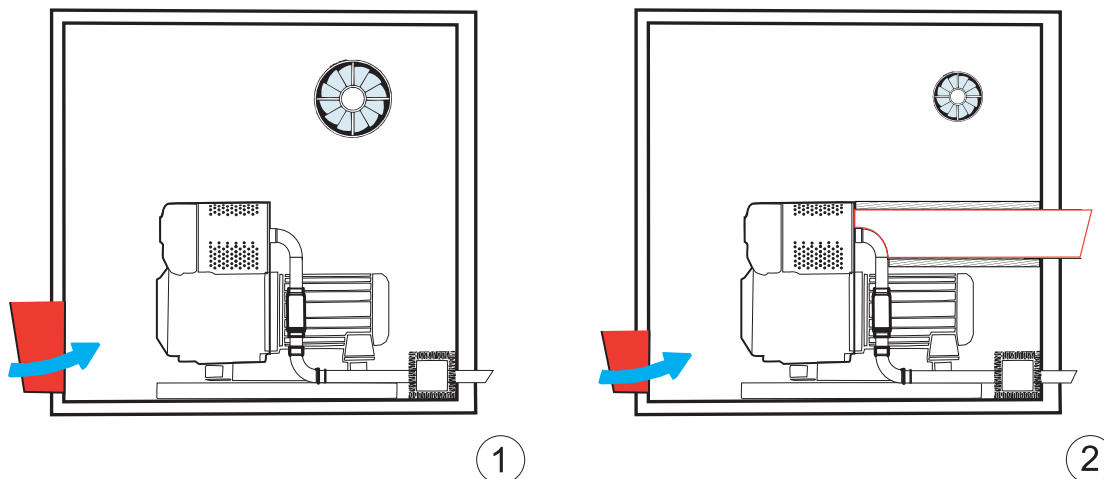
This temperature increase must be taken into account in the power calculation.

The **outlet openings** of the air outlet ducts and the exhaust air fans must always be installed on the building side facing away from the usual direction of the wind. If wind blows into these openings, the air current will be blocked and the temperature level in the machine room will rise to impermissible levels.

(A) If wind blows at the openings, generously dimensioned air deflection hoods must be installed.

8.9 Installing the engines in enclosed spaces

8.9.1 Guide values for the free minimum supply air cross section in machine rooms at max. engine speed



For engines WITHOUT an air outlet duct (1)			Engine	For engines WITH an air outlet duct (2)		
...mm x ...mm		Ø [mm]		...mm x ...mm		Ø [mm]
205 x 205 mm	or	230 mm	1B20	90 x 90 mm	or	105 mm
205 x 205 mm	or	230 mm	1B20V	90 x 90 mm	or	105 mm
250 x 250 mm	or	280 mm	1B30	110 x 110 mm	or	125 mm
250 x 250 mm	or	280 mm	1B30V	110 x 110 mm	or	125 mm
250 x 250 mm	or	280 mm	1B30E	110 x 110 mm	or	125 mm
250 x 250 mm	or	280 mm	1B30VE	110 x 110 mm	or	125 mm
300 x 300 mm	or	330 mm	1B40	135 x 135 mm	or	150 mm
350 x 350 mm	or	390 mm	1B50	155 x 155 mm	or	175 mm
350 x 350 mm	or	390 mm	1B50E	155 x 155 mm	or	175 mm
350 x 350 mm	or	390 mm	1B50W	155 x 155 mm	or	175 mm

At lower max. engine speeds, the duct dimensions can be reduced, namely:

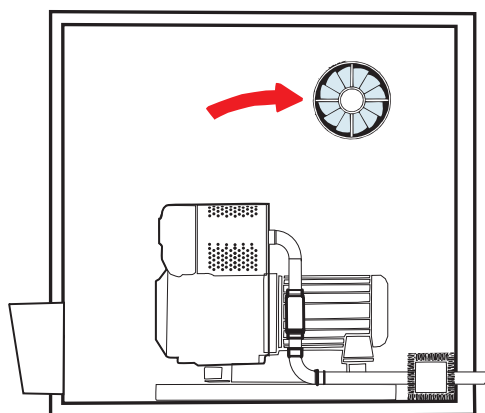
At $n = 2300$ rpm by the factor 0.9

At $n = 1500$ rpm by the factor 0.8

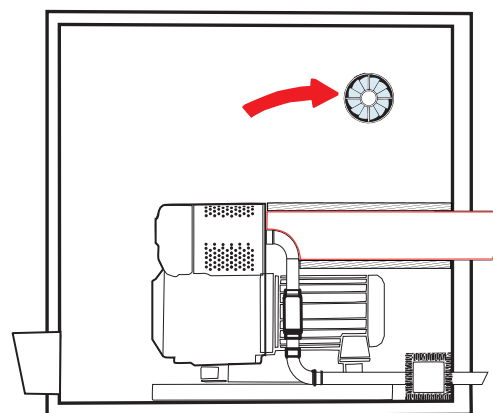
When grids are used in the supply air duct, the surface area must be increased by approx. $\frac{1}{4}$ unless a wire grid with a mesh width of 10 mm and a wire thickness of 1 mm is used, which is highly unrestrictive against air currents.

8.9.2 Guide values for the necessary minimum delivery rate of the exhaust air fan m³ per hour

Assumptions: Efficiency of the driven machine approx. 80% temperature increase over outside air of 10 °C, exhaust air line and air outlet duct, heat-insulated



1



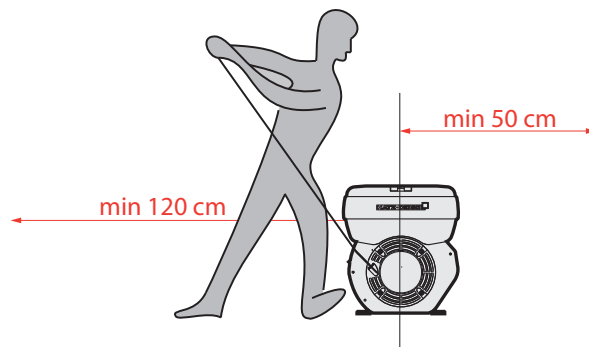
2

rpm	For engines WITHOUT air outlet duct (1) at an engine speed of ... rpm				Engine	For engines WITH air outlet duct (2) at an engine speed of ... rpm			
	1500	1800	2300	Max.		1500	1800	2300	Max.
m³/h	695	880	1,200	1,575	1B20	340	430	590	770
	695	880	1200	1575	1B20V	340	430	590	770
	1065	1340	1575	2270	1B30	520	660	770	1110
	1065	1340	1575	2270	1B30V	520	660	770	1110
	1065	1340	1575	2270	1B30E	520	660	770	1110
	1065	1340	1575	2270	1B30VE	520	660	770	1110
	1660	2020	2280	3400	1B40	610	990	1090	1670
	1900	2100	2480	3800	1B50	930	1030	1210	1860
	1900	2100	2480	3800	1B50E	930	1030	1210	1860
	1900	2100	2480	3800	1B50W	930	1030	1210	1860

Approximate guide values for fans, dimensions	Delivery rate without back pressure	Ø [mm]	Power consumption
The fan delivery rate specified here must be achieved while taking into account the air resistances in windows, frames, shafts, etc. Normally, the resistances reach a value of approx. 12 mm/WC back pressure. At a back pressure of 12 mm WC, for example, the delivery rate is reduced by approx. 30 %.	3000 m³/h	300 mm	0.2 kW
	5000 m³/h	400 mm	0.4 kW
	10000 m³/h	500 mm	1.0 kW
	18000 m³/h	600 mm	2.5 kW
	25000 m³/h	680 mm	4.0 kW

8.10 Recoil start

A hand start with a recoil start means that the machinery is started by a person. After the engine meets all of the requirements to ensure easy starting, it is also necessary for the driven machine to meet the necessary requirements so that it can be started with the limited physical power available to a person.



For this reason, please note the following recommendations:

- The operator must have sufficient room for movement during the starting procedure. The movement of the entire body from head to foot must be taken into account, not just the movement of the hands. During recoil starting, the cable must be able to move freely in the pull direction without sliding over any edges.
- In particular, lightweight machines, machines on very flexible supports and machines that are not fixed in place (e.g. machines on single-axle trailers) need a foot pedal to ensure that they are not raised up or shifted sideways when overcoming the compression point. See also chapter 3.2.5 *Labels*, page 16.

8.10.1 Emergency hand start 1B30E, 1B50E

NOTICE



The standard engine is equipped with an electric starter. An emergency hand start system that can be used to start the equipment by hand can be installed additionally as an option. An emergency hand start should only be performed if an electric start is not possible, e.g. when the battery is weak. More information can be found in the Diesel Engine Manual.

For a hand start of a Hatz engine, 1B30E, 1B50E, the following components must be activated:

- Electrical fuel feed pump
- Engine control unit (ECU)
- Electrical solenoid valve of injection pump

Prerequisite for performing an emergency hand start

- Minimum requirements of battery
 - Min. voltage = 9 volt
 - Min. current = 3 A.
- Ambient temperature: 5 °C or higher

8.10.2 Starting resistances

Driven machines with high friction power or a high starting torque must be disconnected during the starting procedure by a disengageable clutch.

- A disengageable clutch can only be omitted in driven machines with a small rotational resistance, such as generators, fans, small concrete mixers and centrifugal pumps (except for deep well pumps).
- Machines with a high rotational resistance, such as piston pumps, piston compressors or deep well pump (usually right-angle belt drives with very large axis distances and large initial bearing friction) or stone crushers, etc., require a disengageable clutch for starting. Vibration machines of all types are also typical examples of machines with a high starting torque.
- To determine the starting properties of the machine, the colder season should be used to evaluate the amount of force that needs to be applied. The starting resistance is considerably lower in a warm environment.
- Special care must be exercised when using hydraulic drives. Even when the hydraulic system in constant pumps is switched to free circulation (short circuit), a hand start is not trouble-free. Experience has shown that the remaining rotational resistance is usually too high for a person to be able to hand start the equipment, especially during the cold seasons.
- The resistance of the hydraulic system at cold temperatures can be two to three times higher than the resistance of the engine. The force that remains available to start the engine is thus reduced to 1/2 to 1/3. Even if variable pumps are switched to "zero delivery", a hand start is not always easy since this position often is not exactly defined.




NOTICE



Not only the starting procedure but running up of the engine as well can be hindered by the attached hydraulic pumps, with this being particularly pronounced during the cold seasons as well. If an engine is prevented from running up freely after starting, it may overheat due to the large starting fuel quantity required, which can lead to subsequent damage. For this reason, we recommend using a **disengageable clutch**!

8.11 Fuel system

8.11.1 Fuel

 DANGER	
 	Fire hazard from fuel. Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries. <ul style="list-style-type: none"> ▪ Only refuel when the engine is switched off and has cooled down. ▪ Never refuel in the vicinity of open flames or sparks that can cause ignition. ▪ Do not smoke. ▪ Do not spill fuel.
	CAUTION Danger of engine damage from low quality fuel. The use of fuel that does not meet the specifications can lead to engine damage. <ul style="list-style-type: none"> ▪ 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).

Even trace amounts of zinc, lead and copper can lead to deposits in the injection nozzles, which is why elements containing zinc, copper or lead are permitted to be used in the fuel system.

Metal-sheathed fuel lines are not permitted either.

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

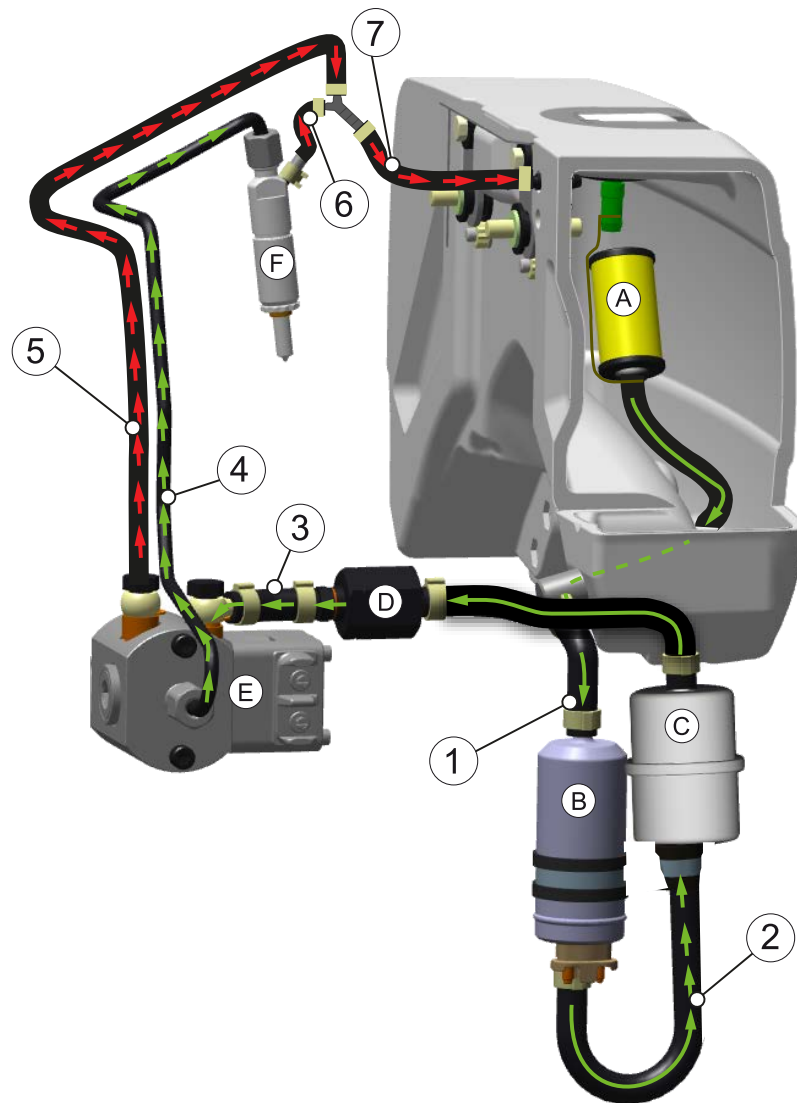
- Zinc ions lead to accelerated clogging of the injection holes in the injectors.
- Copper acts as a catalytic converter and massively lowers the fuel oxidation stability in combination with the FAME (**F**atty **A**cid **M**ethyl **E**ster) content in modern fuels of up to 7%. This also causes injection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

Galvanized (passivated) components may be used.

8.11.2 Fuel specification

See the **Diesel Engine Manual**.

8.11.3 Fuel scheme 1B30E/1B50E



1	Fuel pump infeed
2	Main fuel filter infeed
3	Injection pump infeed
4	Fuel pressure tube
5	Injection pump return feed
6	Injector return feed
7	Tank return feed
A	Fuel prefilter
B	Electric fuel pump
C	Main fuel filter
D	Check valve
E	Injection pump
F	Injector

Electric fuel pump

Rated and test voltage	12 V
Supply/return length with Ø 8 mm	Max. 5 m
System pressure (min.)	0.3 bar
Current consumption at system pressure	≤ 2.0 A
Flow rate at system pressure	≥ 100 l/h
Static pressure	0.44 – 0.57 bar
Current consumption Q=0 l/h	≤ 2.05 A

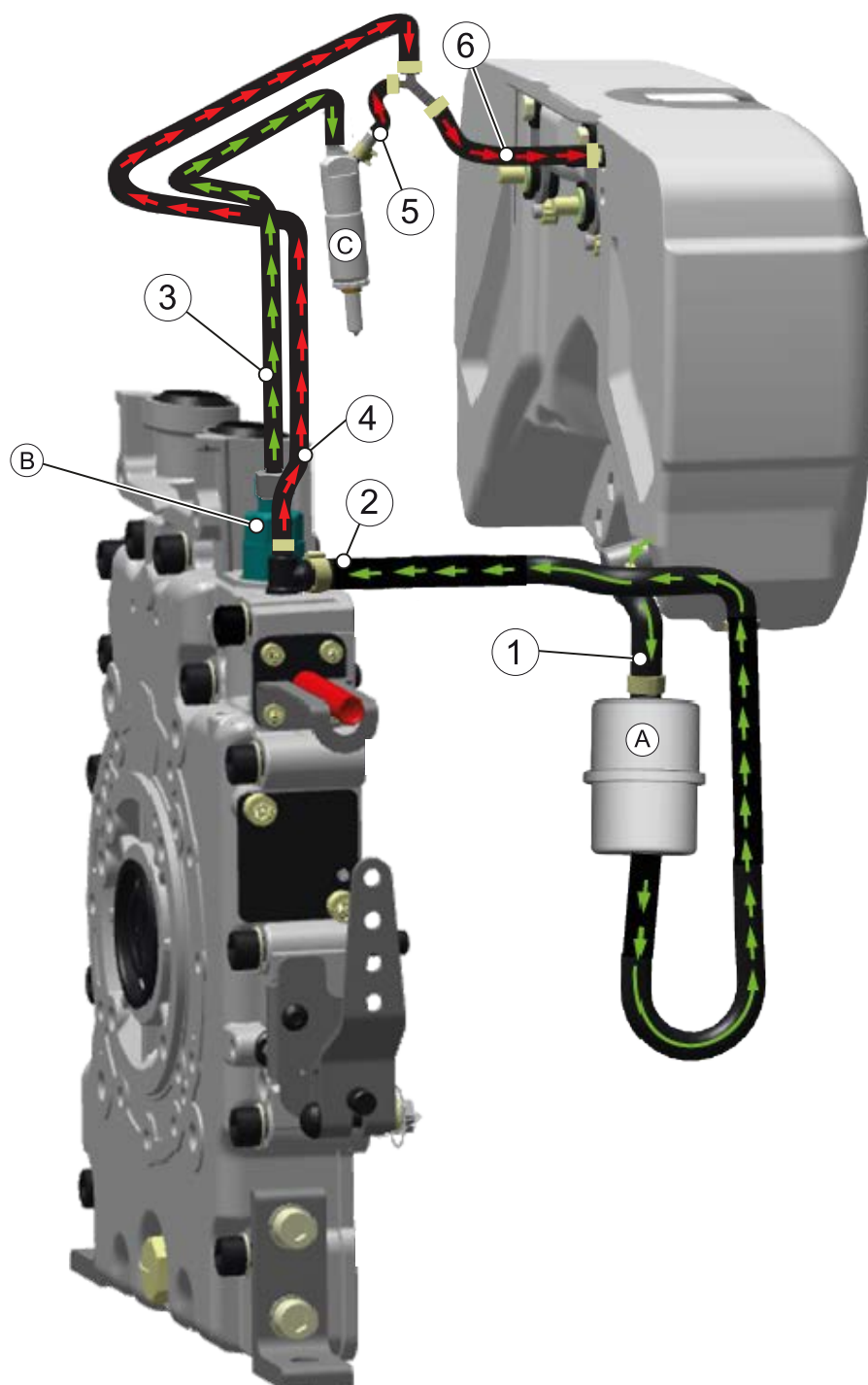
Fuel system ventilation

See the "Venting the fuel system" section in the diesel engine manual.

Fuel prefilter

Due to the different ways of storing fuel in the various fields of application, the fuel cleanliness cannot always be guaranteed. To protect electric fuel pumps, therefore, it is necessary to use a fuel filter that filters any dirt particles out of the fuel. In 1B30E and 1B50E engines, the fuel prefilter is already mounted at the factory.





8.11.4 Fuel scheme 1B20/1B30/1B40/1B50



1	Main fuel filter infeed
2	Injection pump infeed
3	Fuel pressure tube
4	Injection pump return feed
5	Injector return feed
6	Tank return feed
A	Main fuel filter
B	Injection pump
C	Injector

NOTICE	
	<ul style="list-style-type: none"> ▪ Before starting for the first time or if the fuel system is empty, fill the fuel tank fully with diesel fuel. ▪ The fuel system is bled automatically if the fuel tank is attached to the engine or located higher than the injection pump. ▪ If the fuel tank is not built on and lying lower, it must be pre-pumped with the manual lever of the fuel feed pump. ▪ The mechanical oil pressure shut down device (option) must be activated before filling for the first time or if the fuel tank is empty.

8.11.5 Fuel tank

 DANGER	
 	<p>Fire hazard from fuel.</p> <p>Leaked or spilled fuel can ignite on hot engine parts and cause serious burn injuries.</p> <ul style="list-style-type: none"> ▪ 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	
	<p>Danger of environmental damage from spilled fuel.</p> <p>Do not overfill the fuel tank and do not spill fuel.</p> <ul style="list-style-type: none"> ▪ Collect any leaking fuel and dispose of it according to local environmental regulations.
NOTICE	
	<ul style="list-style-type: none"> ▪ An overpressure of max. 0.5 bar must not be exceeded at the injection pump. The overflow oil line and return line of the injector can become damaged at an overpressure of > 0.5 bar. ▪ The tank ventilation must open at the latest at a vacuum of 0.02 bar. Exceeding a vacuum of > 0.02 bar can lead to starting and performance problems.

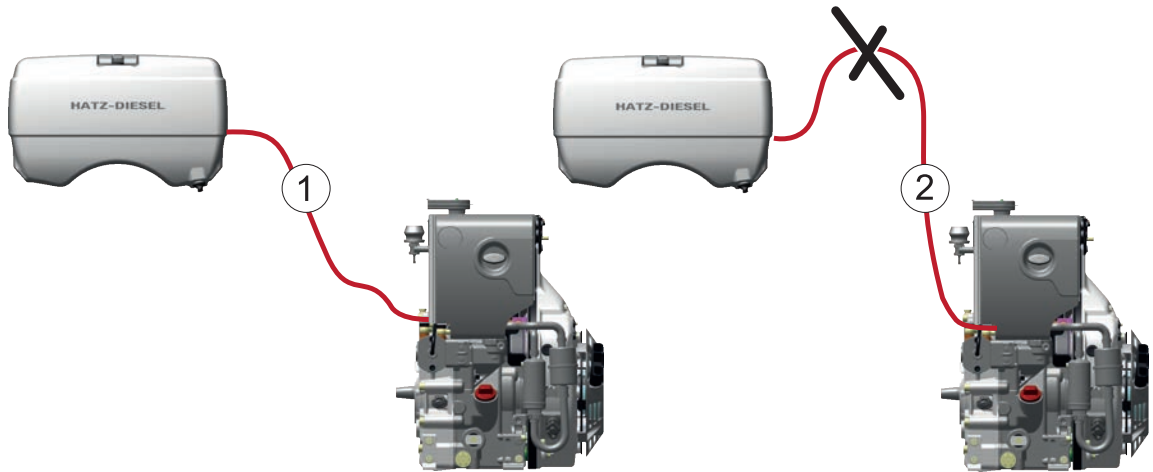
When an external fuel tank is installed, make sure that it does not have any processing residues, impurities, water, etc.

A discharge port is provided at the lowest point on the fuel tank to drain water and dirt when needed. This is due to deposits and EN 590 fuels with a FAME content of max. 7%. Due to the penetration of water (hygroscopic action of FAME) in the fuel tank, biocultures (fungi) can occur in the transition layer between the fuel and water.

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

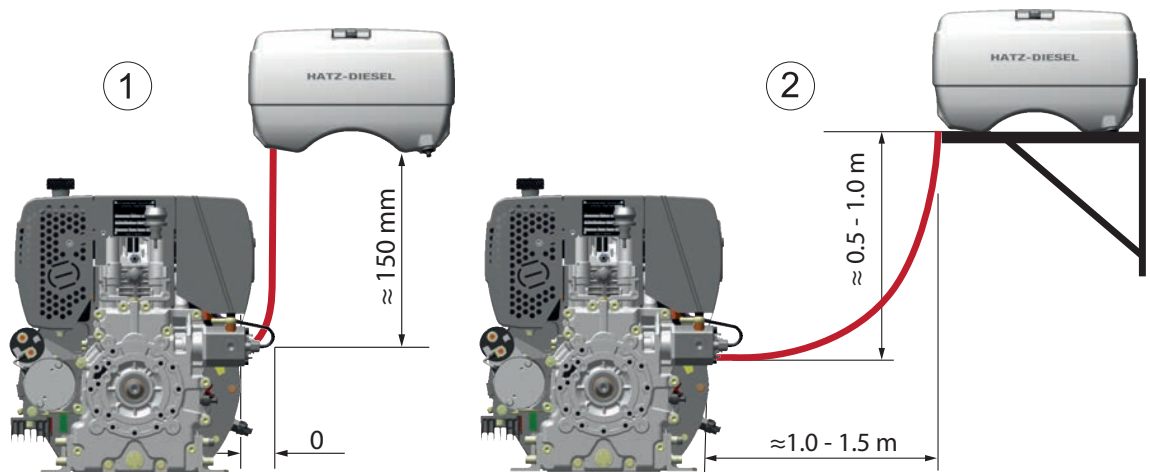
Fuel lines for external fuel tanks

Fuel lines must be bleedable. They can be bled if they are U-shaped or are installed with an upward gradient (1). Fuel lines cannot be bled if they are routed horizontally or in the shape of an up-side-down U (2).



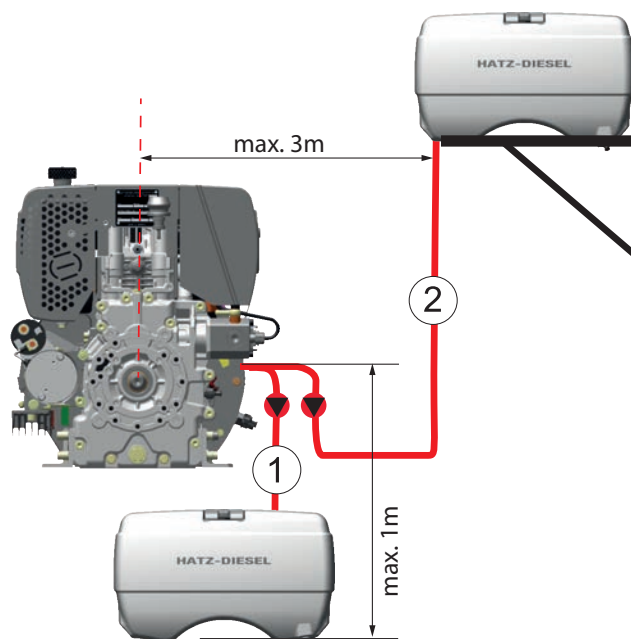
If the fuel tank is installed on the wall and not at the engine, a gradient of 0.5 – 1.0 m must be maintained to overcome the line resistance. If the fuel tank is in the immediate vicinity of the engine, a gradient of approx. 150 mm between the tank outlet and the injection pump is usually sufficient.

The fuel tank may also be lower in engines with an electric fuel pump or a mechanical delivery pump. Any inclined positions during operation must be noted.






A fuel pump is necessary if the tank is lower (1) than the filter and injection pump. Even at an in-feed line length of approx. 1.5 m and with the tank located higher than the engine (2), a fuel pump (standard for 1B30E, 1B30VE, 1B50E) is necessary to overcome the line resistance, or the line cross section can be enlarged.

The suction head of the mechanical diaphragm pump is approx. 0.8 m with a straight supply line combined with a nominal hose width of 8 mm. If the suction head is higher, an electric fuel pump is recommended that is installed in such a way that the fuel runs freely to it from the tank.



When using a fuel pump with a fuel tank that is not installed at the engine, the fuel filter and the fuel lines must be installed in a way that enables them to be bleedable.

8.12 Exhaust gas system

 WARNING	
	<p>Danger of injury from hot exhaust gas system.</p> <p>Hot surfaces on the entire exhaust gas system can lead to serious burn injuries.</p> <ul style="list-style-type: none"> ▪ Keep explosives and flammable materials away from the engine. ▪ Attach safety devices. ▪ Wear safety gloves.
NOTICE	
	<p>The machine manufacturer is obligated to ensure that all safety precautions have been taken in the complete machine so that injuries from hot surfaces can be ruled out.</p> <p>The safety devices are available from HATZ. See chapter 12 <i>Contact protection for machine safety</i>, page 101.</p>

Sound dampers from our auxiliary equipment program are designed for **HATZ** diesel engines in terms of back pressure and noise. The use of third-party sound dampers invalidates the warranty unless written approval has been obtained for the specific case.

The following table provides a rough point of reference for the dimensioning of a straight exhaust gas line; however, the maximum permissible total back pressure of the exhaust gas system incl. the sound damper must not be exceeded and must be remeasured.

Engine type	Recommended pipe Ø (approx. in mm) for length up to:			Max. permissible back pressure (average value)	Permissible intake vacuum (average value)
	7.5 m	15 m	25 m	(mm/WC)	(mm/WC)
1B...	As for exhaust gas flange	50	75	270	343
1B50E		Values on request			
1B30E/VE		Values on request			

If in doubt, the next higher pipe size is recommended.

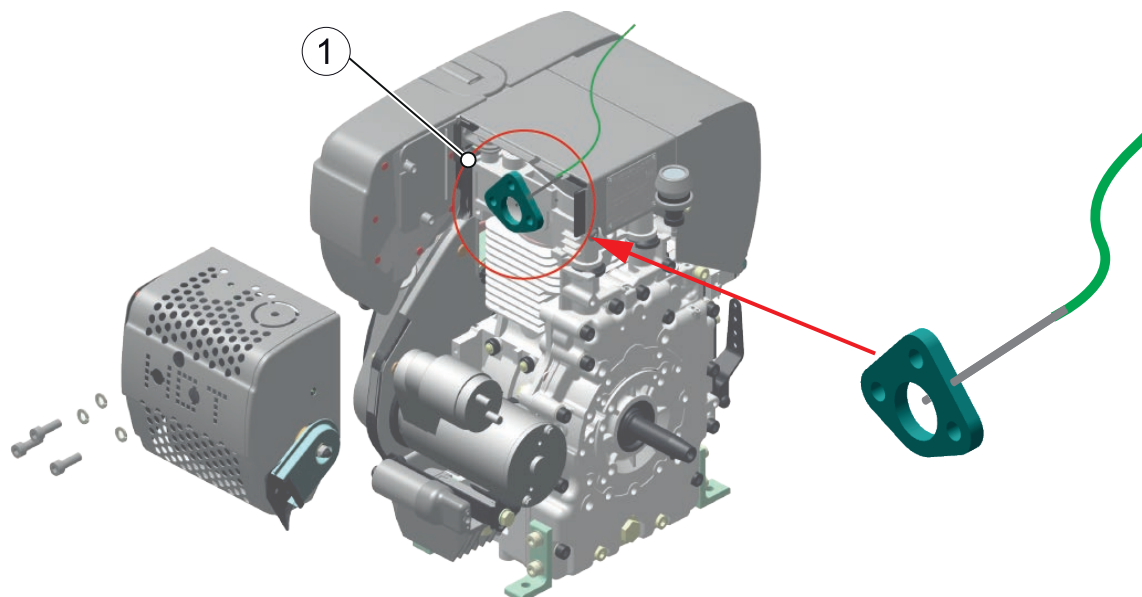
A bend from 45° shortens the permissible straight line length by one meter. If exhaust gas lines are installed on flexibly mounted engines, a flexible intermediate element must be installed in the line to absorb engine movements.

Wherever possible, this flexible intermediate element must be installed close to the fulcrum of the flexible mounting because this is where the amplitudes are the smallest.

8.12.1 Exhaust gas back pressure

EU Stage V / US-EPA Tier 4 final

If additional silencers are used, but also if the exhaust gas is transferred from the engine compartment through pipe bends or flexible lines, pay attention to the permissible exhaust back pressure. The measuring position (1) of the exhaust gas back pressure is located between the cylinder head outlet and the sound damper.



The following values apply at max. power P[kW] and max. speed [rpm]:

Engine type	Intake vacuum [mbar]	Exhaust gas back pressure [mbar]
1B20/1B30/1B30V	15	55
1B30E/1B30VE	15	55
1B40/1B50/1B50E	15	55

8.12.2 Exhaust mass flow rate

m [kg/h]	1500 [rpm]	1800 [rpm]	2300 [rpm]	3000 [rpm]	3600 [rpm]
1B20	15	18	22	29	35
1B30	21	25	32	42	50
1B30V	21	25	32	42	50
1B40	28	34	43	56	67
1B50	31	37	48	62	75
1B30E	21	25	32	42	50
1B30VE	21	25	32	42	50
1B50E	31	37	48	62	75

8.12.3 Diesel oxidation catalytic converter (DOC)

Standard equipment for the engines 1B30E, 1B30VE and 1B50E includes a diesel oxidation catalytic converter. The respective fuel and oil specifications must be abided by. For more information, see the Fuel and Engine Oil chapter in the **Diesel Engine Manual**.






8.13 Engine oil

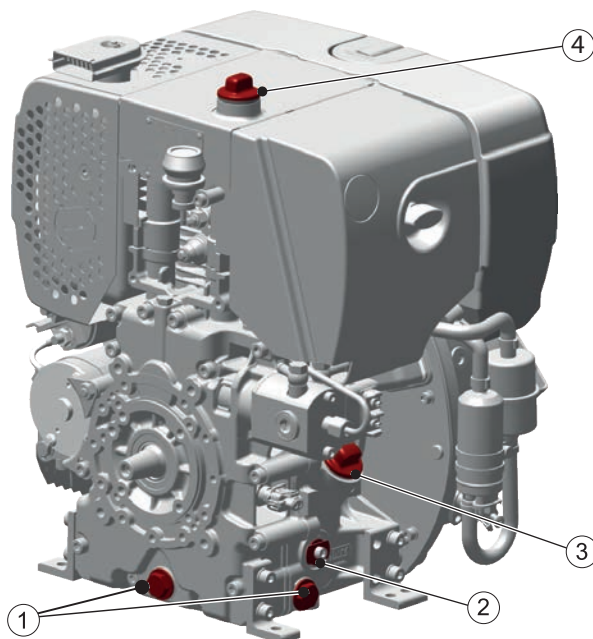
For operating the engine, it is important that the dipstick, oil filler, oil drain and oil filter are all easily accessible. If necessary, extensions are required for the oil filler and oil drain.

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

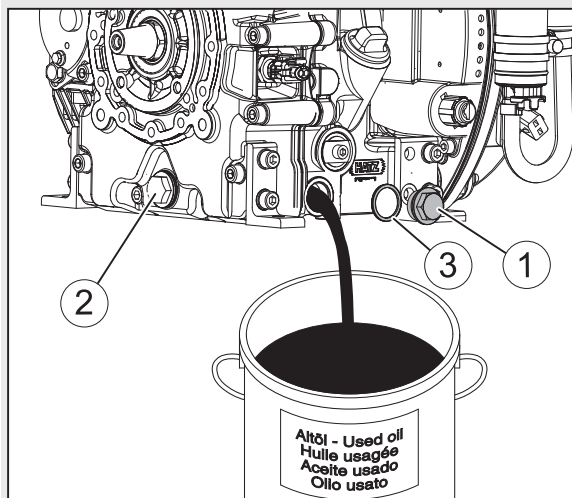
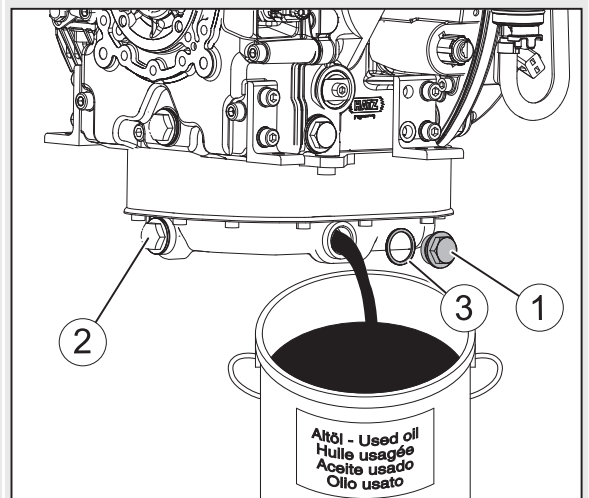
For the oil specification, oil viscosity and oil filling quantity, see the **"Technical data" chapter of the manual for diesel engine.**

8.13.1 Engine oil service points

 CAUTION	
 	Danger of burns. When working on the engine, there is a danger of burns from hot oil. <ul style="list-style-type: none"> Wear personal protective equipment (gloves).
 CAUTION	
	Danger of environmental damage from spilled used oil. Used oil is water-polluting. <ul style="list-style-type: none"> Do not 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.



1	Oil drain screw (front and side)
2	Screw cap for oil filter
3	Oil filling opening and dipstick
4	Oil filling opening, top (option)

Without oil sump**With oil sump**

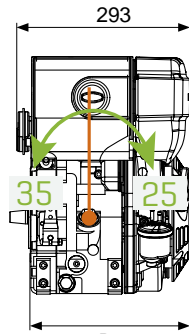
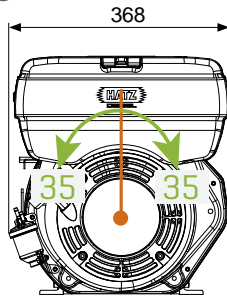
1	Oil drain screw (side)
2	Oil drain screw (front)
3	Seal ring

Depending on accessibility, the engine oil can be drained at oil drain screw (1) or (2). For further information, see the Diesel Engine Manual.

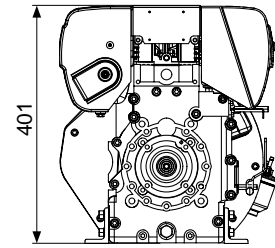
8.13.2 Continuous skewed positions

Dimensions and tilts

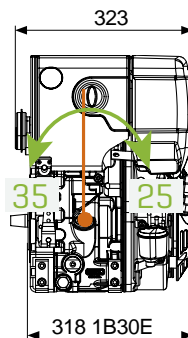
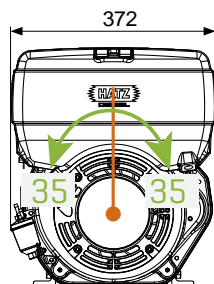
1B20



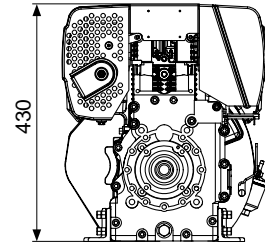
272 1B20
323 1B20 Silent



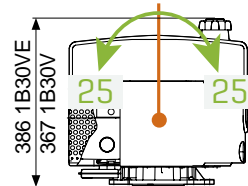
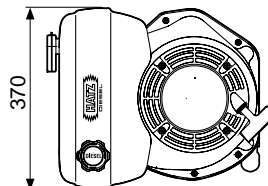
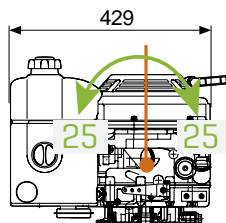
1B30E | 1B30



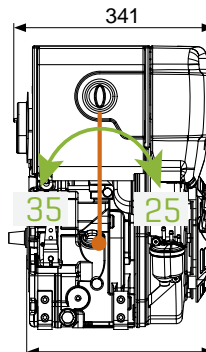
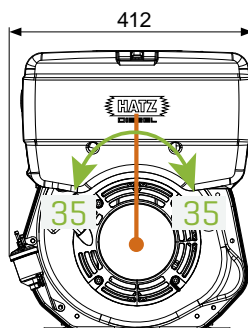
318 1B30E
299 1B30
342 1B30E Silent
323 1B30 Silent



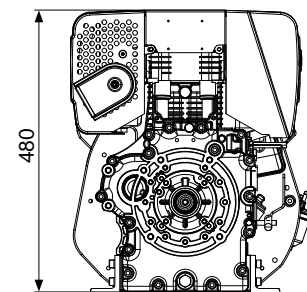
1B30VE | 1B30V



1B40 | 1B50E | 1B50



335 1B50E
316 1B40, 1B50

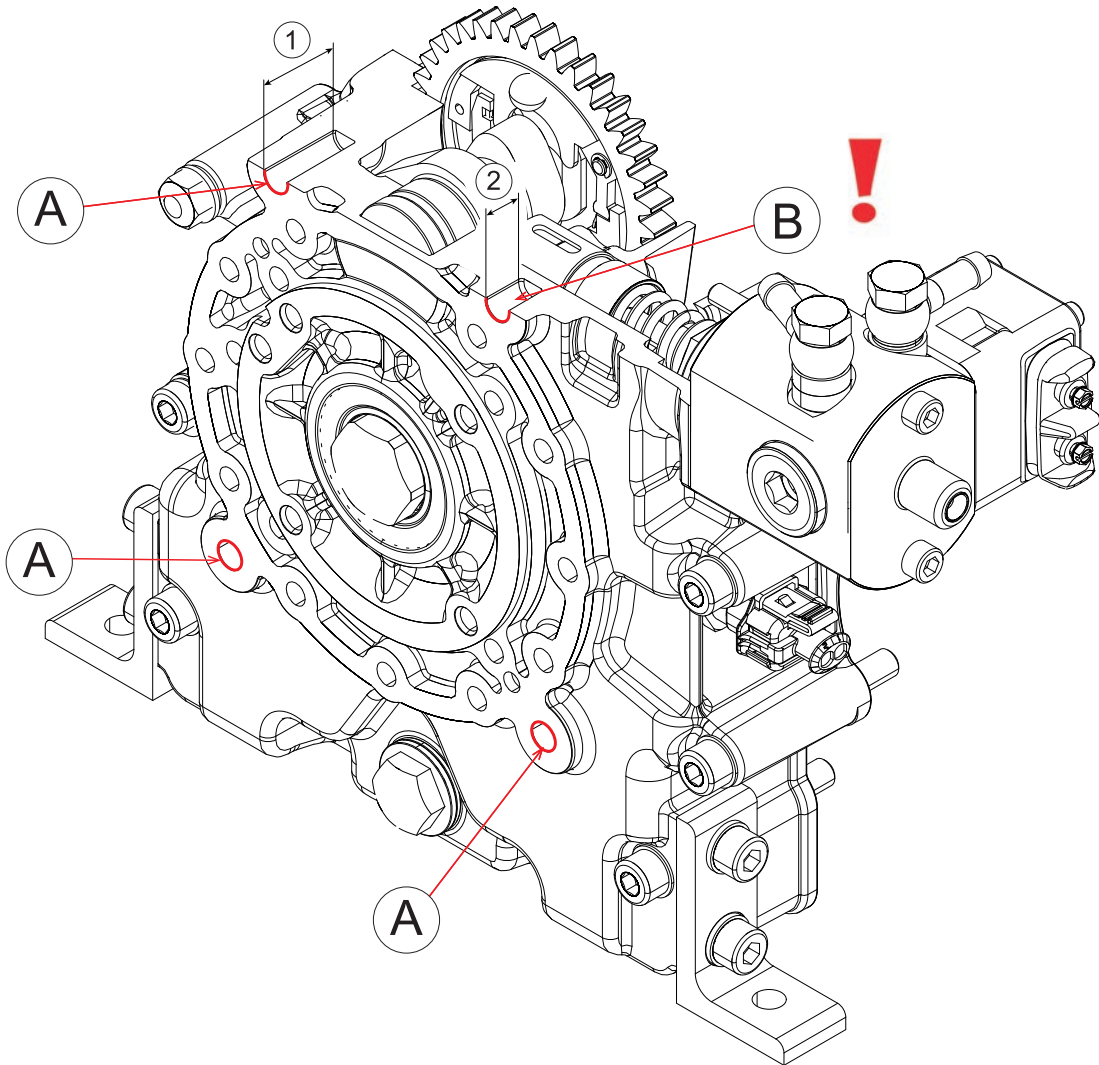


* Max. tilt position [°], dimensions [mm]

The engine oil capacity per type, delta min-max, is found under *5.1 Engine information and filling quantities 1B20, 1B30, 1B30E 1B40, 1B50, 1B50E*, page 36.

8.14 SAE-B flange

When using the SAE-B flange for engine types 1B30E, 1B50E and 1B30VE, the following specifications for the tightening torque and screw-in depth of the fastening screws must be taken into account.



Specified tightening torque (MA) and screw-in depth:

1B30E / 1B30VE / 1B50E							
Drilled hole	Thread	Quality	MA (Nm)	Screw-in depth	Min.	Max.	Loctite 243*
A	M10	8.8.	35	1	10.5 mm	21 mm	3 pieces
B	M10	8.8	35	2	10.5 mm	12 mm	1 piece

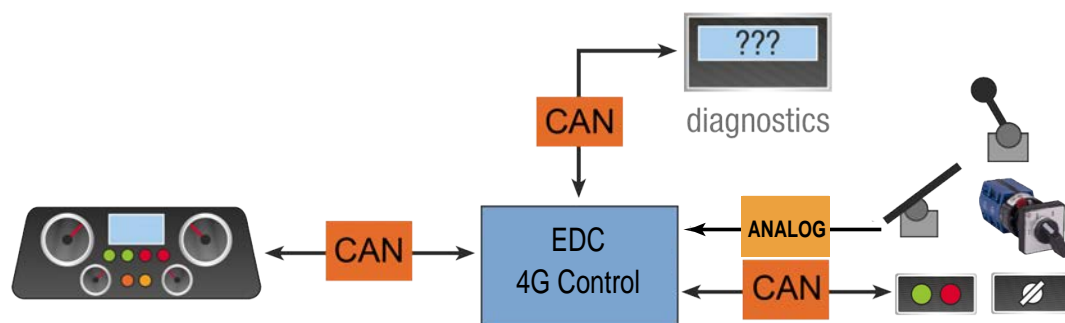
* Degrease the screw thread before applying Loctite.

Attention: An improperly fastened threaded connection can lead to damage to or total failure of the engine.

9 Electrical system

9.1 Engine control

1B30E, 1B30VE, 1B50E



Completely optional CAN control panel	Machine basic control
Speed check	CAN speed adjustment
Speed limiting	Analog speed adjustment <ul style="list-style-type: none"> ▪ Pedal/lever ▪ MSS (2-stage or 3-stage)
Vehicle speed check	Engine start/stop: <ul style="list-style-type: none"> ▪ CAN ▪ Ignition switch ▪ Digital input

NOTICE



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

9.1.1 Setup and installation conditions for control unit

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

- No water can enter into the control unit along the wiring loom.
- No standing or permanently running water is located in the area of the ambient pressure sensor.
- Adequate ventilation is provided since the maximum ambient temperature of 85 °C must not be exceeded.
- The wiring harness of the central connector (1) at the engine control unit is secured on the cable retention plate (2) with two cable ties (200x 4.8 mm) against pull and vibration forces.

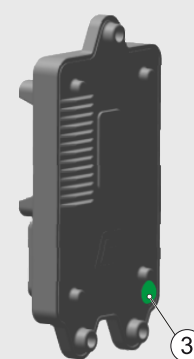
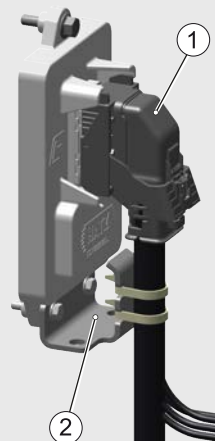
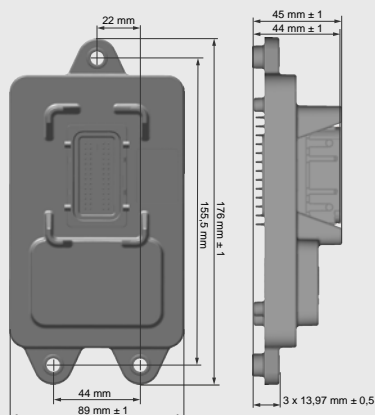
The control unit is mounted on the four locations (3 x M6, 8 Nm) available.

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

The control unit has been tested for mechanical stress due to shock as per **EN 60068-2-27** and for stress from vibrations as per **EN 60068-2-64**.

Installation conditions:

- | | |
|--|---|
| <ul style="list-style-type: none"> ▪ Ambient temperature: ▪ -40° to 85° ▪ Spray water protected ▪ Dust tight ▪ Heavy duty | <ul style="list-style-type: none"> ▪ Vibration decoupled from engine separated ▪ Nominal voltage 12 V ▪ Permissible voltage range 6-18 V |
|--|---|

**NOTICE**

A sticker (3) is located on the back of the control unit. This sticker is an air filter behind which the ambient pressure sensor is located. Do not remove this sticker or else contamination may damage the sensor.

NOTICE

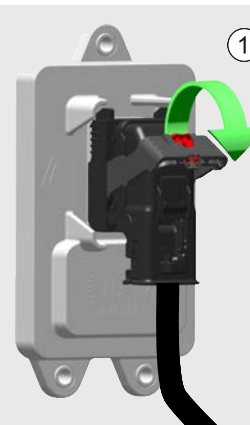
The central connector used to connect the wiring harness to the control unit can easily be damaged by contamination; only open when absolutely necessary.

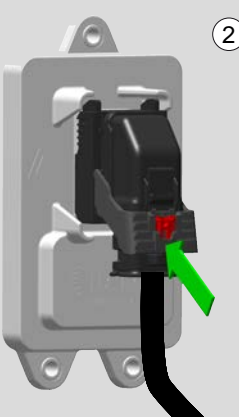
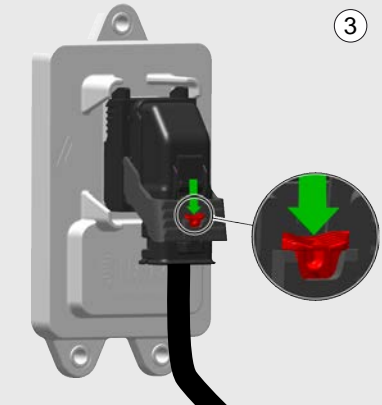
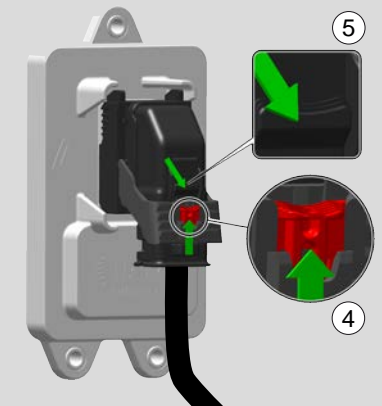
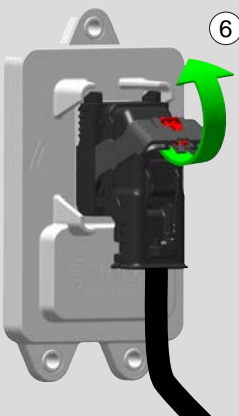
The central connector on the control unit is designed to be opened and closed only approx. 10 times (over the entire service life). Before reconnecting, clean the connector and mount it carefully.

Connect the central connector with the wiring harness on the control unit:

1

Mount the central connector on the control unit. Pull the safety lever down while pressing on the connector lightly.

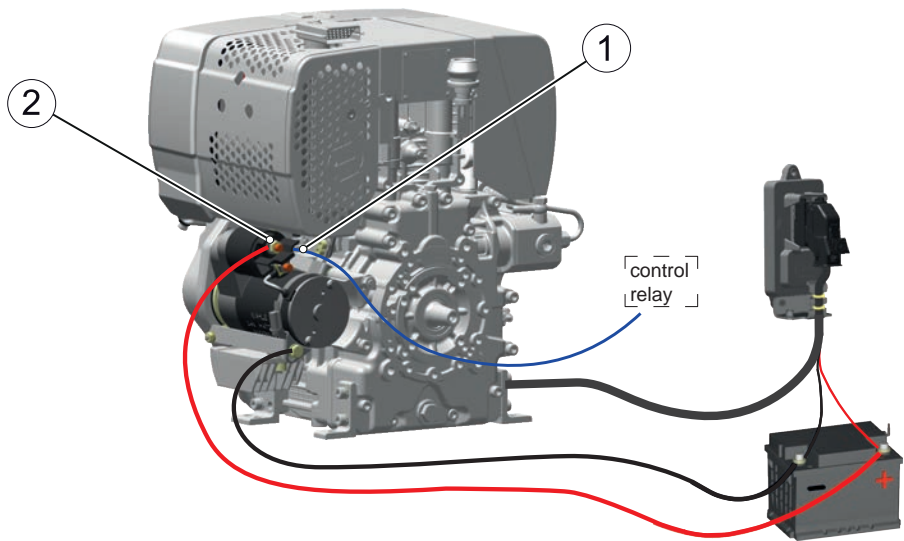


2	<p>Press the safety lever down all the way until a slight clicking noise is audible.</p> <p>Note: If the lever is not pressed all the way down, the connector may come loose or detach after an extended period of operation. The engine will stop working.</p>	 <p>Diagram 2 shows a close-up of the electrical connector assembly. A green arrow points downwards to a black lever, indicating it should be pressed down. A circled number '2' is in the top right corner.</p>
3	<p>The central connector is fully closed by actuating the red lock in the direction of the arrow.</p> <p>Note: It must be ensured that the central connector is fully locked.</p>	 <p>Diagram 3 shows the central connector assembly. A green arrow points to a red lock mechanism. A circular inset shows a close-up of the red lock with a green arrow pointing down into it. A circled number '3' is in the top right corner.</p>
4	<p>The central connector can be unlocked by actuating the red lock in the direction of the arrow.</p>	 <p>Diagram 5 shows the central connector assembly. A green arrow points to the red lock mechanism. A circular inset shows a close-up of the red lock with a green arrow pointing up. A circled number '5' is in the top right corner. A circled number '4' is in the bottom right corner of the inset.</p>
5	<p>To open the lever, press against the connector with a finger until a slight clicking noise can be heard.</p>	
6	<p>Push up the locking lever; the connector is now fully open again and can be disconnected from the control unit.</p>	 <p>Diagram 6 shows the central connector assembly. A green arrow points upwards to a black lever, indicating it should be pushed up. A circled number '6' is in the top right corner.</p>

NOTICE



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



Starter connections

1	T.50, ignition switch
2	T.30, battery +

NOTICE



If using a battery master switch, the power supply of the control unit must be tapped downstream of the main switch. This ensures the full de-energization of all components. When activating the battery master switch, it is necessary to wait at least 30 seconds after "Ignition off (ignition switch)" for internal processes in the control unit to come fully to an end. If the 30 seconds are not adhered to, an error is output by the motor control unit.

9.1.2 Voltage supply for control unit

9.1.3 Control unit connections

E-Controls 4G connections

Outputs



DIGITAL


- Diagnostics lamp (flashing code)
- Maintenance indicator lamp
- Overtemperature lamp

Inputs



ANALOG

- Speed sensor
- Multistage switch

E-Controls 4G connections	
	DIGITAL
	<ul style="list-style-type: none"> ▪ Remote start/stop ▪ Diagnostics request
	CAN bus SAE J1939

9.1.4 Diagnosis tool HDS²

The HDS² diagnostics tool (Hatz Diagnostic Software) is available for troubleshooting and analyzing the engine parameters. Please contact your Hatz subsidiary or go directly to <https://www.hatz-diesel.com/hds2-lizenz>.

CAN messages

The CAN lists can be viewed under the number shown below, which can be found under the following link: <http://www.hatz.com/docu>. (You will need your engine serial number for access.)

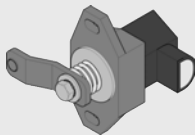
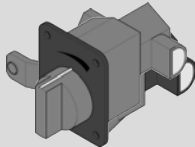
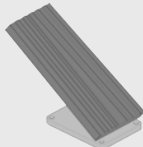


CAN protocol list E1: 05666700

CAN error list E1: 05666800

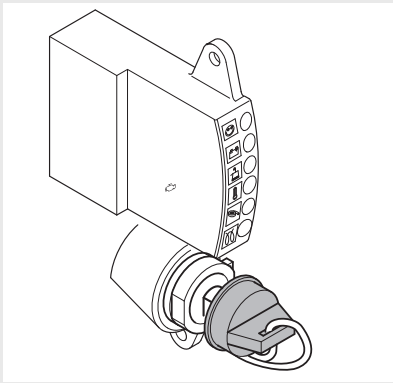
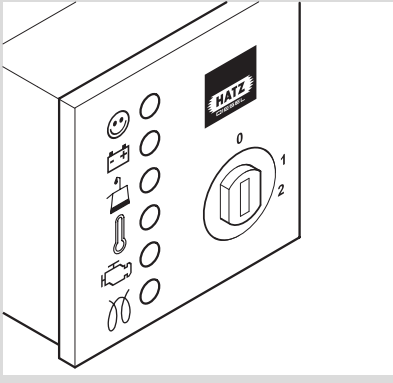
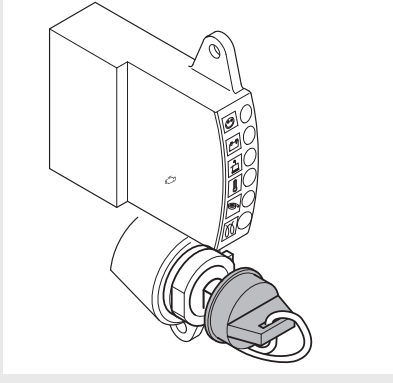
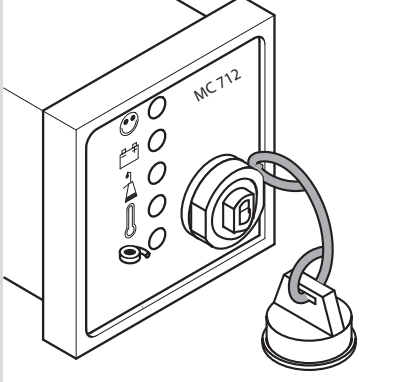
9.2 Engine monitoring

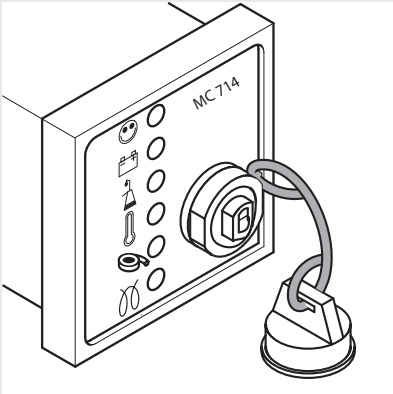
9.2.1 Overview of speed adjuster

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

Speed adjuster		IP degree of protection
Bowden cable (CAN/analog)		IP66
Rotary button (CAN)		IP66
Pedal (CAN/analog)		IP69K
Manual lever (CAN/analog)		IP66
Stepped speed switch (optional 2 or 3 steps) (analog)		IP65

9.2.2 Overview of instrument box

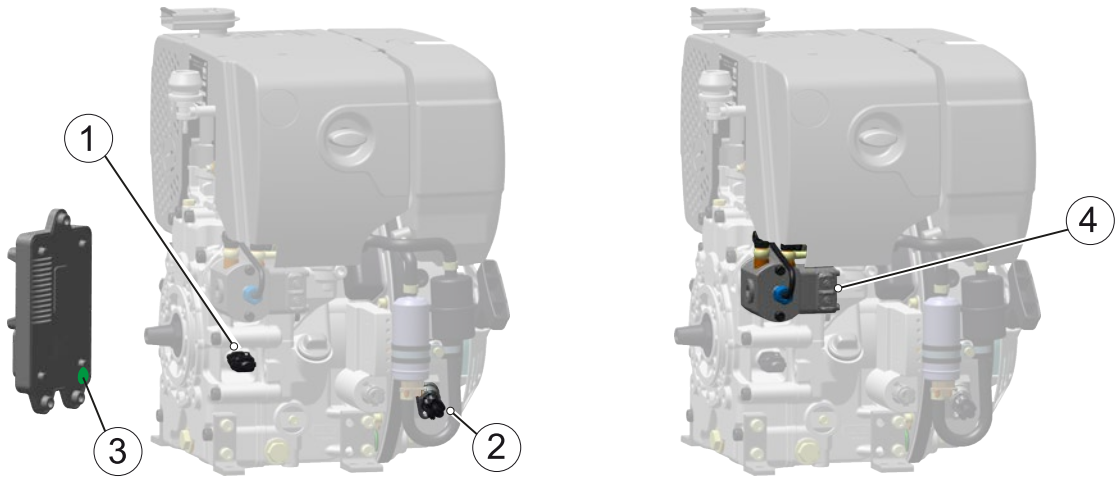
Designation	Indicators	IP degree of protection	Use
Hatz instrument box, installed in place, with optical error display only. Optional with automatic pre-glow feature 12 V		IP67K	1B30E 1B50E
Hatz instrument box (short) installed separately, with optical error display only. 12 V		IP65	1B30E 1B30VE 1B50E
Hatz instrument box, installed in place (programmable) with optical display and automatic switch-off in case of error. Optional with automatic pre-glow feature 12 V/24 V		IP69K	1B20 1B30 1B40 1B50
MC712 Hatz instrument box, installed separately, with optical error display only. Optional with operating hours counter. 24 V		IP69K	1B20 1B30 1B40 1B50

Designation	Indicators	IP degree of protection	Use
<div>MC714</div> <div>Hatz instrument box, installed separately, with automatic pre-glow feature and automatic switch-off in case of error.</div> <div>Optional with operating hours counter.</div> <div>12 V/24 V</div>		IP69K	<div>1B20</div> <div>1B30</div> <div>1B40</div> <div>1B50</div>

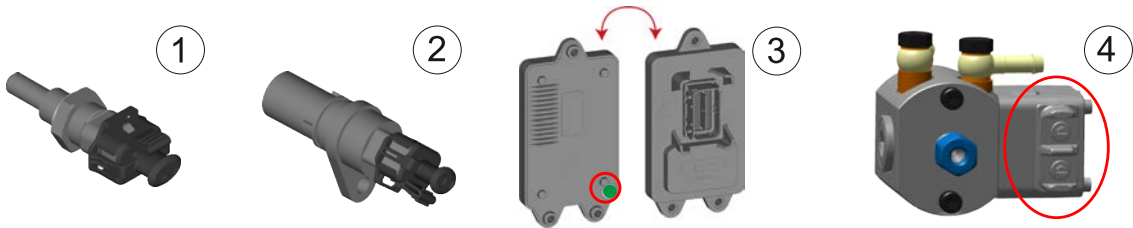
For more information on the circuit diagrams, see <https://www.hatz-diesel.com/docu>. (You will need your engine serial number for access.)

9.2.3 Overview of sensors and actuators

Installation position



Sensors	
1	Oil temperature sensor
2	Crankshaft speed sensor
3	Ambient pressure and temperature sensor (control unit)
Actuator	
4	Injection pump with solenoid valve



NOTICE

A sticker (3) is located on the back of the control unit. This sticker is an air filter behind which the ambient pressure sensor is located. Do not remove this sticker or else contamination may damage the sensor.

9.3 Battery

**DANGER**

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

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

**DANGER**

Danger of explosion from flammable substances.

There is a danger of explosion from flammable gases.

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

**CAUTION**

Danger of chemical burns

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

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

Temperature limits of normal batteries:

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

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

9.3.1 Battery recommendation

Recommended max. battery capacity of a 12-V lead battery during starting.						
Engine type	Power, 12-V starter	Max. permissible capacity	Low-temperature measuring current [A] as per			
			EN ¹⁾	SAE ²⁾	DIN ³⁾	IEC ⁴⁾
1B20/1B30/1B30V	1.6 kW	55 Ah	420 A	450 A	255 A	290 A
1B40/1B50	1.2 kW	55 Ah	420 A	450 A	255 A	290 A
1B30E/1B30VE	1.0 kW	55 Ah	420 A	450 A	255 A	290 A
1B50E	1.2 kW	55 Ah	420 A	450 A	255 A	290 A

Recommended battery capacity of a 24-V lead battery (2x12 V) during starting.						
Engine type	Power, 24-V starter	Max. permissible capacity	Low-temperature measuring current [A] as per			
			EN	SAE	DIN	IEC
1B20/1B30/1B30V	1.6 kW	44 Ah	360 A	400 A	225 A	260 A
1B40/1B50	1.6 kW	44 Ah	360 A	400 A	225 A	260 A

¹⁾ European Standard 60095-1

²⁾ Society of Automotive Engineers, United States standard

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

⁴⁾ International Electrotechnical Commission) 95-1

Besides the battery capacity, the low-temperature test current A (see table) is decisive for the cold start behavior. If a battery is used with a larger cold test current than recommended, the starter can be mechanically and thermally overloaded and damaged. If a battery with a low-temperature test current that is too small is used, the cold start behavior deteriorates.

NOTICE



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

9.3.2 Installation location

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

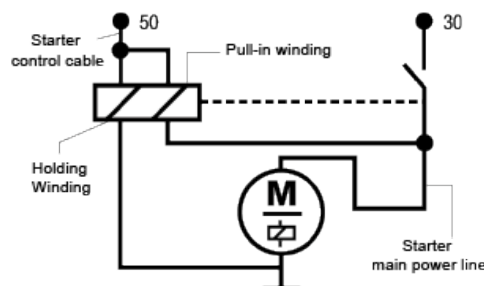
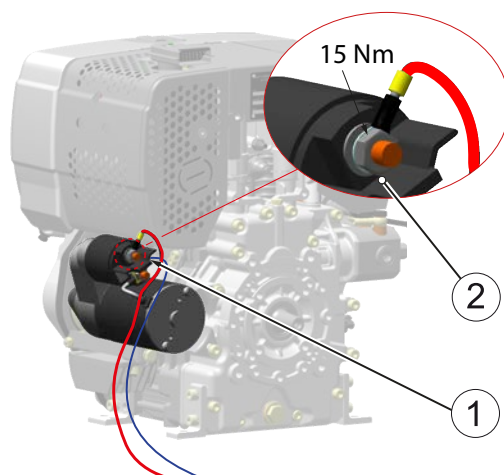
NOTICE



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

9.4 Starter

Installation position



NOTICE



The hex nut M8 for fastening the starter line to the starter must be tightened with 15 Nm.

Sizing of the line between the starter and battery:

With the ignition switch, the pull-in winding and holding winding of the starter solenoid (terminal 50) (1) are switched on via the starter relay (short-term max. 50 A in the pull-in winding). At the end of the pull-in path (starter pinion engaged in the ring gear), the main starter current is switched on (depending on the starter and condition, approx. 450 to 500 A). The starter motor is now connected directly to the battery by terminal 30 (2) and the main starter line.

Line cross section for main starter line:



Starter protection

If faulty switching on of the starter cannot be ruled out, the iPB+ (Intelligent Powerbox) is used in combination with the currently available Hatz instrument boxes, loose instruments, with the customer's own control unit (also with CAN bus) and the new Hatz CAN bus control panel, e.g. instrument box tCAN or CANarmatur, and mounted directly on the engine.

The IPB+ offers the following starter protection function:

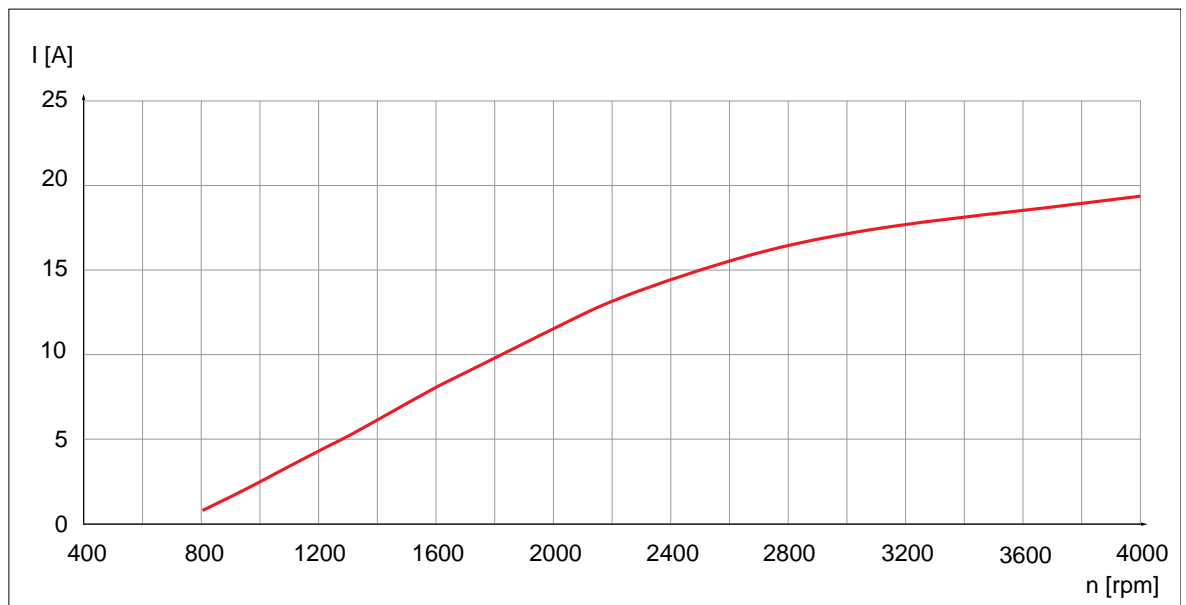
- Beginning at a defined speed (frequency) of the running engine, the main starter line is interrupted. This prevents reactivation of the starter while the engine is running.
- Starting becomes possible again only after the engine comes to a standstill and a fixed time period has expired. This prevents reactivation of the starter while the engine is coasting to a stop.
- If the start is interrupted (faulty start) and the switch-off speed has not been reached, the engine can only be restarted after the fixed time period has expired.

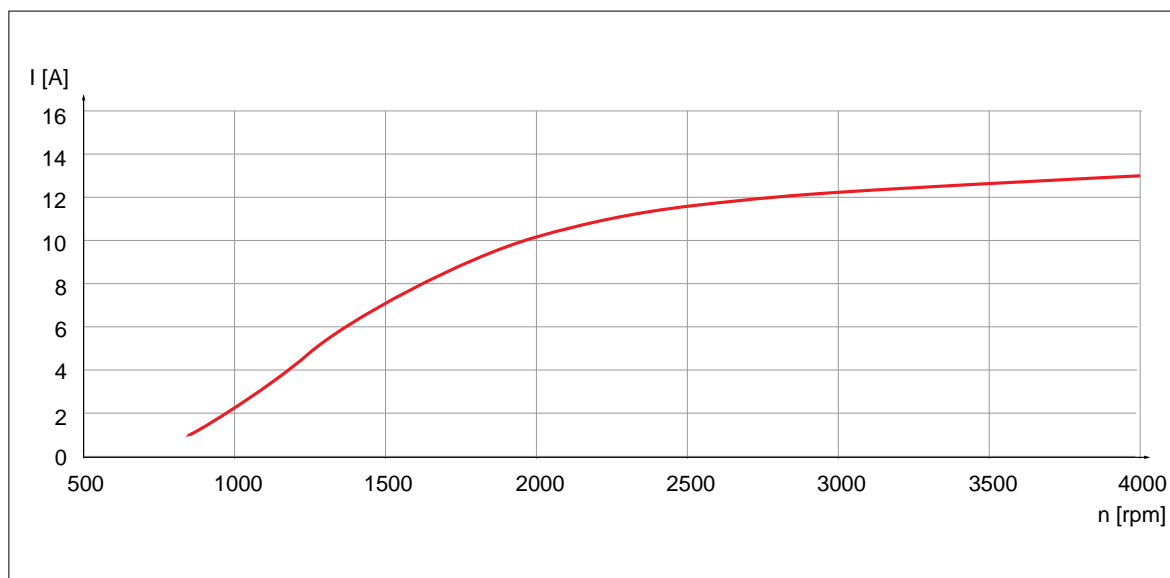
The starter protection units are wear-free. This helps avoid damage to the starter and ring gear.

Frequency output of engines										
Motortyp	Frequency terminal W						Frequency gearing			
	pulse [p] / rev of crankshaft [r.p.m.]	ratio [i]	pulse [p] / rev of alternator	frequency [Hz] at n = 3000 r.p.m.	frequency [Hz] at disengage starter	recommended frequency [Hz] at disengage starter	pickup on gearing [p]	frequency [f] at 3000 r.p.m. [Hz]	recommended [n] r.p.m. at disengage starter	recommended frequency [f] at disengage starter
1 B20	5	1	5	250	60	650	88	4400	650	1000
1B 30	5	1	5	250	60	650	94	4700	650	1100
1 B 40	5	1	5	250	60	650	110	5500	650	1280
1 B 50	5	1	5	250	60	650	110	5500	650	1280
Frequenzberechnung	$f = \frac{n * p * i}{60}$						$f = \frac{n * p}{60}$			

9.5 Alternator

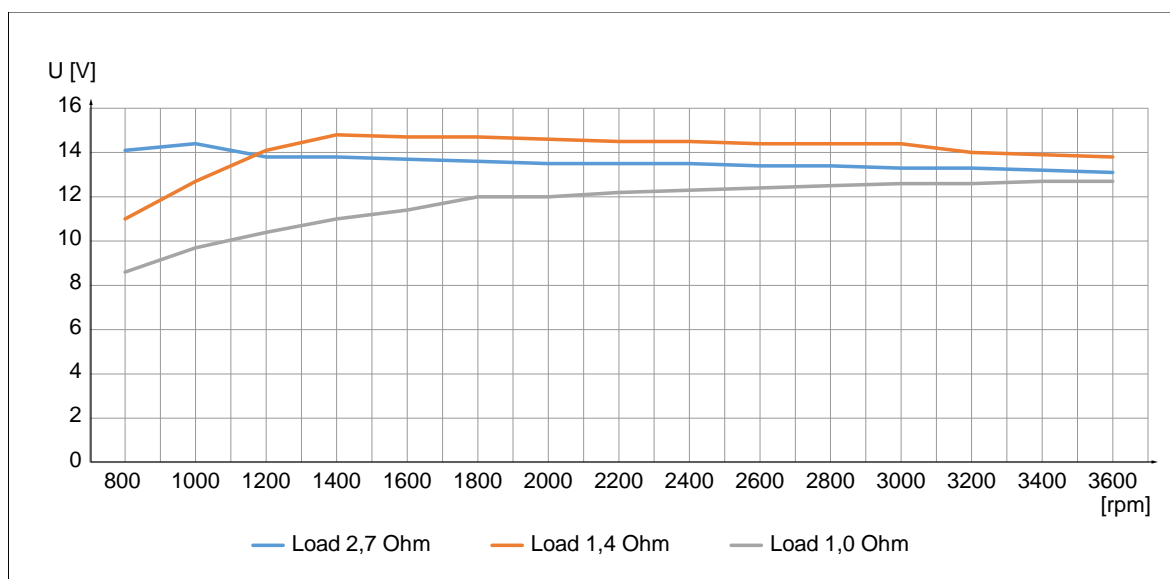
Charging curve 12 V alternator – 1B20 / 1B30, 1B30E, 1B30VE / 1B40 / 1B50, 1B50E



Charging curve 24 V alternator – 1B20 / 1B30 / 1B40 / 1B50**Charge/voltage diagram of the 12-V alternator without battery – 1B20 / 1B30 / 1B40****CAUTION****Damage to the machine due to voltage peaks**

12-V power supply (alternator), without battery in machine, used solely to supply ohmic consumers (filament bulbs, heating resistors, etc.). Caution with electronic components: high voltage peaks may occur.

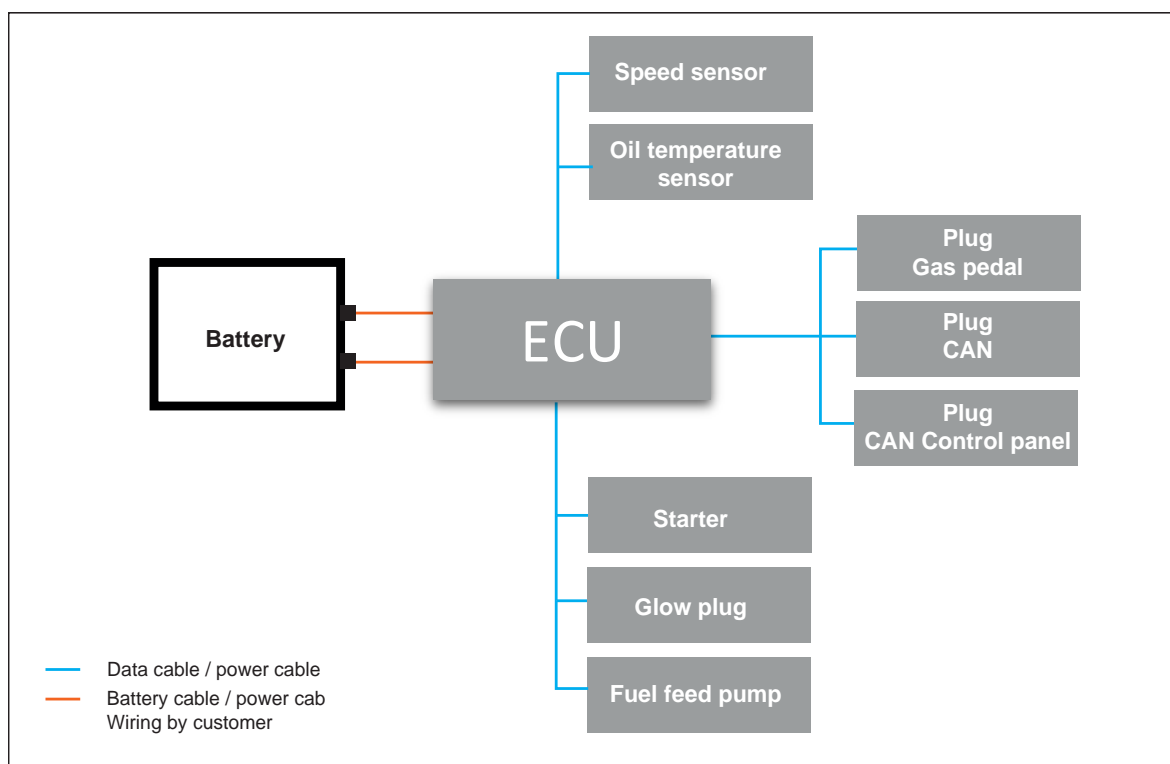
Never connect a battery!



1B20	2.7 ohm	3 – 3.5 A
1B30	1.4 ohm	8 – 9 A
1B40	1.0 ohm	10 – 12 A

9.6 Cabling

1B30E, 1B30VE, 1B50E



NOTICE



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

NOTICE



For leaktight plug connections, it must be ensured that the lines pass straight out of the plug for approx. 50 mm and the single conductor seals have a suitable diameter, as the tightness of the plug connection otherwise cannot be ensured.

9.7 Hatz terminal designation

Terminal designation on terminal strips, cable ends and circuit diagrams:

0	Weight
1	Alternator B+
2	For three phase alternator: D+, for flywheel alternator: terminal L on the controller
3	Starter, terminal 50
4	Oil pressure switch
5	Temperature switch on the cylinder head
6	Glow plug I
7	Electromagnet for engine switch-off [Haltewicklung]
8	Glow plug II
9	Start-stop input
10	Plus terminal for DC motor, fine speed adjustment
11	Minus terminal for DC motor, fine speed adjustment
12	Oil pressure sensor
13	* Reserved for special applications *
14	Speed adjustment magnet - excitation circuit
15	* Reserved for special applications *
16	Lift magnet for decompression
17	Maintenance switch for air filter
18	Electromagnet for engine switch-off [Anzugswicklung]
19	Temperature sensor on cylinder head
20	Oil temperature switch
21	Blower monitoring switch
22	Terminal W for rotational speed measurement
23	Starter 30 [bei Amperemeteranschluß]
24	Terminal C for controller on flywheel alternator
25	Oil temperature sensor
26	Terminal 50f on the starter protection module
27	* Reserved *
28	Speed adjustment magnet [Anzugswicklung]
29	* * * Reserved * * *

Max. permissible voltage drop on all control cables:

- 12 V < 1.5 V
- 24 V < 3 V

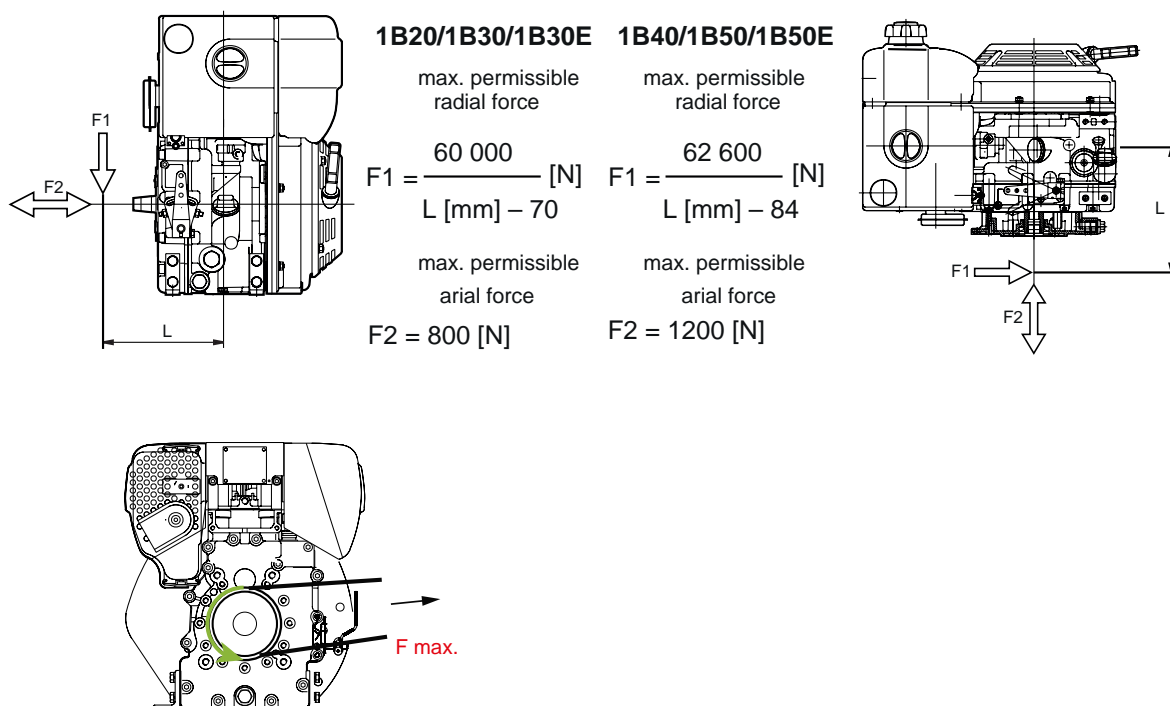
Ensure a good ground connection. Where possible, do not mount the switch box on the engine but attach it to vibration-free components.

For information on the circuit diagrams, see <https://www.hatz-diesel.com/docu>. (You will need your engine serial number for access.)

10 Power take off

10.1 Power take off on timing cover side



The load capacity of the power take off on the engine



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

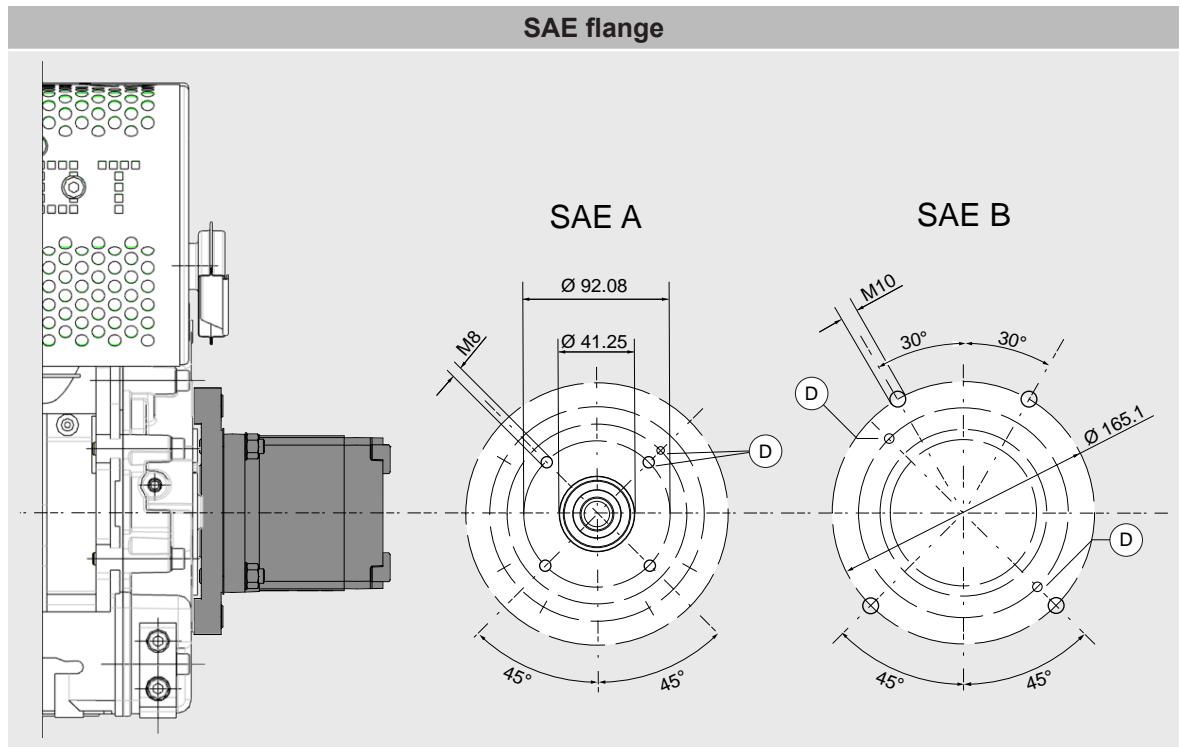
If the permissible limits cannot be adhered to, please contact your **HATZ subsidiary**.

10.2 Main take off at hydraulic pump

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

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

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



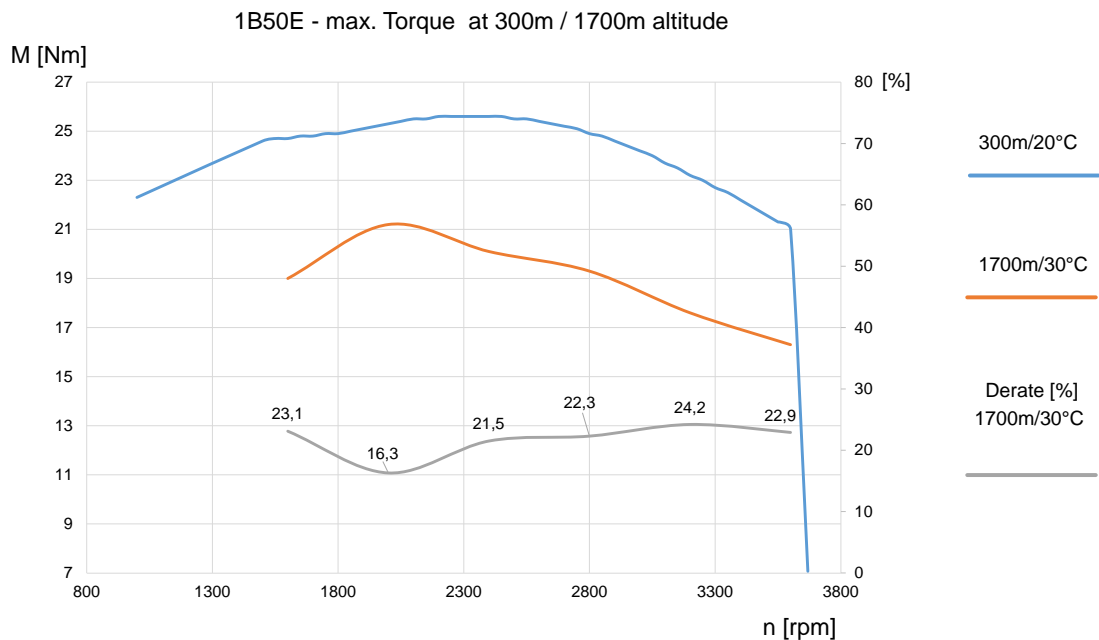
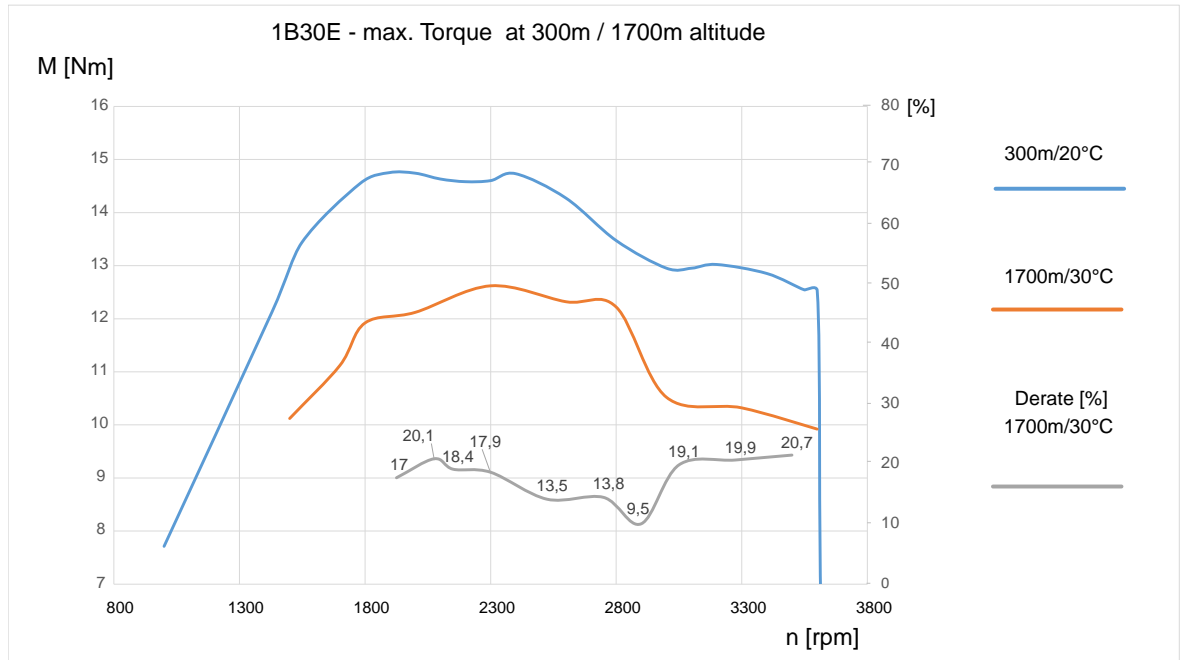
For details on the flange and shaft dimensions of the planned hydraulic pump, please contact your **HATZ Service Station**.

Apart from hydraulic pumps of various sizes, Hatz also has additional attachments for hydraulic pumps available on request. Please contact your **Hatz subsidiary**.

11 General limits of use

In general, it must be taken into account that, beginning at a certain elevation at which the engines are used, the engine power will be reduced in accordance with the ambient pressure.

The engines 1B30E, 1B30VE and 1B50E are equipped with an ambient pressure sensor in the engine control unit (ECU).



HATZ diesel engines can be used at temperatures from approx. – 25 °C to approx. + 45 °C (with a hand start, from approx. – 6 °C to approx. + 45 °C).

When using engines under extreme conditions, below – 25 °C and over + 45 °C, please contact your HATZ subsidiary regarding the necessary starting aids, special sealing materials, etc.

12 Contact protection for machine safety

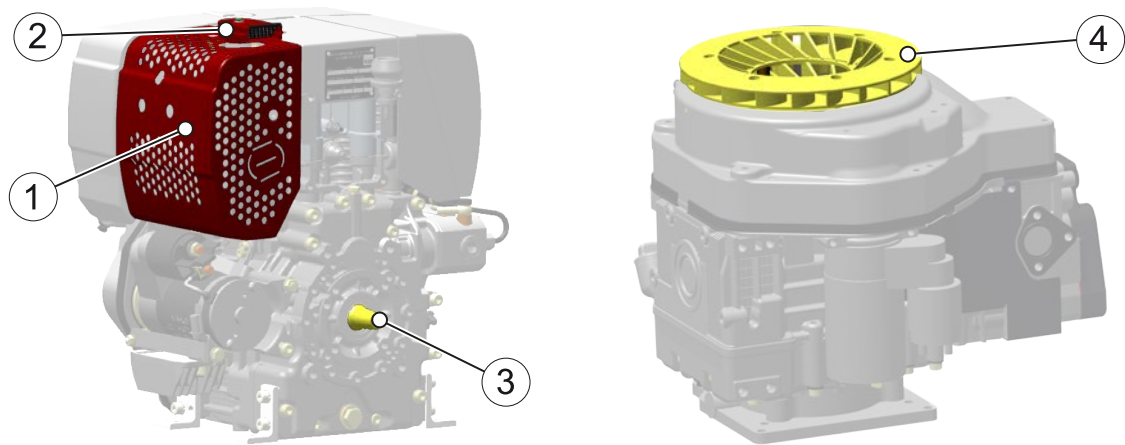
It is the responsibility of the manufacturer to heed and comply with the safety rules that apply to an engine in a finished machine.

The following figure shows you an overview of hot surfaces and turning parts. There is an increased risk of injury here.

It is the duty of the machine manufacturer to ensure that all safety precautions (e.g. contact guard at silencer) are taken for the whole machine so that any injury from hot surfaces and rotating parts can be ruled out. The protective devices are available from HATZ.

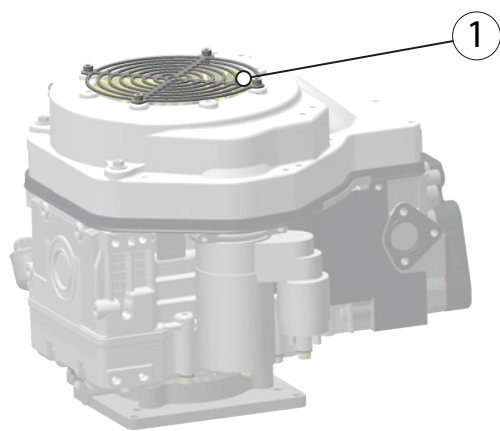
For more information, see chapter 8.2 *Installation notes – general information*, page 50.

12.1 Hot surfaces and rotating parts



Pos	Parts with hot surfaces
1	Silencer with contact protection
2	Exhaust manifold with exhaust screen
Pos	Rotating parts
3	Crankshaft
4	Blower ring with flywheel

12.2 Contact protection



Pos	Contact protection
1	Contact protection for blower ring

13 Maintenance

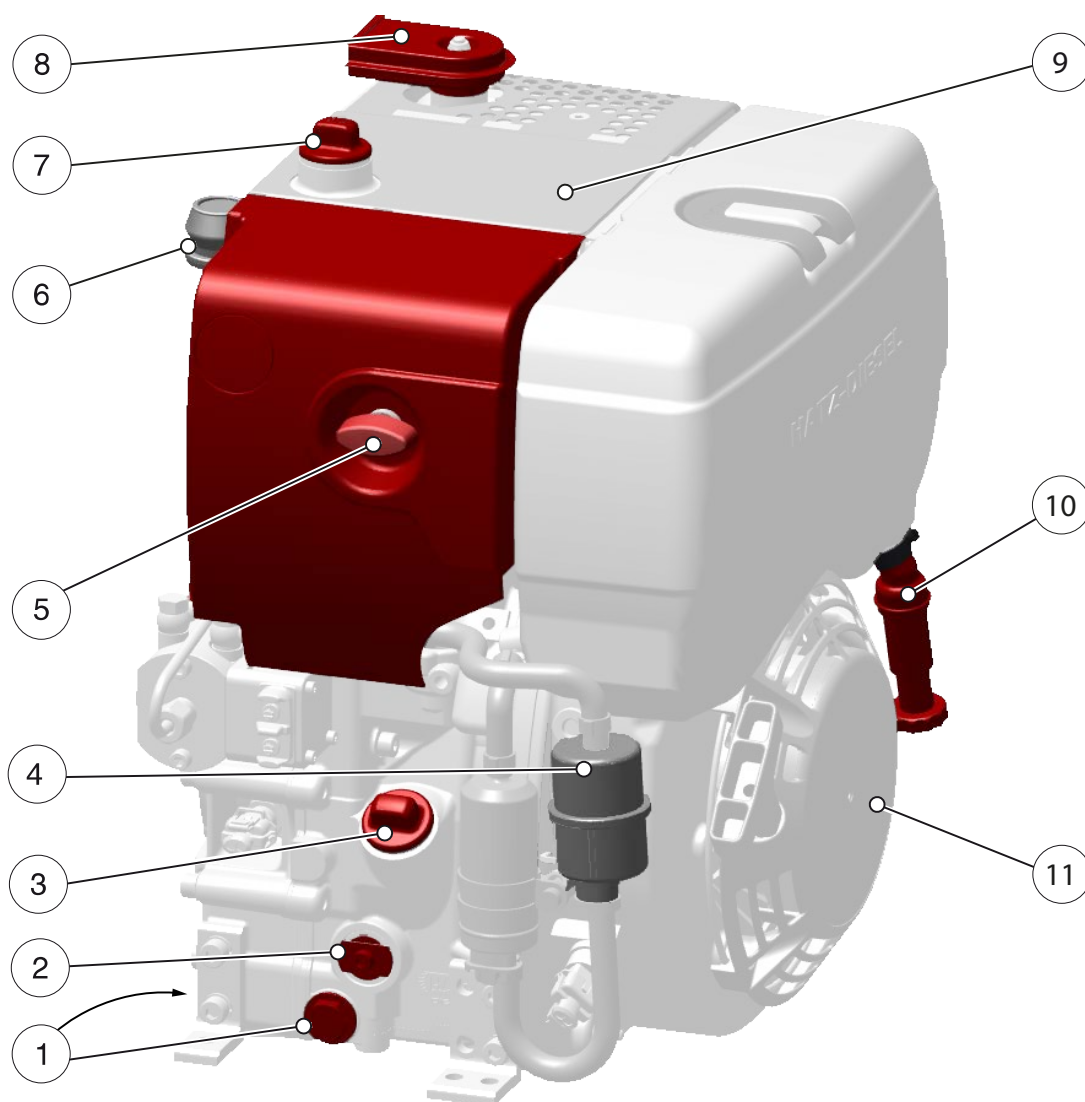
13.1 Accessibility of service points

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

If the original service label is fully or partially obscured after the engine is installed in the machine, another unattached service label included must be applied in a clearly visible location on the machine.

If there is no easy access to the service points, there is a risk that the necessary maintenance work will not be carried out at all or will not be carried out at the right time.

This can lead to increased wear and premature failure of the engine.



1	Oil drain screw	7	Oil filling opening, top (option)
2	Screw cap for oil filter	8	Exhaust manifold with exhaust screen
3	Oil filling opening and dipstick	9	Sound protection hood
4	Main fuel filter	10	Water separator with window (option)

5	Dry air filter	11	Intake opening for cooling and combustion air
6	Air filter maintenance indicator (option)		

13.2 Maintenance intervals

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

14 Engine preservation

NOTICE



If an extended storage period is planned, preservation procedures as per the Hatz Preservation Instructions 951916XX must be followed.

15 Test of the engine installation (checklist)

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

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

We recommend proceeding as follows:

15.1 Installation note

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

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

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






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

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

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

15.2 Initial startup

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

 DANGER	
	Danger to life from inhaling exhaust gases. Toxic engine exhaust gases can lead to loss of consciousness, and even death, in closed-off and poorly ventilated rooms. <ul style="list-style-type: none"> ▪ Never operate the machine in closed-off or poorly ventilated rooms. ▪ Do not breathe in the exhaust gases.
 CAUTION	
	Danger of injury and danger of engine damage from the use of starting fluid. <ul style="list-style-type: none"> ▪ Danger of injury during hand starting because the use of starting fluid can result in uncontrolled ignitions. ▪ Engine damage from uncontrolled ignition. ▪ Never use starting fluid.
NOTICE	
	Before installing further add-on parts, the preservation wax must be removed from the screw-on surfaces and the surfaces must be cleaned.

Before starting

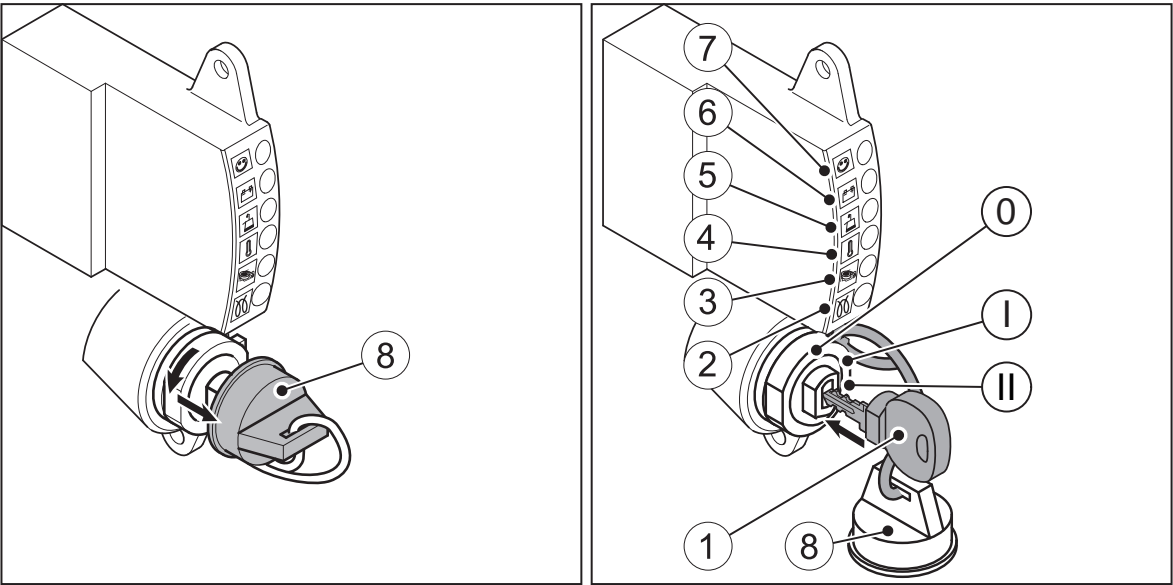
Before starting the engine, several tests need to be performed to ensure the machine is working properly.

Procedure

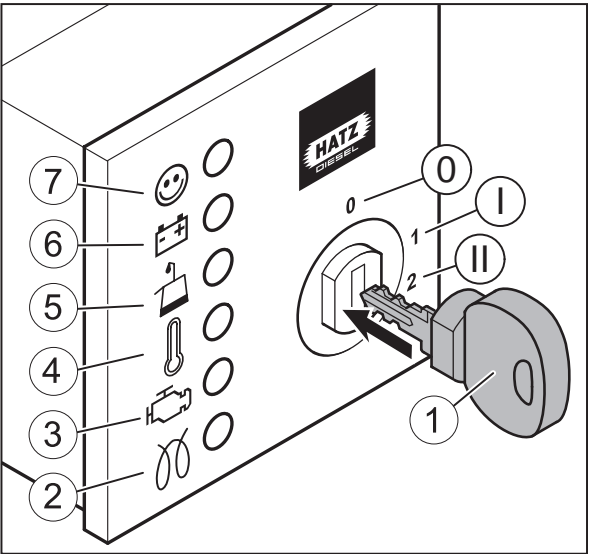
Step	Test
1	The machine is standing securely and on a level surface.
2	The installation location is adequately ventilated.
3	Sufficient amount of fuel in the fuel tank.
4	Sufficient amount of engine oil in the engine housing.
5	The starter rope of the recoil start does not exhibit abrasion (hand start).
6	No persons are located in the danger zone of the engine or machine.
7	All safety equipment is in place.

15.3 Overview - instrument box 1B30E, 1B50E

Standard (instrument box attached on the engine)



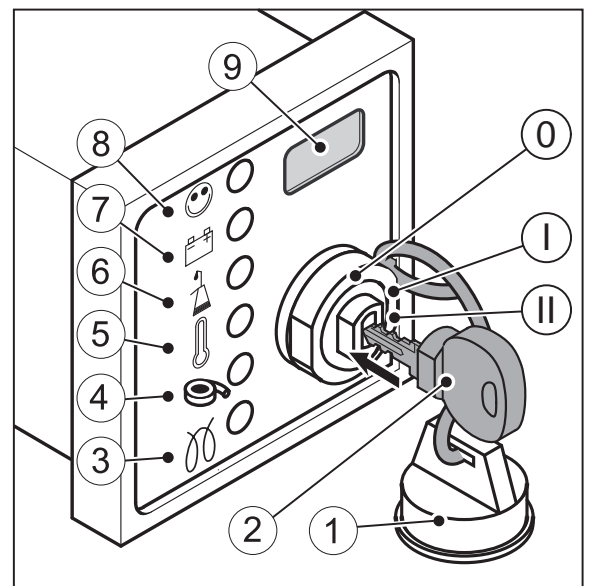
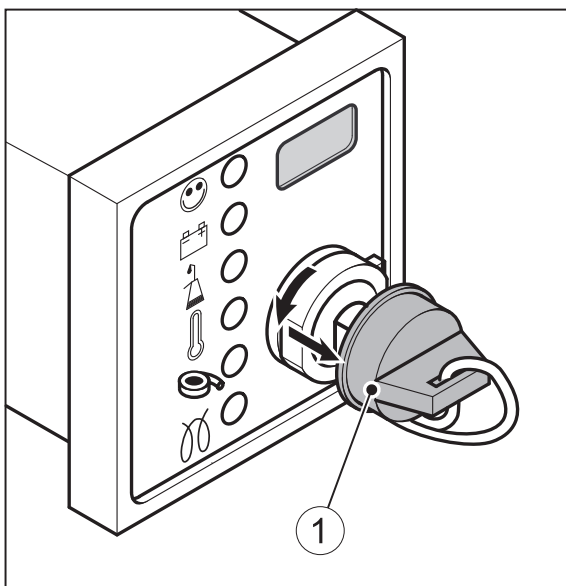
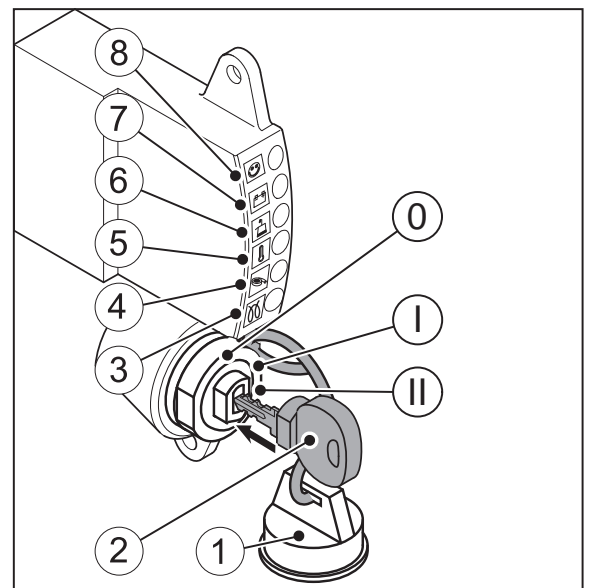
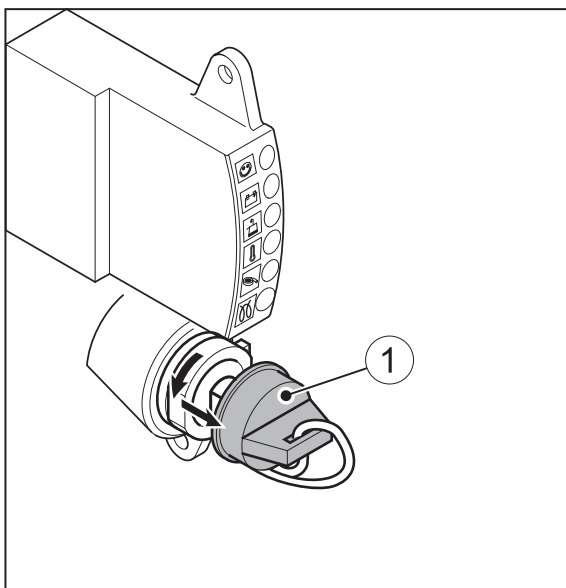
Option (external instrument box)



1	Starting key
2	Pre-glow indicator (option)

3	Engine fault
4	Engine temperature indicator
5	Oil pressure indicator
6	Charge control
7	Operating indicator
8	Protective cap (only for standard instrument box)
Ignition lock	
0	Off
I	Operation
II	Start







15.4 Overview - instrument box 1B20, 1B30, 1B40, 1B50





1	Protective cap
2	Starting key
3	Pre-glow indicator (option)


4	Air filter maintenance indicator (not activated)
5	Engine temperature display (option)
6	Oil pressure indicator
7	Charge control
8	Operating indicator
9	Operating hours counter (option)
Ignition lock	
0	Off
I	Operation
II	Start

15.5 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. Switch off the engine immediately and check the oil level. Contact the HATZ service if the oil level is correct.
	Engine temperature indicator Engine temperature is impermissibly high. Danger of engine damage. Switch off the engine immediately!
	Engine malfunction (symbol at external instrument box. 1B30E, 1B30VE and 1B50E only). This indicator lights up steadily or flashes if there are engine malfunctions. Depending on the engine specification, the engine controller reacts as follows in case of a malfunction: <ul style="list-style-type: none"> ▪ Emergency operation The engine switches to emergency operation. In this situation, the engine power is reduced or the maximum speed is limited. The engine malfunction indicator lights up. ▪ Engine stop The engine switches off automatically. The engine malfunction indicator flashes. ▪ Warning lamp Only the engine malfunction indicator calls attention to a malfunction.
	Air filter maintenance indicator (only active if wired on the customer side) This indicator lights up when the air filter is soiled. Clean or replace the filter cartridge immediately.

Symbol	Meaning
	<p>Engine malfunction (symbol installed on engine at instrument box. 1B30E and 1B50E only) This indicator lights up steadily or flashes if there are engine malfunctions.</p> <p>Depending on the engine specification, the engine controller reacts as follows in case of a malfunction:</p> <ul style="list-style-type: none"> ▪ Emergency operation The engine switches to emergency operation. In this situation, the engine power is reduced or the maximum speed is limited. The engine malfunction indicator lights up. ▪ Engine stop The engine switches off automatically. The engine malfunction indicator flashes. ▪ Warning lamp Only the engine malfunction indicator calls attention to a malfunction.
	<p>Pre-glow indicator Lights at temperatures below 0 °C. Start the engine after the indicator has gone out.</p>

15.6 Starting the engine

NOTICE	
	For details, see the Diesel Engine Manual.

15.7 Checking of engine choice and engine environment

- Is the speed correctly chosen, properly adjusted and matches the operating hours per year?
- Is the load on the engine in order?
- Has the climate at the place of use been taken into account?
- When installing the engine under a cowl or in a room, has the climate change been taken into account in the power calculation?
- Is the machine **vibration free/oscillation decoupled** as far as possible?
- Have our recommendations for **engine attachment** been taken into account?
- Have all prerequisites for a **good hand start** been fulfilled? The best way to check this is to attempt to **hand start the engine yourself**. Then you will know what you are offering to your customer and expecting of them.

15.8 Testing of engine equipment

- Was the engine mount designed correctly?
- Are the fuel lines laid in a flexible and ventable manner?
- Is the (fuel) tank content large enough for the intended operating time?
- Is the engine adequately protected against environmental influences?
 - Dust formation
 - Driving rain
 - Corrosive substances in the air
 - Rock fall
- Where present, are the supply and return air lines flexible, laid with the correct dimension, and in the right place?
- Were the lines laid without chafing and are they free of collision?
- Was the correct fault compensation response option chosen? (1B30E, 1B30VE, 1B50E only)
- Has the exhaust pipe (if present) been selected so the exhaust gas back pressure is within the tolerance band and was the exhaust pipe laid in a flexible manner?

- Are the load limits adhered to at the power take off points?
- Do the following parameters of the engine installation correspond to the requirements of the machine?
 - Vibrations
 - Speed stability
 - Start-up time
- Is the max. oil capacity sufficiently large for the intended operating period?
- Is the max. possible machine skew \leq the max. engine skew?
- Does the machine correspond to
 - the **noise regulations** in the specified fields of use?
 - the exhaust gas regulations?
 - the safety regulations?
 - all relevant **statutory regulations** (e.g. noise emission, exhaust gas emission, low voltage, electromagnetic compatibility, functional safety ...)?

15.9 Checking the accessibility of the operating and service points

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

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

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

Operating points:

See type sheet and Diesel Engine Manual

Service points:

See installation drawings, Diesel Engine Manual and chapter "Accessibility of service points"

- Dipstick
- Oil filler
- Oil drain
- Oil filter
- Oil screen
- Air filter
- Cylinder head cover
- Cooling air passages
- Battery
- Main fuel filter
- Fuel prefilter (1B30E, 1B30VE, 1B50E)
- Diagnostics interface (1B30E, 1B30VE, 1B50E)

15.10 Installation approval

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

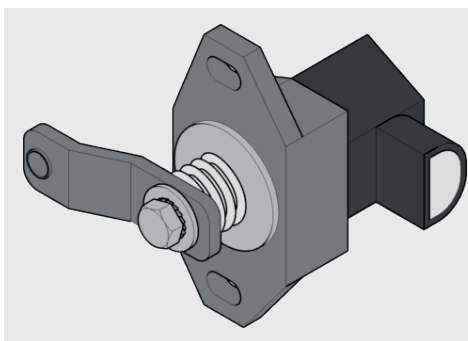
15.10.1 Prerequisite for carrying out the installation inspection

Before an installation inspection is performed with cooling capacity measurement, the following prerequisites must be fulfilled by the machine manufacturer:

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

16 Functional safety

16.1 Speed adjustment



All continuously adjustable, analog speed set point adjustment devices supplied by Hatz (gas pedal, hand lever, etc.) feature a speed specification (control circuit: 0.5 – 4.5 V)

Speed via a multistage switch or a controller with a simple potentiometer.

Speed setpoint via CAN bus

16.2 Fault replacement reaction

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

Emergency running

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

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

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

*Multistage switch

Engine stop

The engine switches off automatically after the following faults. The engine malfunction indicator flashes.

- Oil pressure error
- Temperature error (oil or cylinder head, cabling)
- Speed error (overspeed, speed too high, speed signal malfunction)
- Battery voltage too high
- Fuel pump output error, injection pump

Failure	Fault replacement reaction
Engine speed setting, analog	Emergency running
Speed setpoint CAN	Lower idling speed

Display for engine control

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

- Oil pressure error
- Temperature error (oil or cylinder head, cabling)
- Charge control

- Speed error (speed too high, speed signal malfunction, wiring)
- Battery voltage too high/low
- Sensor voltage too high/low
- Ambient pressure too high/low
- Fuel pump output error, glow plug, injection pump, wiring

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

NOTICE



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

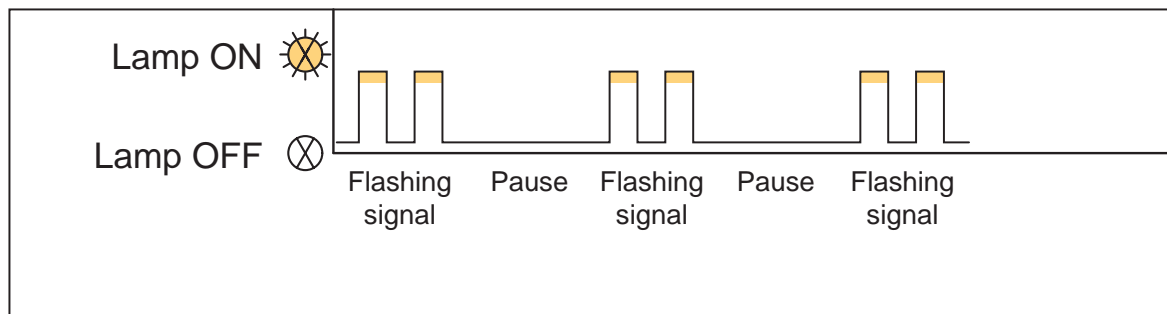
16.3 Flash code table for engine faults

If an engine malfunction occurs, the indicator for "Engine malfunction" lights up (see *Explanation of symbols*, chapter). If the engine is switched off and the starting key is set to "I", a flashing signal is output on the engine control indicator. The table below shows possible flashing signals, their meaning, as well as measures for remedies.

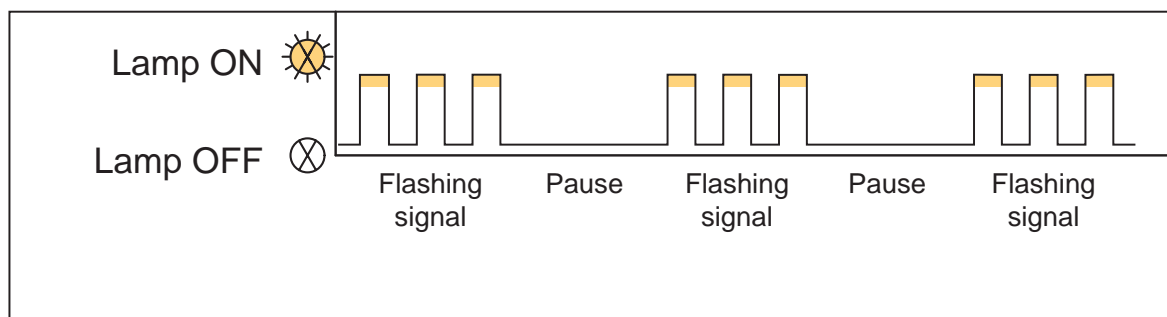
If the listed fault cases have been worked through but the fault continues to persist, please contact your nearest **HATZ Service**.

The diagrams show the structure of a flash code using flash codes 2 and 3 as examples:

Flash code 2



Flash code 3



The light flashes three times in a row for each error. If two or more errors are active, these are flashed immediately afterwards. To repeat, turn the starting key to position "0" and then back to position "I". The flash code is deleted automatically if the error does not reoccur within two operating cycles (= start/operation/stop).

Flash code table

Flashing signal	Possible causes	Remedy	Chapter
1 <i>Area affected:</i> Engine oil pressure	Engine oil pressure too low.	Check the oil level.	Checking the oil level (QV)
2 <i>Area affected:</i> Overtemperature	Engine temperature is too high.	Clean the cooling air area.	Cleaning the cooling air area (QV)
	Oil temperature too high.	Reduce the engine load.	
3 <i>Affected area:</i> Charge control	Faulty voltage controller.	Contact HATZ service.	
	Battery voltage too high.	Contact HATZ service.	
	Battery voltage too low.	Check the electrical equipment and its components or contact Hatz service.	
	Speed adjustment is faulty.	Contact HATZ service.	
	Supply voltage for sensors is faulty.	Check the cabling.	
4 <i>Area affected:</i> Analog setpoint or CAN communication	Cabling is faulty.	Check the cabling.	
	Speed adjustment is faulty.	Contact HATZ service.	
5 <i>Area affected:</i> Ambient pressure sensor	Sensor is faulty.	Contact HATZ service.	
7 <i>Area affected:</i> Fuel pump, glow plug, injection pump	Cabling is faulty.	Check the cabling.	
	Fuel pump, glow plug or injection pump is faulty.	Contact HATZ service.	
8 <i>Area affected:</i> Speed sensor system	Cabling to the crankshaft speed sensor is faulty.	Check the cabling.	
	Crankshaft speed sensor is faulty.	Contact HATZ service.	
	Engine speed is impermissibly high.	Contact HATZ service.	
9 <i>Area affected:</i> Control unit	Cabling to the control unit is faulty.	Check the cabling.	
	Faulty control unit.	Contact HATZ service.	

17 Declaration of incorporation

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

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

hereby declares that the incomplete machine: product description: **Hatz diesel engine**

Type designation and as of serial number:

1B20=10034; 1B20V=11124; 1B20R=14413

1B30=10129; 1B30V=11220; 1B30E=18204; 1B30VE=18303

1B40=11019;

1B50=12416; 1B50V/W=12616; 1B50E=18405; 1B50E=18805

satisfies the following basic safety and health protection requirements in acc. with Annex I to the above-mentioned Directive.

- Annex I, General principles no. 1

- No. 1.1.2., 1.1.3., 1.1.5., 1.2.1., 1.2.2., 1.2.3., 1.2.4.1., 1.2.4.2., 1.2.6, 1.3.1., 1.3.2., 1.3.3., 1.3.4., 1.3.7., 1.3.9., 1.4.1., 1.5.1., 1.5.3., 1.5.8., 1.5.9., 1.5.10, 1.5.11, 1.6.1., 1.6.2., 1.6.4., 1.7.

All relevant basic safety and health protection requirements down to the interfaces described

☒ in the manual for diesel engine

☒ in the enclosed data sheets

☒ in the enclosed technical documents

have been complied with.

The following standards have been applied (fully or in part):

- EN 1679-1: 092011

- EN ISO 12100: 032011

- EN ISO 13857: 062008

- EN 60204-1: 062007

The manual for the diesel engine has been attached to that of the incomplete machine and the Assembly Instructions have been provided to the customer electronically together with the order confirmation.

The special technical documents in acc. with Annex VII B of the Directive 2006/42/EC have been prepared. If necessary, I will submit the above-mentioned special technical documents in electronic form to the competent authority.

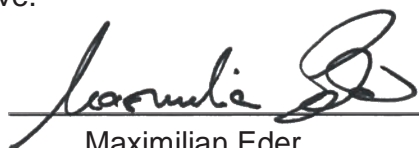
The above-mentioned special technical documents can be requested from:

Wolfgang Krautloher, address, see manufacturer

Commissioning is prohibited until it has been established, where applicable, that the machine into which the above-mentioned incomplete machine is to be incorporated, satisfies the provisions of the Machinery Directive.

19/10/2021

Date


 Maximilian Eder

Series manager air-cooled engines



Dr.-Ing. Simon Thierfelder
 Chief Technical Officer - CTO

Motorenfabrik Hatz GmbH & Co. KG

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