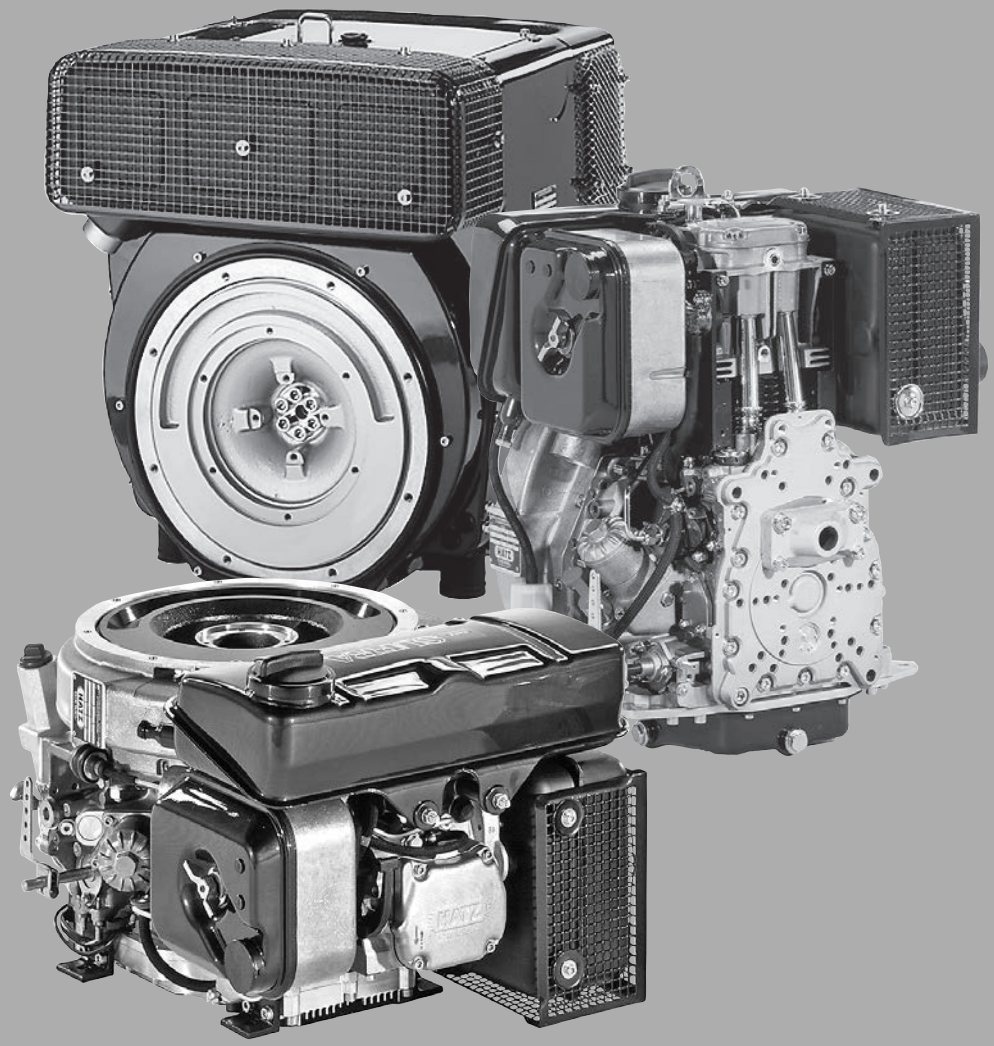
CREATING POWER SOLUTIONS.



1D.. | 1D..V | 1D..E

ASSEMBLY INSTRUCTIONS

Hatz Diesel

www.hatz-diesel.com

1 Legal notices

Copyright

Contact data

© 2023
Motorenfabrik Hatz
Ernst-Hatz-Straße 16
94099 Ruhstorf
Germany

Tel. +49 (0)8531 319-0

Fax +49 (0)8531 319-418

marketing@hatz-diesel.de

www.hatz-diesel.com

Original manual

This manual has been translated into multiple languages.

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

Revision

Version	Date	Name
00 - Rev. 00	01/25/2022	GMV / bw
00 - Rev. 01	09/26/2022	GMV / bw
00 - Rev. 02	11/02/2022	GMV / bw
00 - Rev. 03	06.07.2023	GMV / bw

2 General information

Information on the document

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

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

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

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

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

Machine

This manual describes the following machine.

Machine name	HATZ diesel engine
Type number	1D42, 1D50, 1D81, 1D90, 1D90V, 1D90E

Customer service

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

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

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

Exclusion of liability

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

Modifications, which serve the technical improvements, are reserved.

3 Safety

3.1 General information

Introduction

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

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

Read this chapter carefully before beginning work.

3.1.1 Intended use

Intended use

The machine described in this manual fulfills the following functions:

- Diesel engine intended for installation in a machine or for assembly with other machines to form a machine. See chapter *18 Declaration of incorporation, page 120*.

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

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

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

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

Foreseeable misuse

The following is considered to be foreseeable misuse:

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

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

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

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

User obligations

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

Obligations of the operating and maintenance personnel

Personnel assigned with operating and maintaining the machine must have read and understood this manual or must possess the qualifications necessary for working with this equipment, acquired in training/instructional courses. No one may work with the machine without the necessary qualifications, even if for just a brief period.

The operating and maintenance personnel must not be under the influence of drugs, medication or alcohol.

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

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.

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

3.1.4 Meaning of safety symbols

Explanation of symbols

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

Symbol	Meaning
	Smoking, fire, and open flames are prohibited!
	Warning of personal injury!
	Warning of hot surfaces!
	Warning of hot surfaces! (Alternative)
	Warning of flammable substances!
	Warning of explosive substances!
	Warning of toxic engine exhaust!
	Warning of corrosive substances!
	Warning of heavy loads!
	Warning of environmental damage!
	Comply with this manual or additional documentation from other manufacturers or the operator.

Symbol	Meaning
	Additional information that is useful to the reader.

3.2 Safety notes

3.2.1 Operational safety

Introduction

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

 **DANGER**	
	**Danger to life, danger of injury or danger of property damage due to failure to comply with this manual and the safety instructions contained therein.** ▪ As the operator of the machine, you must ensure that all people working on the machine are familiar with the content of this manual. ▪ Before working on the machine, read this manual carefully, paying special attention to the safety notes. ▪ 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: ▪ 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.

Personal protective equipment	Pictogram	Function
Safety goggles (with side protection)		Safety goggles protect the eyes from flying objects (e.g., dust particles, spraying liquids, spraying acid).
Fine dust mask		A fine dust mask protects the wearer against particulate pollutants.
Working clothes		Wear close-fitting working clothes. It must not restrict the wearer's freedom of movement, however.

Warning labels and information signs on the machine

The warning labels and information signs on the machine must be followed (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 *2 General information, page 7*).

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

Safety equipment

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

General safety instructions

DANGER

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

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

WARNING

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

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

WARNING

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

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

⚠ CAUTION
 **Danger of injury from overloading the body.** Lifting the machine to transport it or to move it to another location can lead to injuries (of the back, for example). ▪ Only lift the machine with a hoist (see chapter *7.1 Transport, page 45*).

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

⚠ DANGER
 **Danger of fire from hot exhaust gas system.** If inflammable materials come into contact with the exhaust gas flow or the hot exhaust gas system, these materials can ignite. ▪ Keep inflammable materials away from the exhaust gas system. ▪ Do not operate the engine (exhaust flow or hot exhaust gas system) in the direct vicinity of combustible materials.

DANGER

Fire hazard from fuel.

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

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

3.2.3 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 *2 General information, page 7*).
- When disposing of parts that can no longer be used, do so in accordance with local environmental regulations or send them to a recycling center.

Measures following maintenance and troubleshooting

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

Safety instructions for maintenance work

DANGER

Danger of explosion from flammable cleaning agents.

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

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

WARNING

Danger of injury from compressed air and dust particles.

Eye injuries can occur when cleaning with compressed air.

- Wear safety goggles.

CAUTION

Danger of injury from ignoring the maintenance instructions.

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

CAUTION

Danger of burns.

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

- Let the engine cool before maintenance.

3.2.4 Electrical equipment

Safety notes

DANGER

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

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

DANGER

Danger of explosion from flammable substances.

There is a danger of explosion from flammable gases.

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

CAUTION

Danger of chemical burns

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

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

- Promptly replace defective 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.

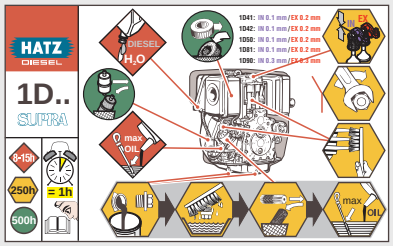
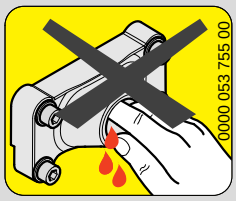
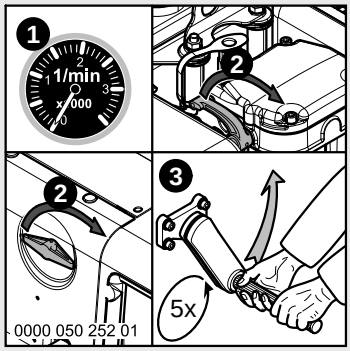
- When performing welding work on the machine, disconnect the battery and place the ground clamp of the welding equipment as close as possible to the welding area. Disconnect the plug-in connections to the voltage regulator of the alternator. For 1D90E, also disconnect the plug-in connection to the engine control unit.

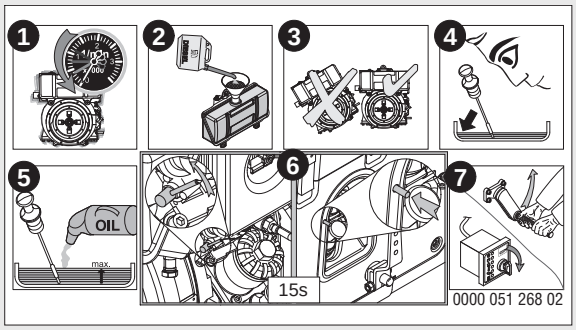
NOTICE

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

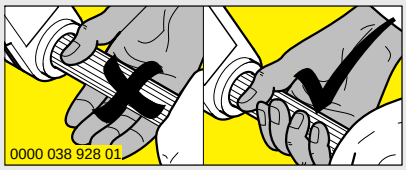
3.2.5 Labels

Warning labels and information signs on the engine

Label	Meaning
	Maintenance instructions (see Diesel Engine Manual)
	CAUTION! Danger of injury on the guide sleeve of the starting mechanism. ▪ Do not reach into the guide sleeve of the starting mechanism while the engine is running.
	Crankhandle start: 1.Engine stopped. 2.Actuate the decompression lever. 3.After engaging the automatic decompression on the end stop, five crank handle turns are required until the engine compresses again and can ignite.
	Refuel with diesel fuel only. Specification, see the Diesel Engine Manual.

Label	Meaning
	Mechanical oil pressure shut down device (option): 1.Engine has switched off automatically. 2.Fill with fuel. 3.Make sure the engine is horizontal. 4.Check the oil level. 5.Top up engine oil if required. 6.Press manual lever for approx. 15 seconds. For engines with a fuel pump, simultaneously actuate the manual lever on the fuel pump several times. 7.Start the engine. For further information, see the Diesel Engine Manual.

Warning labels and information signs on the crankhandle

Label	Meaning
	Hold the handle bar so that it cannot twist and quickly turn the crank so that continuous traction between the engine and crank is ensured. For further information, see the Diesel Engine Manual.

Warning label (sticker) EU, US market and Canada

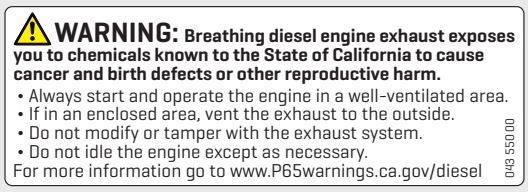
Each sticker on the engine was changed to ISO labels (pictograms) to meet the specifications of the European market on the basis of the Machinery Directive.
If an engine is sold to and operated on the US market or in Canada, the following additional label (see below) must be applied to it.

Label	Meaning
	"WARNING"

Guide sleeve - short	Guide sleeve - long
	

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

sign	Meaning
	CALIFORNIA Proposition 65 Warning. For more information, see www.P65warnings.ca.gov/diesel (The warning label must be attached in a location where it is clearly visible on the machine. If necessary, Hatz can deliver the adhesive label unattached.)

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: ▪ 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: ▪ Temperature ▪ Height above sea level ▪ Efficiency of the driven machine (see section *4.4.1 Leistungsaufnahme des Gerätes, page 24*) ▪ Safety margin (see section *4.4.3 Sicherheitsreserve, page 26*) ▪ Load profile, power classes of the standard
Engine variations	Selection of the engine, taking into account: ▪ 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	▪ 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, …)

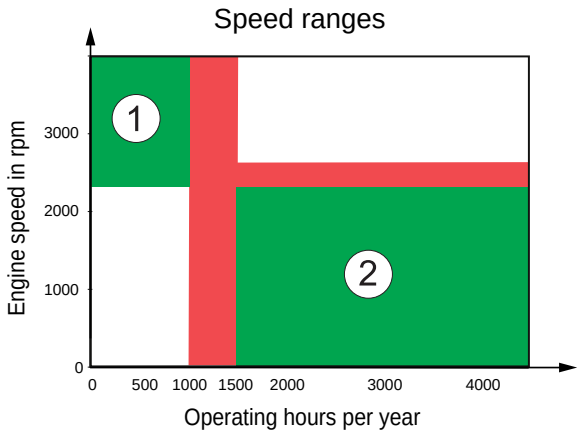
Specify the operating speed at the beginning of the equipment specification since this variable has significant influence on all the essential operating parameters of your machine. It is important to pay attention to a balanced compromise of efficiency for the following parameters:

- 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 2,300 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 1,000 h/year, although this limit can certainly occasionally be at 1,200 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 3,600 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 interval is adhered to consistently. 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 1,500 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. 1,800 h/year by operating as little as 5 hours daily, or 9,000 hours in 5 years.

For these types of drives, speeds from speed range 2 must be selected, i.e. for more than 1,500 operating hours/year, the selected speed selection must be from 2,300 rpm to a maximum of 2,600 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:

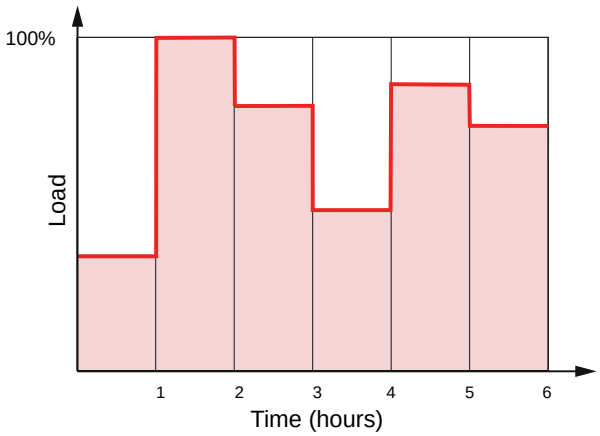
- Air pressure: 100 kPa (at approx. 100 m height above sea level),
- Intake air temperature: 298 K (25 °C)
- Relative humidity: 30%

Power class ISO 3046-1:		
1	Blocked power for intermittent operation = **blocked ISO effective power**	IFN
2	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.

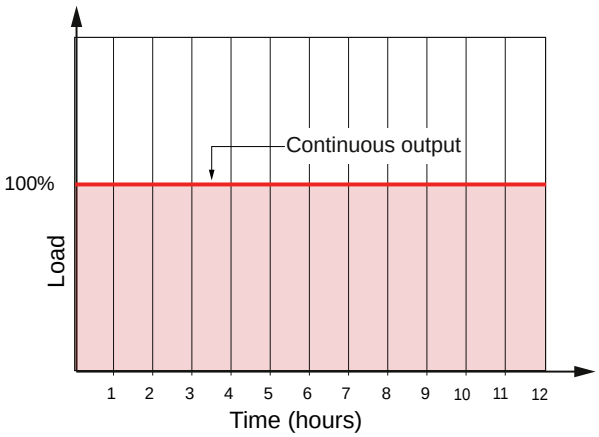


Typical uses are with machines such as:

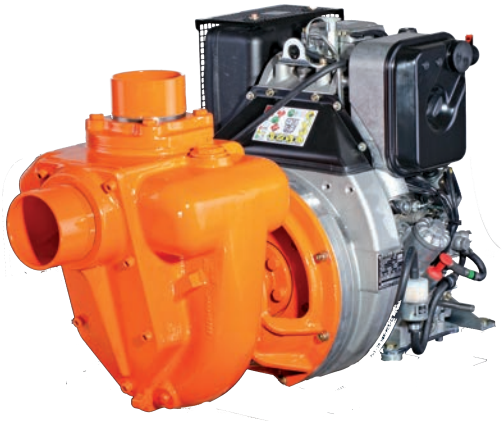
- Compressors,
- Trench cutting machines,
- Earth-moving equipment with hydrostatics such as caterpillars, loaders, etc.,
- Fire-fighting pumps,
- Vibratory plate compactors and vibratory rollers.

4.3.2 Power class 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

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**

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

Example:

A non-self-priming centrifugal pump with η = 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**

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

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:

$$P = \frac{20 \times 160}{600 \times 70/100} = 45{,}7kW$$

- **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 φ 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 φ 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 = 3,000 rpm	
	Unloaded approx.	Loaded approx.
1D90E	300 W	600 W [14V/15A]

Engine family	Power loss of unloaded alternator	
	Speed range rpm	Power loss kW
1D42/1D50 Standard Lima 200 W	3300 - 3600	0.3
	2500 - 3250	0.2
	1500 - 2450	0.1
1D81/1D90/1D90E Standard Lima 200 W	3300 – 3600	0.4
	2600 – 3250	0.3
	1800 – 2550	0.2
	1500 – 1750	0.1
1D81/1D90/1D90E Special Lima 350 W	3500 - 3600	1.0
	3200 - 3450	0.9
	2900 – 3150	0.8
	2600 – 2850	0.7
	2300 - 2550	0.6
	2000 – 2250	0.5
	1700 – 1950	0.4
	1500 – 1650	0.3

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.

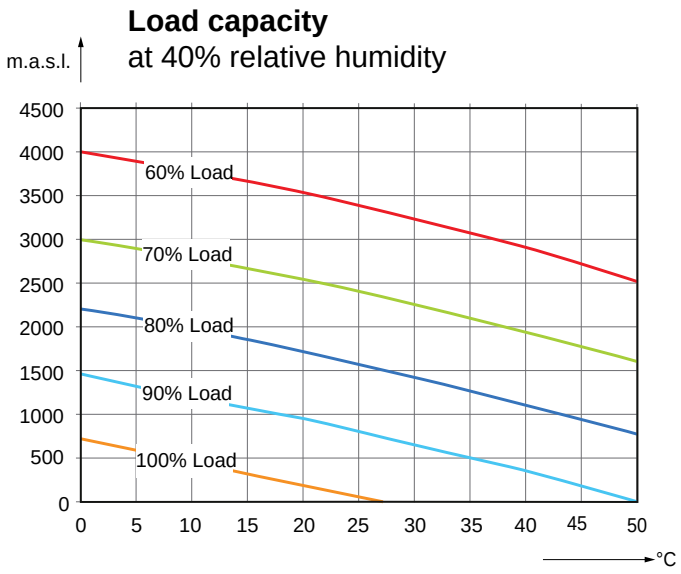
In addition, the power requirement of the machine can change during operation and increase, e.g. due to wear. For both reasons, a margin of safety is necessary.

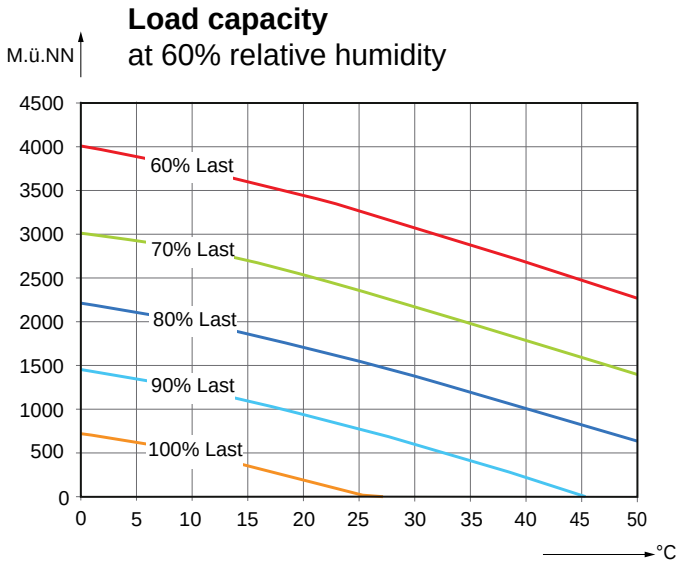
It is generally recommended that a safety margin between 5 and 10% is assumed for uncertainties in the calculation. This results in the safety factor fs:

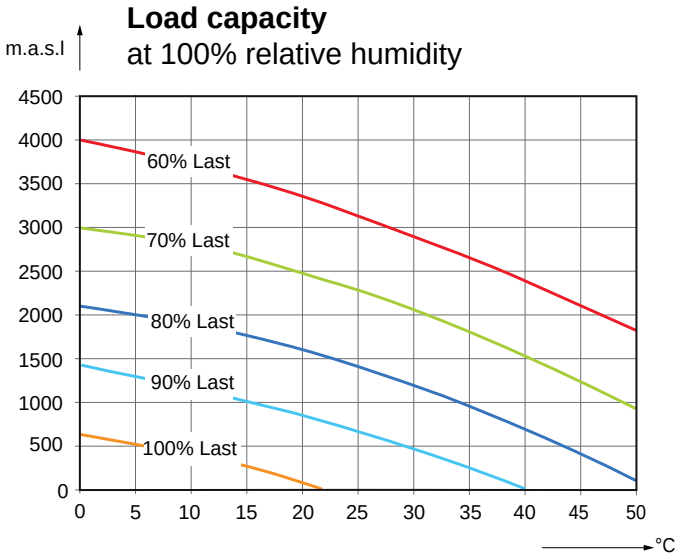
Safety			
%	5	10	15
fs	1.05	1.1	1.15

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 106*) 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

(ηmech. 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:

$$P\ (kW) = \frac{(\mathrm{PG} + \mathrm{PN})\ x\ fs}{\mathrm{K}}$$

As an example for the determination of the engine power size, the aforementioned 6 kVA generating set with ohmic load is used for which the following data apply:

Power requirement of the generator	PG	7.3 kW
Power requirement for auxiliary take-off systems	PN	1 kW
Margin of safety 5%	fs	1.05
Climate	60 % relative humidity, 35 °C, 1,200 m above sea level	K = 0.8

$$\mathrm{P} = \frac{(7{,}3 + 1)\ \mathrm{x}\ 1{,}05}{0{,}8} = 10{,}9kW$$

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.

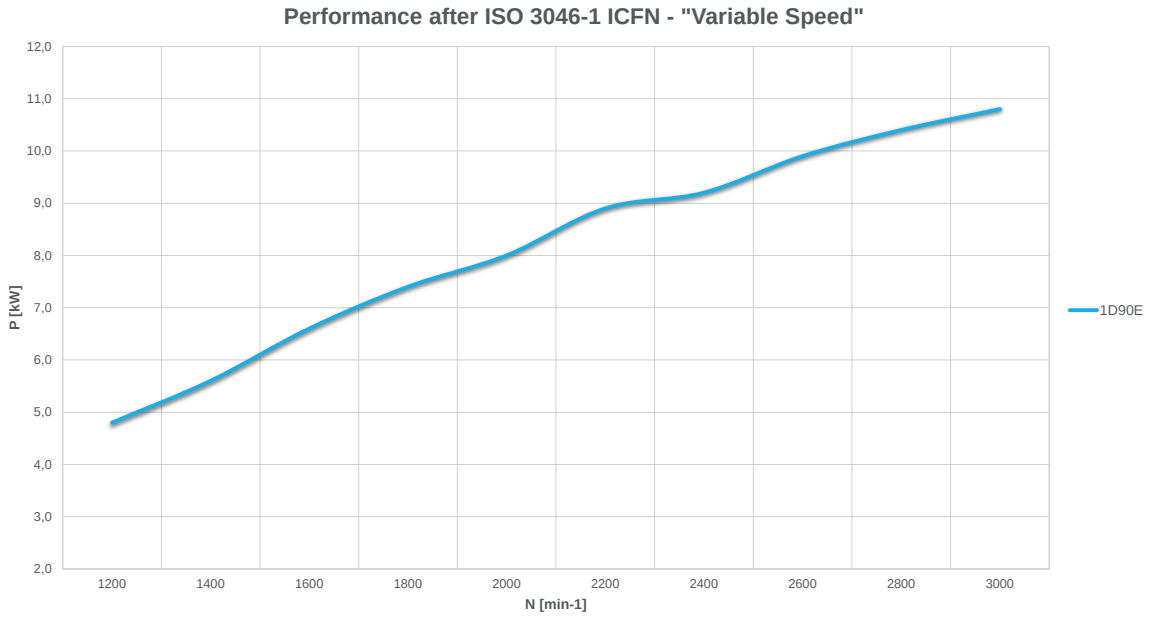
When calculating the climate margin, do not only bear in mind the overseas territories in Africa, South East Asia or South America, but also the high altitudes in Europe (Alps), in warm areas of Europe and also the high altitudes and warm zones in North America.

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**.


Performance after ISO 3046-1 ICFN - "Variable Speed"
P [kW]
12,0
11,0
10,0
9,0
8,0
7,0
6,0
5,0
4,0
3,0
2,0
1200
1400
1600
1800
2000
2200
2400
2600
2800
3000
N [min-1]
1D90E


Performance after ISO 3046-1 IFN - "Variable Speed"
P [kW]
12,0
11,0
10,0
9,0
8,0
7,0
6,0
5,0
4,0
3,0
2,0
1500
1600
1700
1800
1900
2000
2100
2200
2300
2400
2500
2600
2700
2800
2900
3000
3100
3200
N [min-1]
1D42
1D50
1D81
1D81C
1D90
1D90V


Performance after ISO 3046-1 IFN - "Non Certified"
P [kW]
N [min-1]
1D42
1D50
1D81
1D81C
1D90
1D90V


Performance after ISO 3046-1 IFN - „Constant Speed“
P [kW]
N [min-1]
1D42
1D50
1D81
1D81C
1D90
1D90V

4.6 Engine speed setting and accuracy

4.6.1 Setting for mechanically controlled engines - 1D42, 1D50, 1D81, 1D90

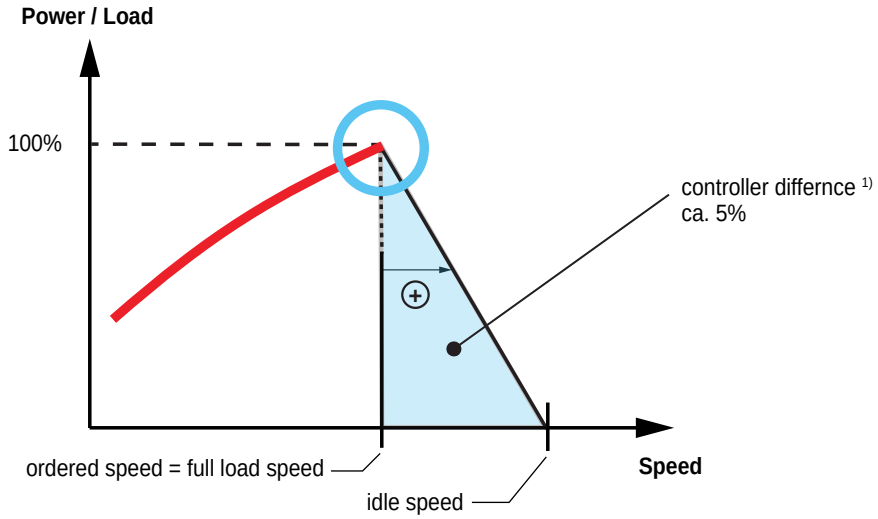
The ordered engine speed is the full load speed. The idle speed is then above the ordered speed by the "control difference". The setting of the upper idle speed can be acceptable for generating sets if the generating set is intended to run close to the rated frequency at the rated load.

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

1500 / **300**[1)]

2300 / 240

3000 / 180



[1] *The controller differential range is not valid for* 1D90E 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" 1,500 rpm, 1,800 rpm and 3,000 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.

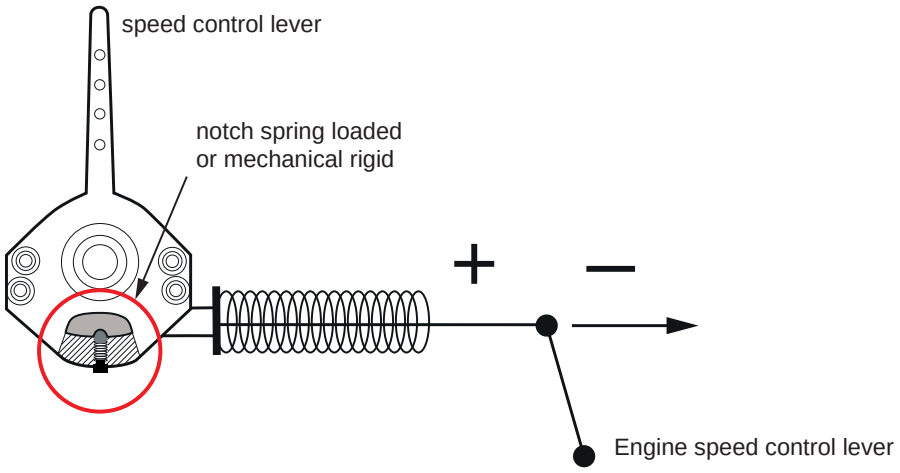
The standard equipment of 1-cylinder diesel engines 1D42, 1D50, 1D81, 1D90 includes a speed control that enables the speed to be adjusted continuously between the maximum speed and stop.

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 engine - 1D90E

Engine 1D90E 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).**

⇨ With 3000 rpm

b) **For variable speed**

⇨ With 3000, 2600 rpm

Under standard ambient conditions, the machine must not be loaded with more than 90% of the engine power. An **installation check and an installation record** for the machine are 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 fill quantities 1D42, 1D50, 1D81, 1D90, 1D90E

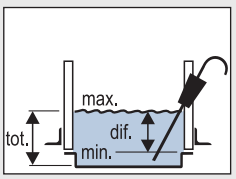
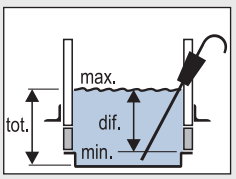
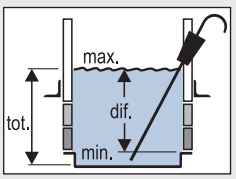
Type		1D42	1D50	1D81	1D90 1D90E
Model		S, Z	S, Z	S, Z, C	S, Z
Type		Air-cooled, four stroke diesel engine			
Combustion system		Direct injection			
Number of cylinders		1	1	1	1
Bore/Stroke	mm	90 / 70	97 / 70	100 / 85	104 / 85
Displacement	cm^3	445	517	667	722
Engine oil consumption (after running-in period)	Approx.	1 % of fuel consumption, pertaining to full load			
Engine oil pressure at oil temperature of 80–120 °C	Min.	0.6 bar at 850 rpm			
Sense of rotation		When viewing flywheel: left			
Tappet clearance at 10–30 °C Inlet Outlet	 mm mm	 0.10 0.20	 0.10 0.20	 0.30 0.30	 0.30 0.30
Permissible inclination[1)]	Max.	30°	30°	25°	25°
Weight					
Model S	Approx. kg	78	83	105	106[2)]
Model Z	Approx. kg	81	85	107	108[3)]
Model C	Approx. kg	–	–	126	–
Battery capacity	Max.	12 V – 88 Ah / 640 A (EN) / 700 A (SAE)			
		24 V – 55 Ah / 420 A (EN) / 450 A (SAE)			
Model **S**: non-encapsulated, normal counter balance Model **Z**: non-encapsulated, additional counter balance Model **C**: SILENT PACK, additional counter balance					

[1)] The values apply to continuous operation in any direction.
Exceeding these limit values causes engine damage.

[2)] 1D90ES: 107 kg

[3)] 1D90EZ: 109 kg

Engine oil capacities

	Oil sump					
	Standard		1 adapter ring		2 adapter rings	
						
Type	**tot. ltr.[2)]**	**dif. ltr.[3)]**	**tot. ltr.[2)]**	**dif. ltr.[3)]**	**tot. ltr.[2)]**	**dif. ltr.[3)]**
1D42 S/Z	1.2	0.4	2.8	2.0	4.4	3.6
1D50 S/Z	1.5	0.5	–	–	–	–

	Oil sump					
	Standard		1 adapter ring		2 adapter rings	
1D81 S/Z	1.9	0.9	3.2	2.2	4.5	3.5
1D81 C	1.9	0.9	–	–	–	–
1D90 S/Z	1.9	0.9	3.2	2.2	4.5	3.5
1D90E S/Z	1.9	0.9	3.2	2.2	4.5	3.5

[2] **tot. ltr.**: engine oil capacity (in liters) for the first filling or oil change.
For engines without an oil filter, the filling quantities are reduced by approx. 0.1 liter.

[3] **dif. ltr.**: Oil refill quantity (in liters) between the "min" and "max" marking on the dipstick.

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

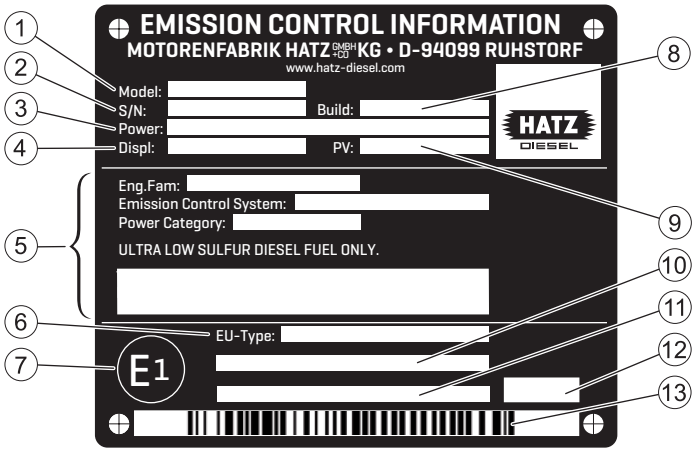
5.2 Engine information and fill quantities 1D90V, 1D90W

Type		**1D90**
Model		V, W
Type		Air-cooled, four stroke diesel engine
Combustion system		Direct injection
Number of cylinders		1
Bore/Stroke	mm	104 / 85
Displacement	cm^3	722
Engine oil capacity	Approx. ltr.	1.6 [1]
Difference between "max" and "min" marking	Approx. ltr.	0.7 [1]
Engine oil consumption (after running-in period)	Max.	1 % of fuel consumption, pertaining to full load
Engine oil pressure at oil temperature of 80–120 °C	Min.	0.6 bar at 850 rpm
Sense of rotation		When viewing flywheel: left
Tappet clearance at 10–30 °C inlet/outlet		0.30
Permissible inclination	Max.	25° [2]
Weight Model **V** Model **W**	 Approx. kg Approx. kg	 106 108
Battery capacity	Max.	12 V – 88 Ah / 640 A (EN) / 700 A (SAE)
		24 V – 55 Ah / 420 A (EN) / 450 A (SAE)
Model **V**: Normal counter balance Model **W**: Additional 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

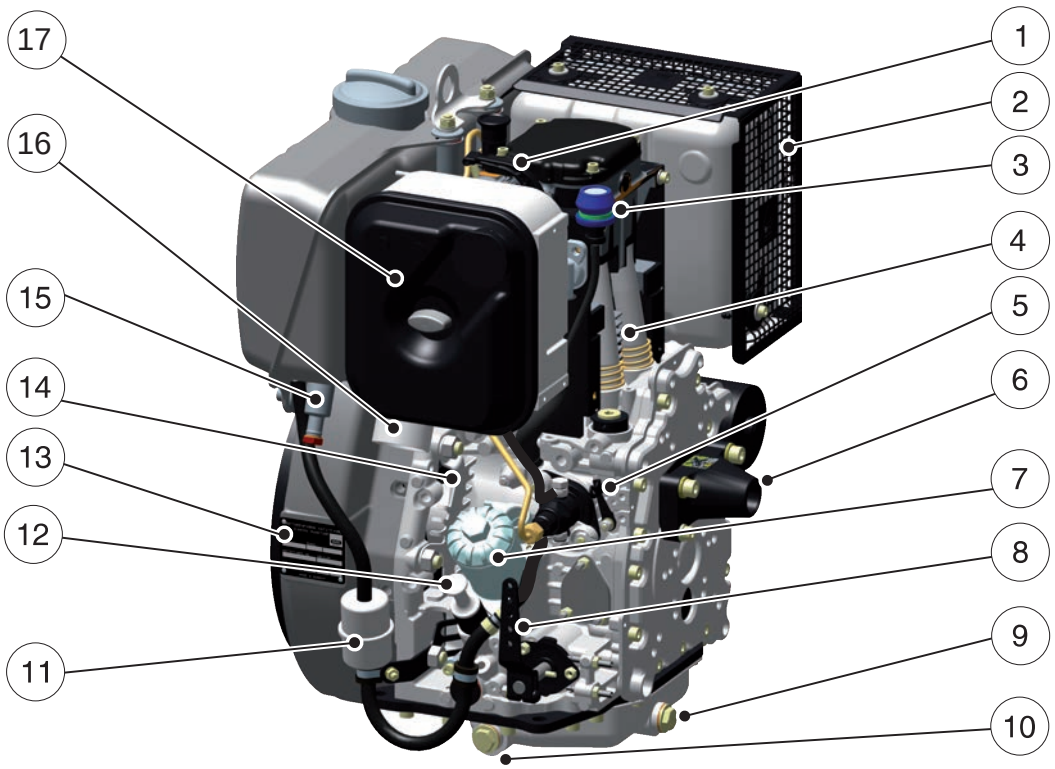


1	Model designation of the engine
2	Engine serial number
3	Engine power (kW) at rated speed (rpm)
4	Displacement (liters)
5	Information for US emission certification (EPA/CARB)
6	EU type approval number
7	EU country of origin (Germany)
8	Model year (month/year)
9	Test specification for special settings
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

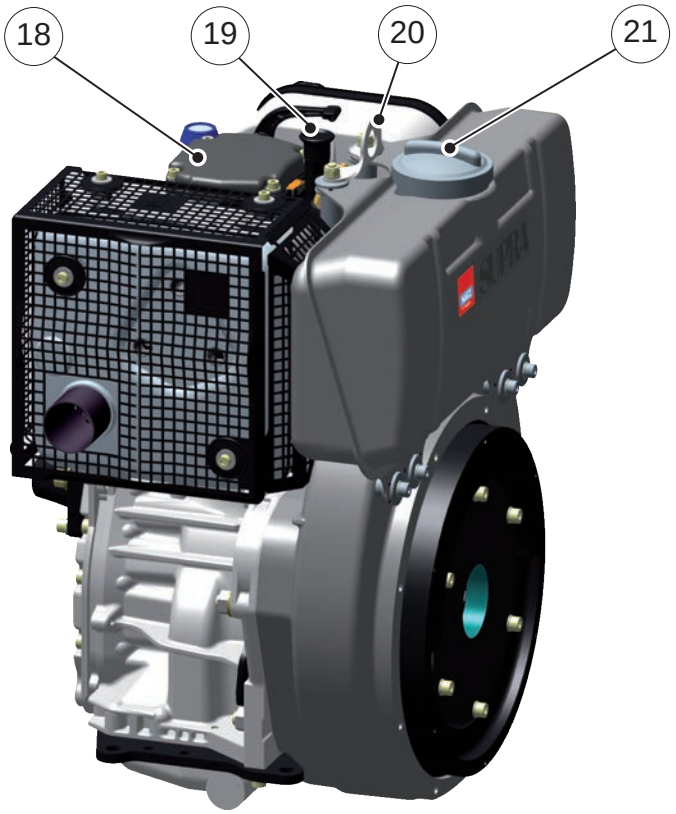
6.1 Version - mechanical engine control

Intake side – 1D42, 1D50, 1D81, 1D90 S/Z



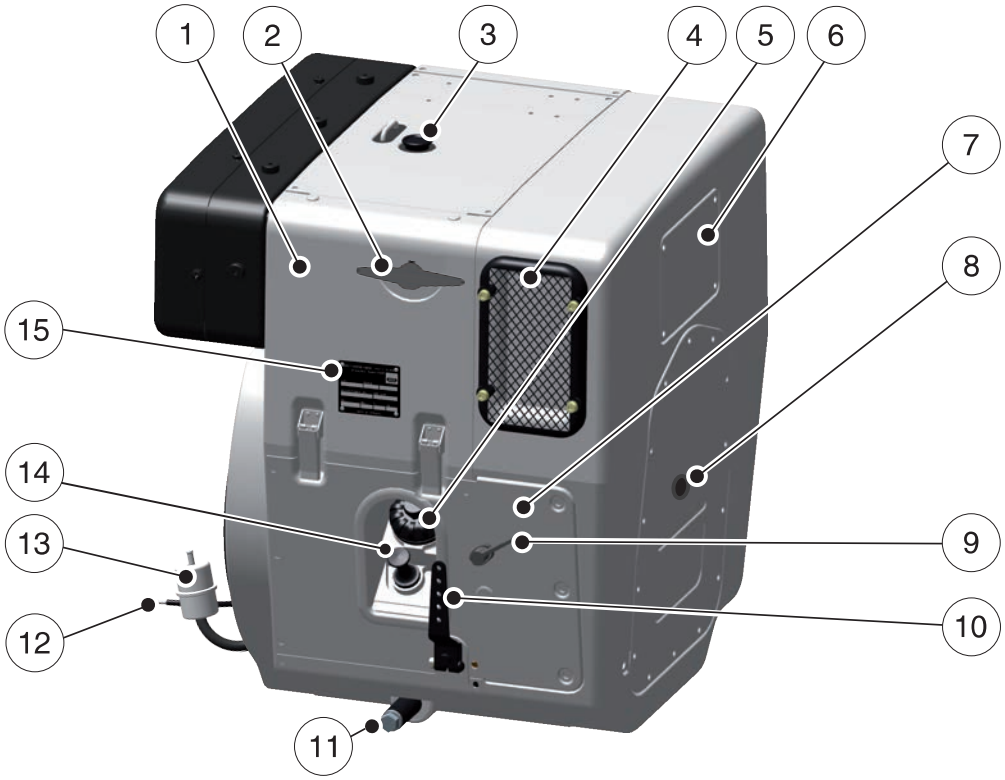
1	Decompression lever (for hand start)
2	Silencer with contact protection
3	Air filter maintenance indicator (option)
4	Coolant air outlet
5	Stop lever (option)
6	Guide sleeve for starting handle (in model with hand start facility)
7	Oil filter (option)
8	Speed control lever
9	Oil drain screw (front)
10	Oil drain screw (side)
11	Fuel filter
12	Oil filling opening and dipstick
13	Type plate
14	Intake opening for cooling air
15	Water separator
16	Intake opening for combustion air
17	Dry air filter

Exhaust side – 1D42, 1D50, 1D81, 1D90 S/Z



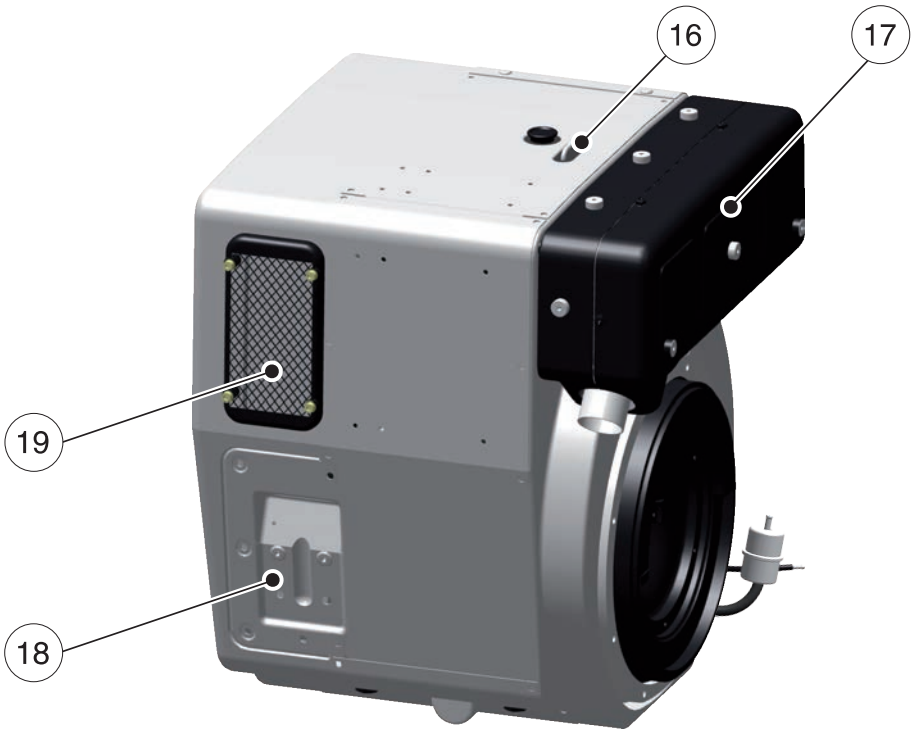
18	Cylinder head cover
19	Cold-start oil metering device (option)
20	Lifting eye
21	Fuel cap

Intake side – 1D81C



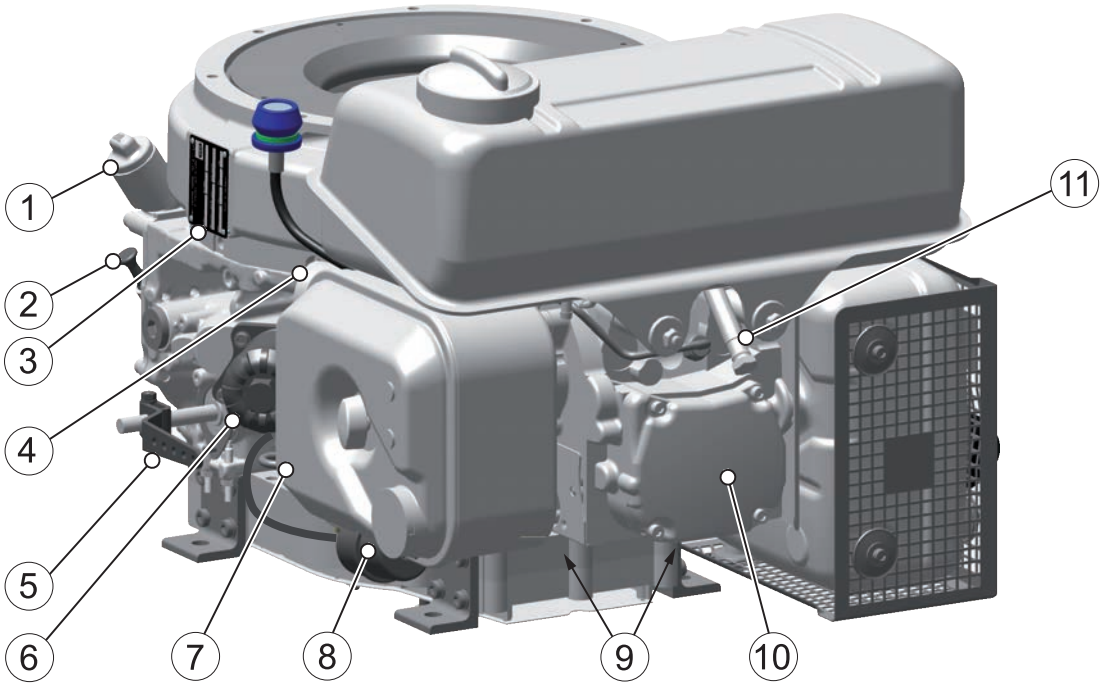
1	Access cover to air filter
2	Decompression lever (for hand start)
3	Cold-start oil metering device (option)
4	Intake opening for combustion air and cooling air
5	Oil filter (option)
6	Cleaning opening
7	Side trim panel
8	Opening for crankhandle (for hand start)
9	Stop lever (option)
10	Speed control lever
11	Oil drain screw
12	Fuel return line
13	Fuel filter
14	Oil filling opening and dipstick
15	Type plate

Exhaust side – 1D81C



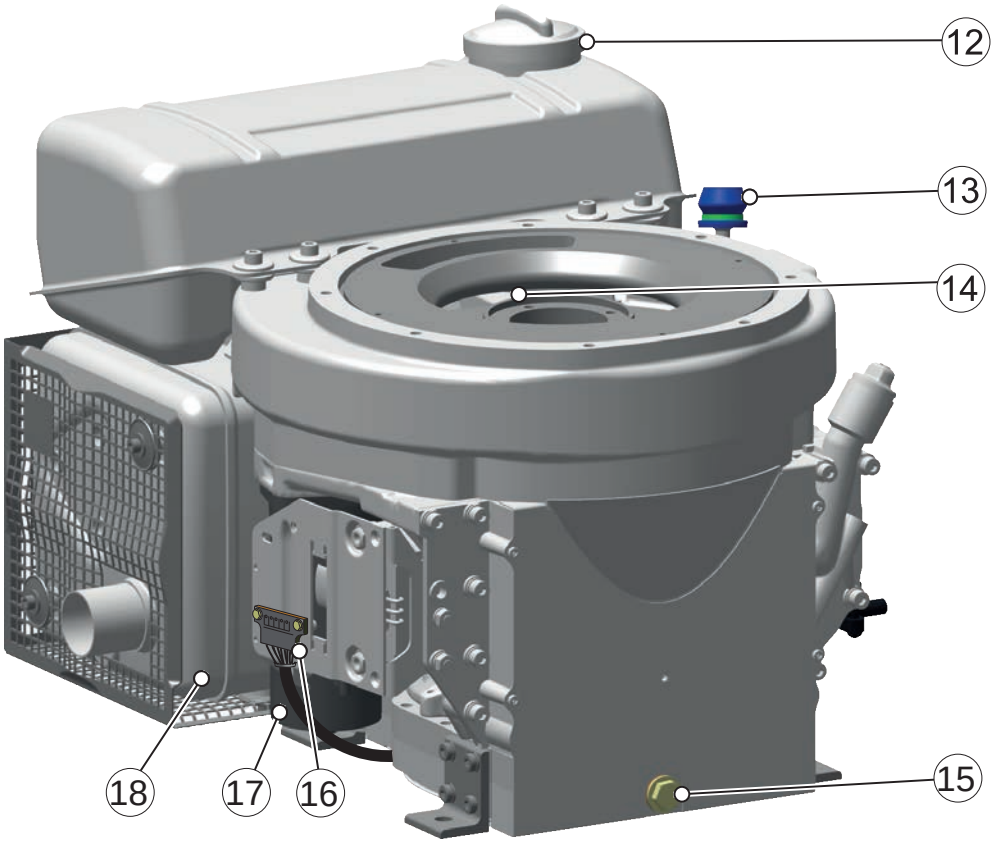
16	Lifting eye
17	Silencer (encapsulated)
18	Battery connection and central connector for electrical equipment (option)
19	Coolant air outlet

Intake side – 1D90V / W



1	Oil filler plug
2	Dipstick
3	Type plate
4	Intake opening for combustion air
5	Speed control lever
6	Oil filter (option)
7	Dry air filter
8	Fuel filter
9	Coolant air outlet
10	Cylinder head cover
11	Water separator

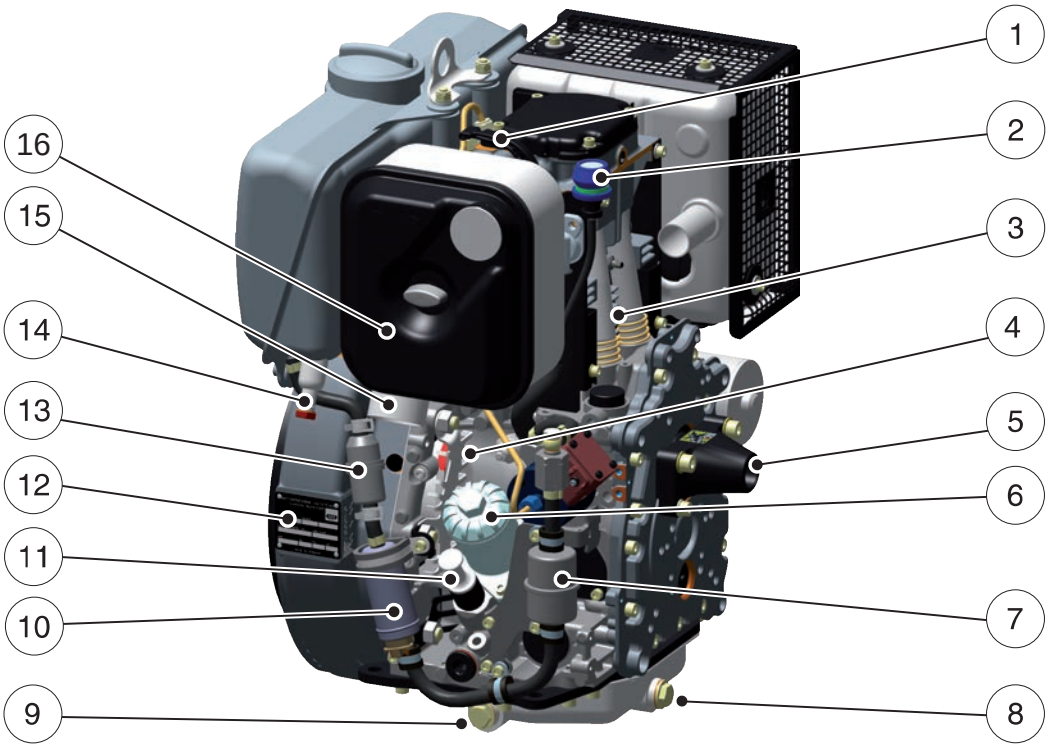
Exhaust side – 1D90V / W



12	Fuel cap
13	Air filter maintenance display (option)
14	Intake opening for cooling air
15	Oil drain screw
16	Central connector for electrical equipment
17	Starter
18	Silencer

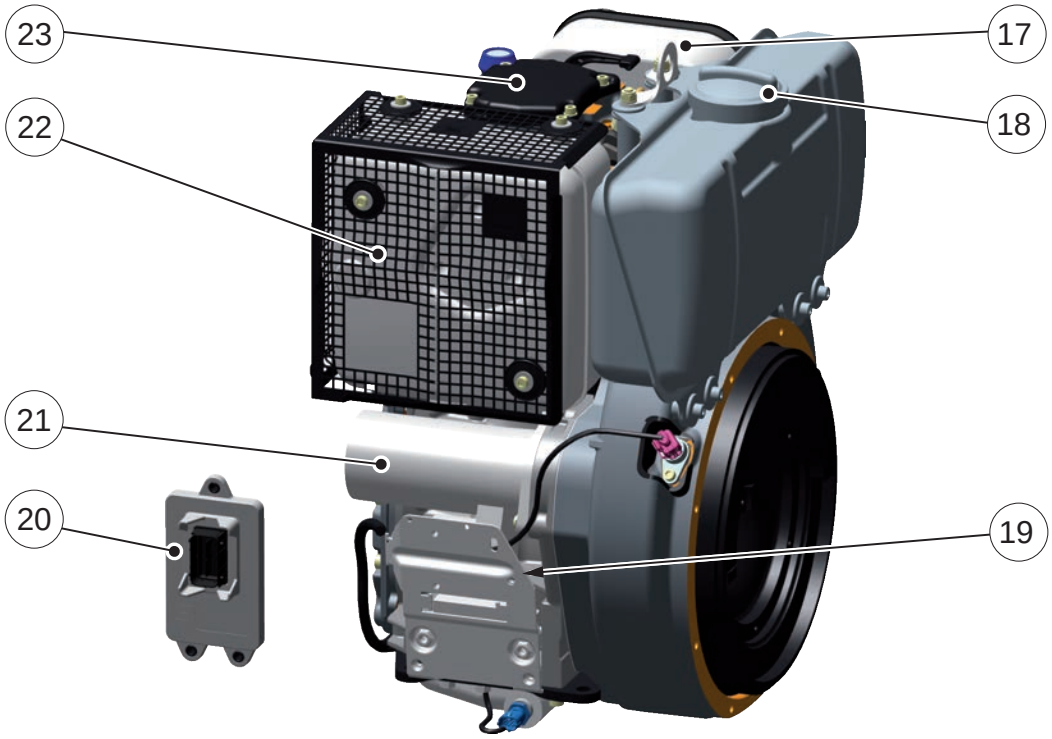
6.2 Version - electronic engine control

Intake side – 1D90E



1	Decompression lever
2	Air filter maintenance indicator (option)
3	Coolant air outlet
4	Intake opening for cooling air
5	Guide sleeve for starting handle (in model with emergency hand start system)
6	Oil filter (option)
7	Main fuel filter
8	Oil drain screw (front)
9	Oil drain screw (side)
10	Electric fuel pump
11	Oil filling opening and dipstick
12	Type plate
13	Fuel prefilter
14	Water separator
15	Intake opening for combustion air
16	Dry air filter

Exhaust side – 1D90E



17	Lifting eye
18	Fuel cap
19	Voltage controller
20	Engine control unit
21	Starter
22	Silencer with contact protection
23	Cylinder head cover

7 Transport and packaging

7.1 Transport

Safety notes

⚠ WARNING

Danger of injury from improper lifting and transport.

Danger of crushing from the engine falling or tipping.

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

⚠ CAUTION

Only use the lifting eye for transporting the engine.

Do not use for lifting the entire machine.

⚠ CAUTION

Danger of injury from overloading the body.

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

- Only lift the machine with a hoist.

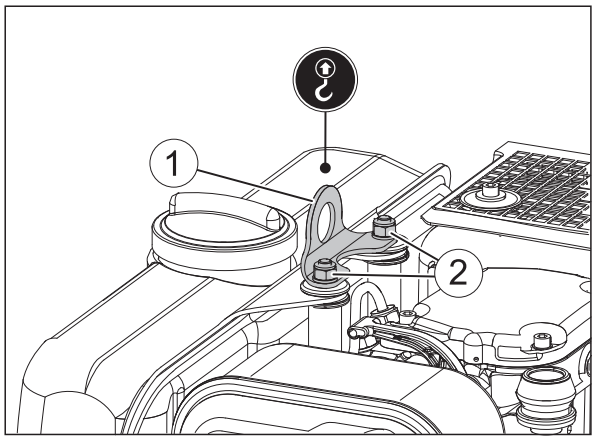
NOTICE

Danger of environmental damage from leaking fluid.

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

- Only transport the machine in an upright position.

Overview – lifting eye (standard model , 1D90E)

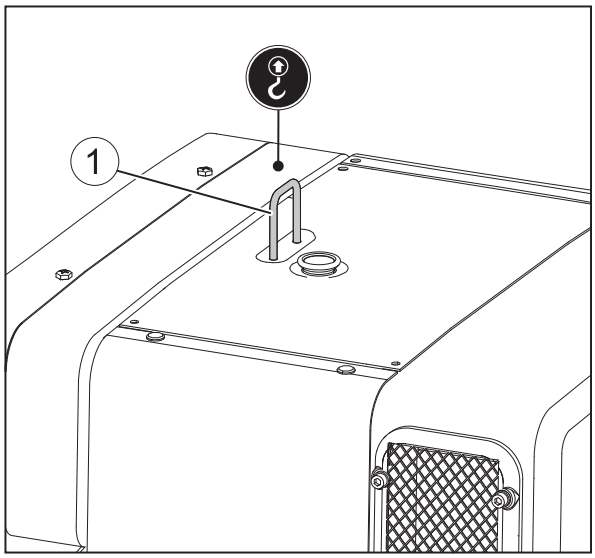


1	Lifting eye (lifting point)
2	Fastening nuts for lifting eye

Procedure

Step	Activity
1	Ensure that the lifting eye (1) is not damaged.
2	Ensure that the fastening nuts (2) are tight. Then lift the engine.

Overview – lifting eye (encapsulated model 1D81C)



1	Lifting eye (lifting point)

Procedure

Step	Activity
1	Ensure that the lifting eye (1) is not damaged. Then lift the engine.

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 or **www.hatz-diesel.com**.

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 and oil filter.
3	Change the fuel filter.
4	Let the machine cool down.
5	Remove the battery (if present) in accordance with the Operator's Manual for the machine and store at ambient temperature. Comply with the local regulations as well as the regulations of the battery manufacturer for the storage of batteries.
6	Close and seal all engine openings (air intake openings, air outlet openings and the exhaust gas opening) so that no foreign bodies can enter, but a small amount of air can still be exchanged. This avoids condensation.
7	After the machine has cooled down, cover it to protect it against contamination, and store it in a dry and clean place.

*FAME = Fatty Acid Methyl Ester

Ambient conditions during storage

- Max. permissible storage temperature: -25 °C to +60 °C

- Max. permissible humidity: 70%
- Protect the engine from direct sunlight

Recommissioning

Step	Activity
1	Remove all covers.
2	Check the cables, hoses and lines for cracks and leak tightness.
3	Check the engine oil level.
4	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 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.

8.2 Engine support/installation

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

Generally, flexible mounting of the engine should be aimed at. In addition, the engine should be uniformly loaded; see *8.6.3 Uniform bearing load, page 59*.

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

8.3 Rigid engine support on frame

Rigid fastening can only be allowed up to an engine speed of approx. 2,300 to 2,600 rpm. At higher speeds, the free mass forces are so large that a flexible support is recommended. (Exceptions prove the rule)

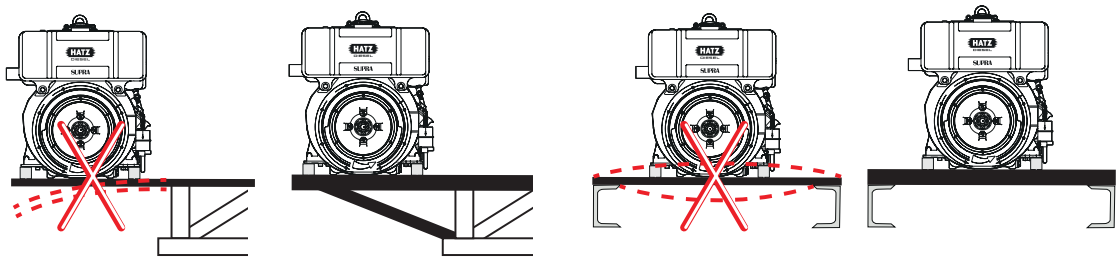
Important prerequisites for each engine fastening:

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.

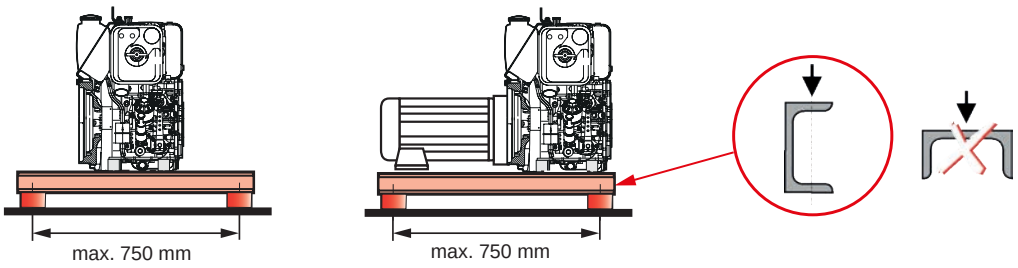
The following dimensions of the frame parts are sufficiently stiff for a rigid engine fastening (up to max. approx. 2300 to 2600 rpm):

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.

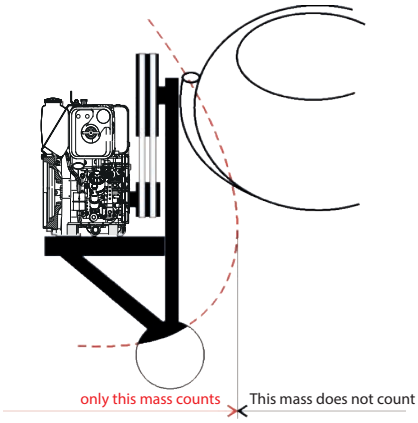


The dimensions recommended above for the rolled U profile only apply for vertically erected U profiles. The necessary stiffness is only achieved in this position.

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 1,500 to 2,000 rpm, the frame mass should be roughly as heavy as the engine mass.
- For engine speeds of 2,000 to 2,600 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.

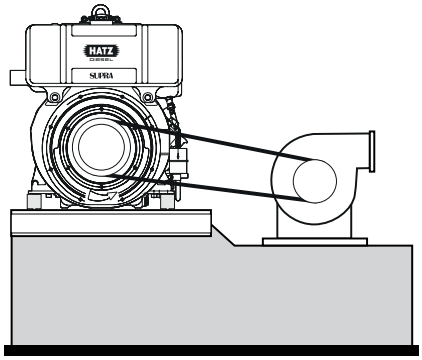


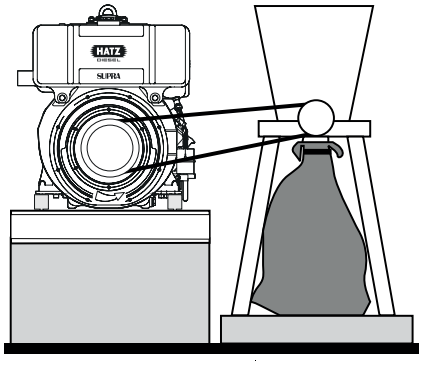
Only sufficiently large masses in the direct vicinity of the engine can prevent strong vibrations and possible material breakage.

8.4 Rigid engine support on foundation

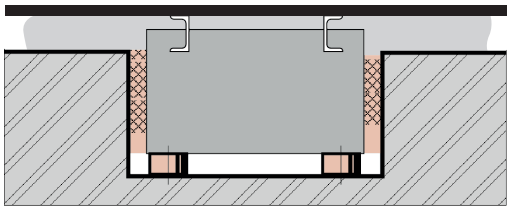
Speed recommendation: Max. 2,300 rpm, although it would be better to operate it at a lower engine speed.

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.

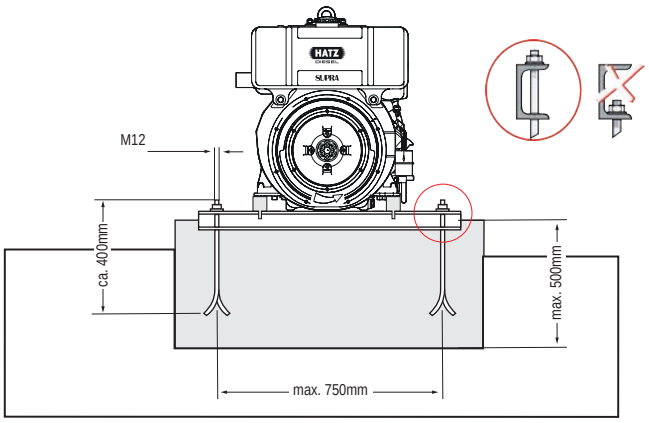


Building of the foundation must be commissioned with a construction company that provides a guarantee that the foundation is properly constructed. The foundation block is seated on ground with a sufficient load-bearing capacity.

If ground with a sufficient load-bearing capacity is not reached at the defined depth, the bottom of the foundation must be enlarged until its 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.

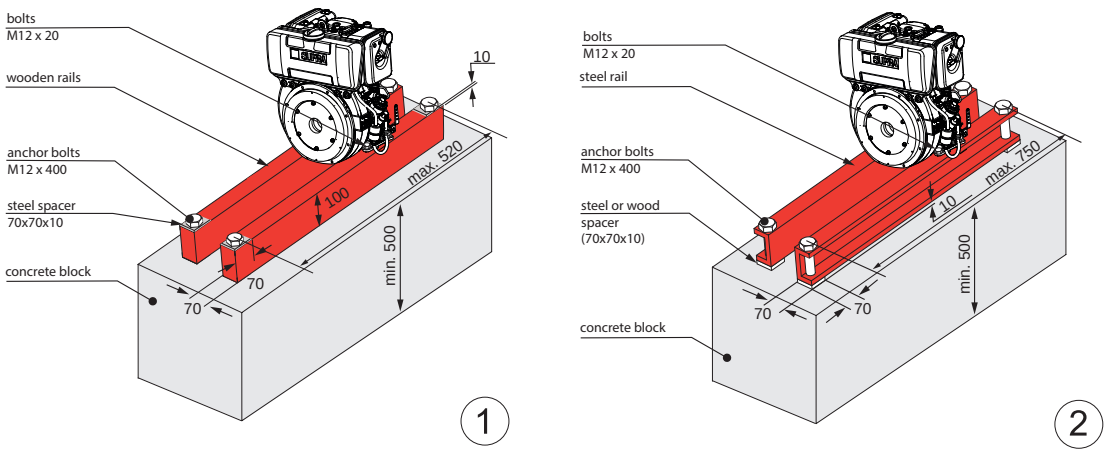
Summary:

- 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.

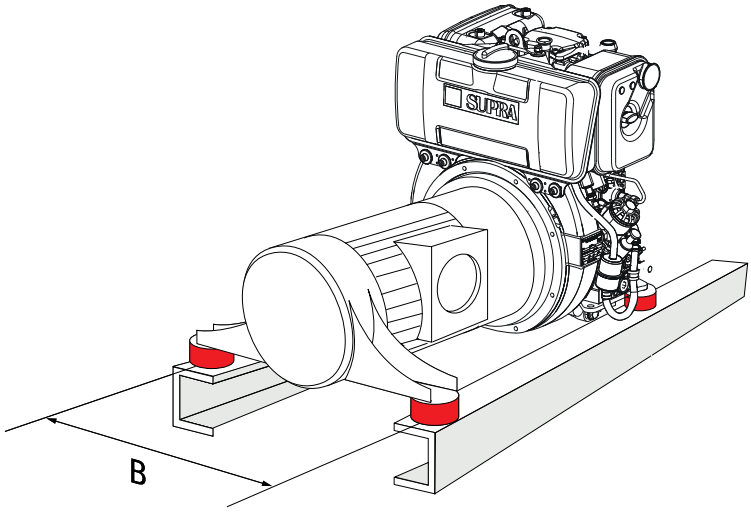
8.5 Flexible engine mounting

A flexible engine mount is recommended in general. For noise reasons too, a flexible mount can be advantageous because when rubber is used as a bearing element, no structure borne noise is passed on.

The following vibration dampers, see chapter *8.6.2 Flexible mounting, page 58*, have proven effective for the elastic engine mount.

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

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



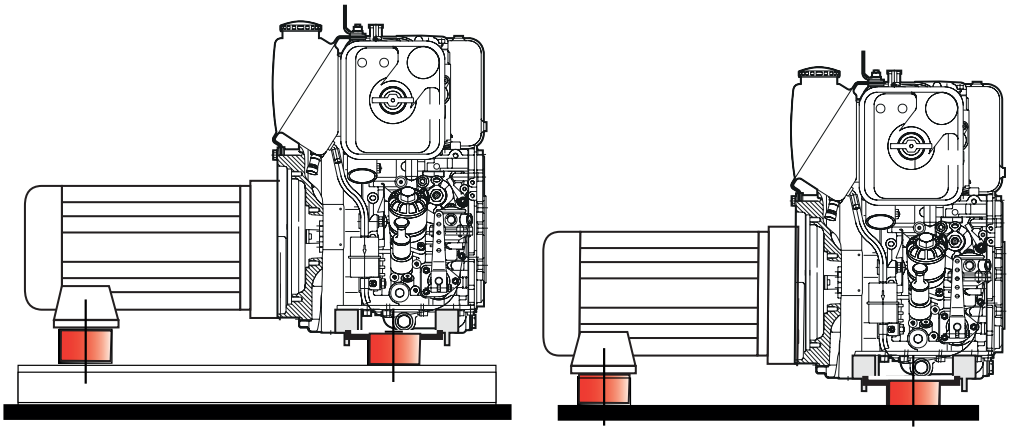
Depending on the type of machine with a flexible mounting, a decision must be made between a

a) **Flange-mounted** power take-off,

b) **Non-flange-mounted** power take-off and

a) Flexible mounting for flange-mounted force sensors

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.

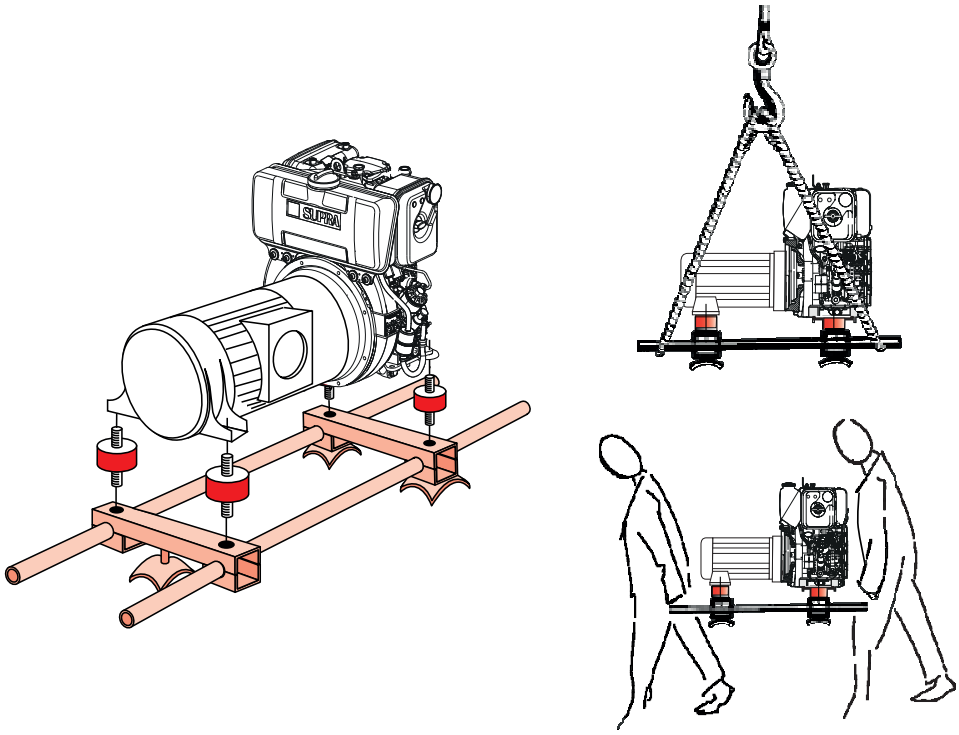


A U 80 profile (vertical) is adequate for the frame parts of a flexibly supported and flange-mounted force sensor, since the flange-mounted power take-off is stiff and cushioned by the rubber buffers. To stabilize the flexibly supported machine during the starting and coasting phases, stable rubber buffers must be used under the machine part with low vibration (e.g. generator).

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.



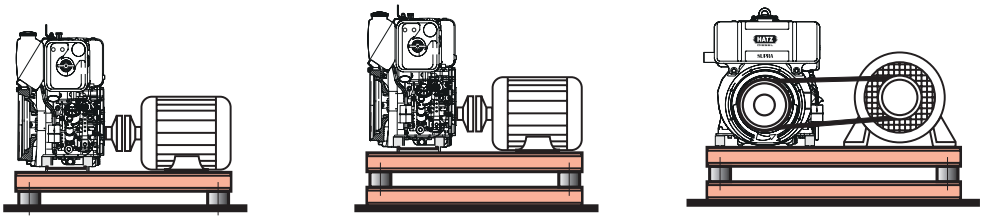
b) Flexible mounting for non-flange-mounted force sensors

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:

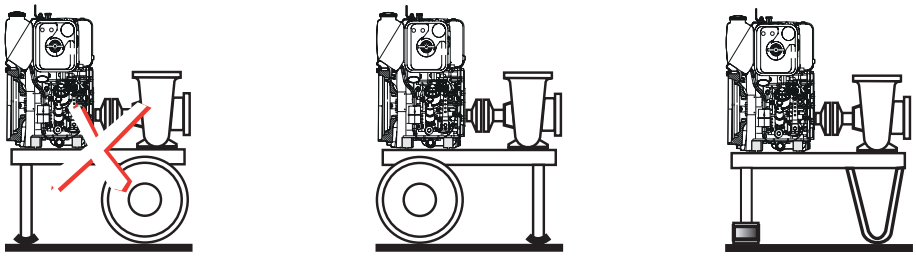
- For the top frame, on which a 1-cylinder engine is mounted:
  - U 80, vertical
- For the spring-loaded subframe:
  - U 80, vertical, for all numbers of cylinders

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.



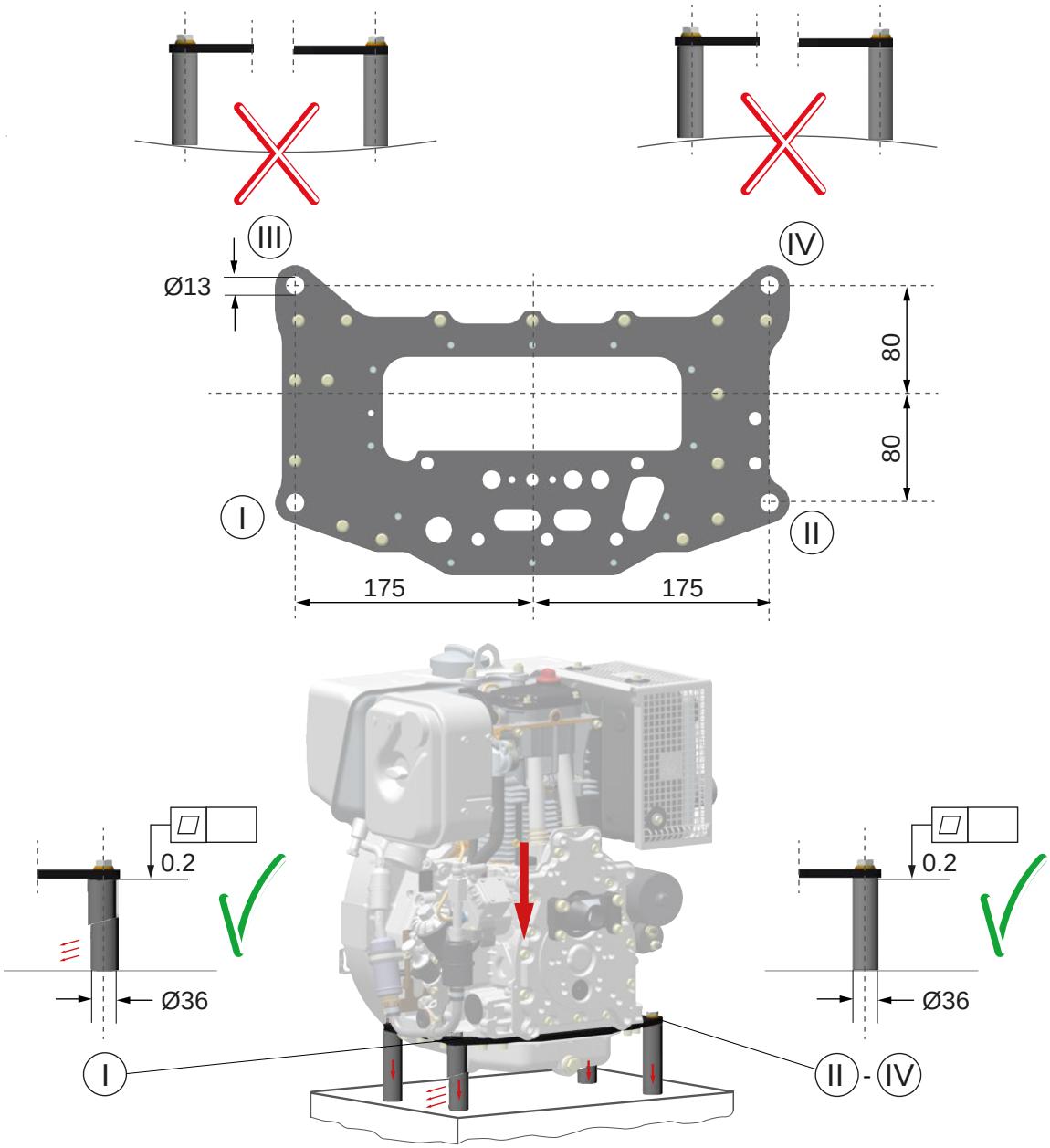
8.6 Stress-free fastening of the engine

8.6.1 Rigid engine suspension

CAUTION

Danger of injury and danger of engine damage if the engine is not mounted without stress

- If the engine fastening is rigid, the engine brackets with the baseplate must be set up in a stress-free manner (flatness tolerance of the contact surface must be 0.2 mm).
- The engine is not permitted to be mounted on painted surfaces.
- Non-observance can lead to a risk of injury, breaking of the engine brackets/baseplate, and thus engine damage.



In order for the engine to be installed absolutely free of stress, one of the spacer bushings (I) must be adjusted/aligned to the contact surface.

Action:

1	Place the bushings on the foundation at (II) to (IV).
2	Place the "adjustable" bushing pair on the foundation at (I).
3	Place the engine on the bushing.
4	Tighten the screws at (III) and (IV).
5	For (I), shift the bushings relative to each other to set the correct height so that there is no gap between the baseplate and the bushing*; the lower and upper bushings are in the same rotational position (indicated by the tangential surfaces on the bushings)
6	Tighten the screws at (I) and (II).

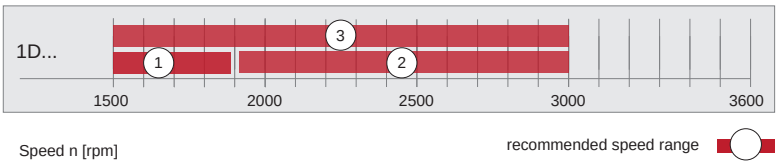
If the setting ranges are insufficient, use a spacer disk (not supplied by Hatz). The gap must be less than 0.2 mm.

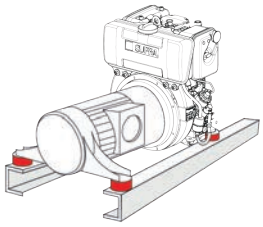
"Adjustable" bushings can electively be installed at (I), (II), (III) or (IV).

8.6.2 Flexible mounting

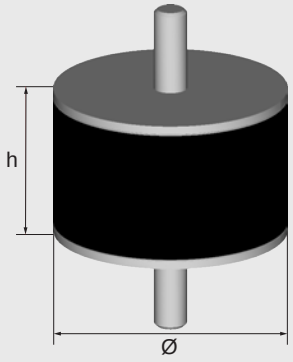
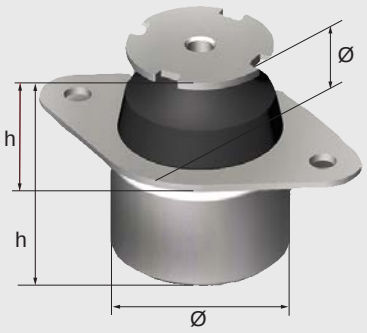
Recommendation for cylindrical rubber buffer for flexible mounting of stationary systems with vertical installation and use of four anti-vibration pads per system. See also chapter *8.5 Flexible engine mounting, page 53*.

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	503868xx	Cylindrical rubber buffer	50	45	55
2	503867xx	Cylindrical rubber buffer	50	45	40
3	503236xx	Hydro mount V600	64/88	32/91	45

Cylindrical rubber buffers (1,2)	Hydro mount (3)
	

NOTICE

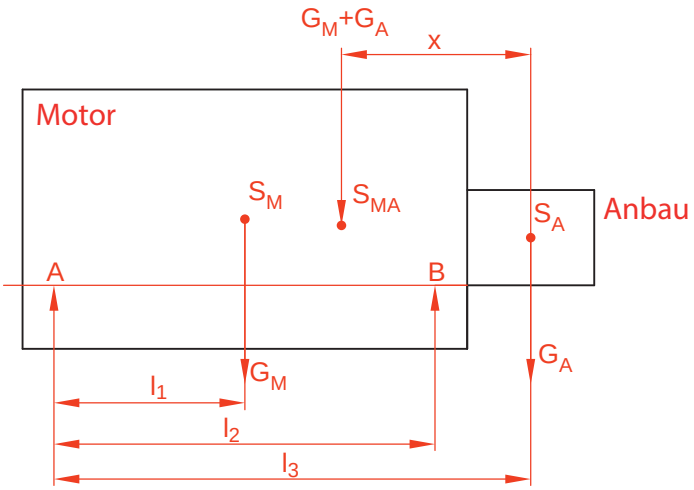
Depending on the application, the device manufacturer must define and set up the installation of the engine together with the appropriate vibration dampers.

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.

8.6.3 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)



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

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

Abbreviation	Meaning
S_M	Center of gravity of engine
S_A	Center of gravity of attachment (e.g., hydraulic pump, 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]

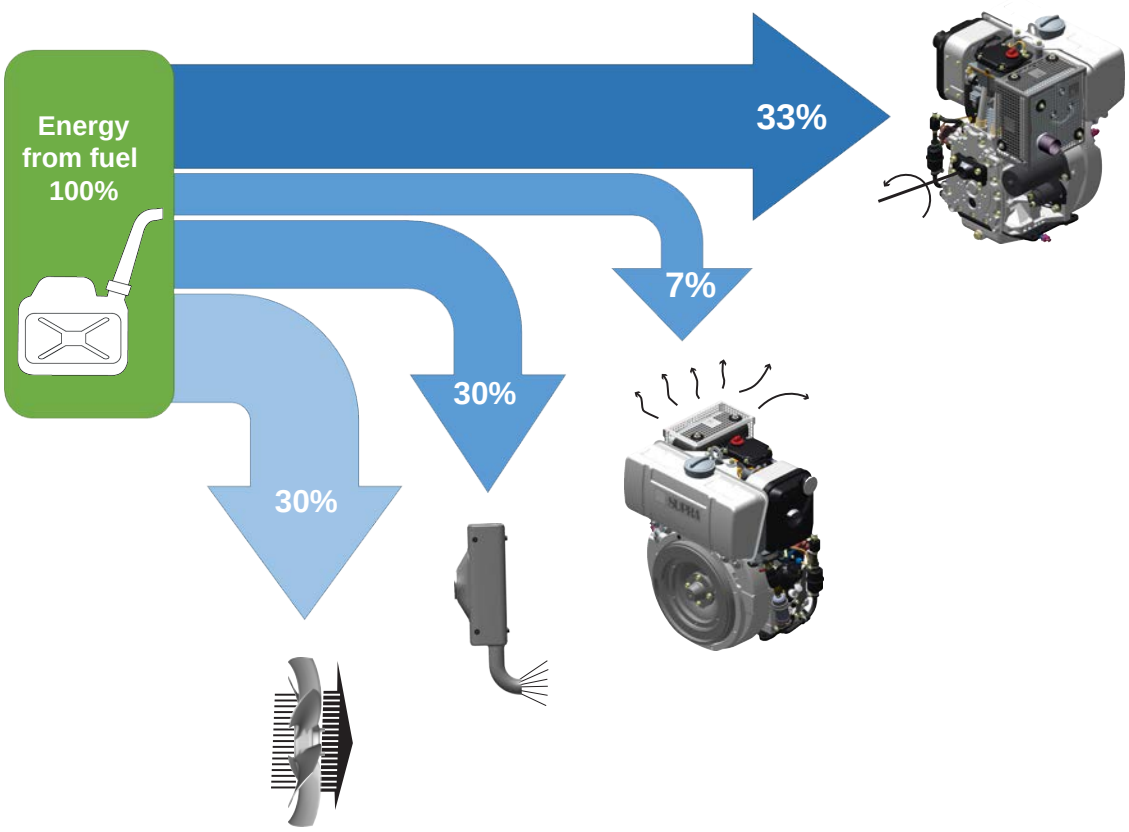
For the position of the overall center of gravity (engine with attachment):

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

8.7 Energy balance

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

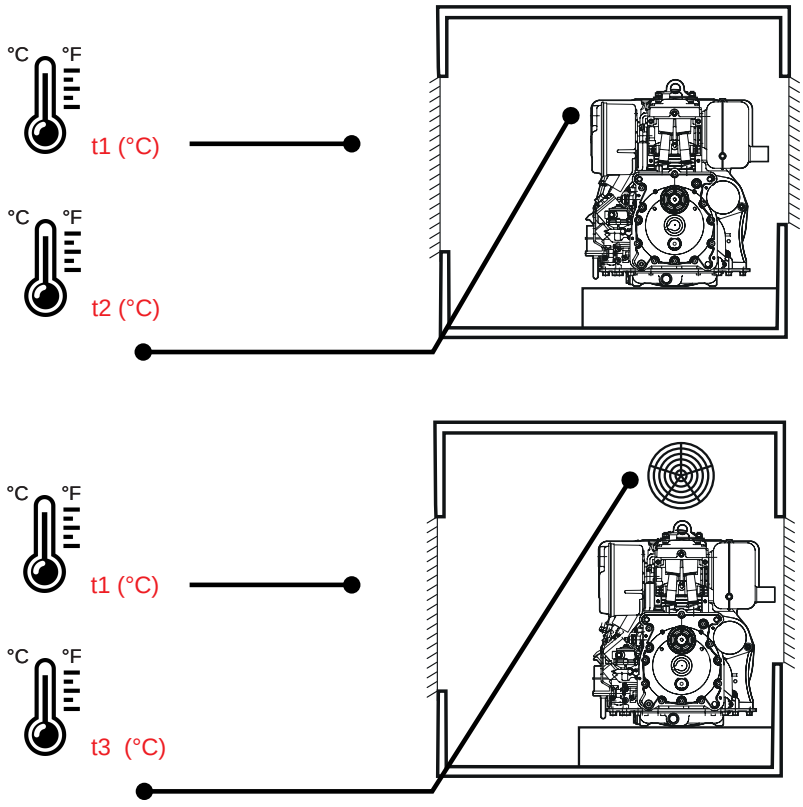


8.8 Installation of engines under a cowling

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 cover 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.



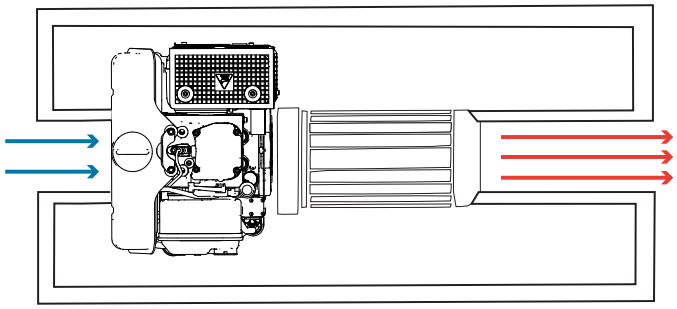
A temperature increase, of course, overrides the normally applicable temperature limits. This means that at a temperature increase between the outside air and the intake air of 8 to 10 °C, the engine can no longer be operated up to the ambient temperature of +45 °C but now only up to approx. 35 – 40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

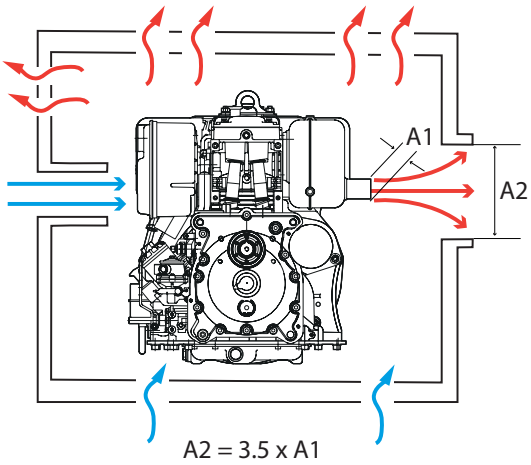
Installation recommendation:

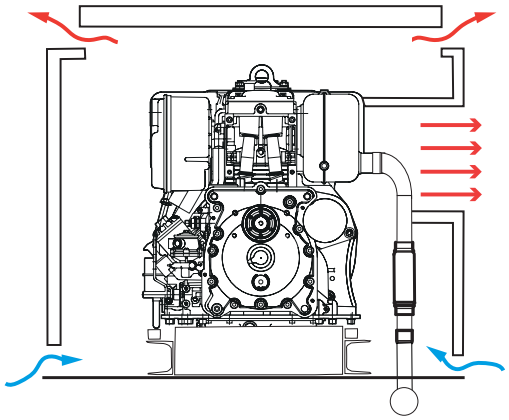
- **Engine installation in the vicinity of the supply air or exhaust air openings**

The cooling air intake and combustion air openings of the engine must overlap with the measured cutouts in the cover. 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 cover should have guide plates.

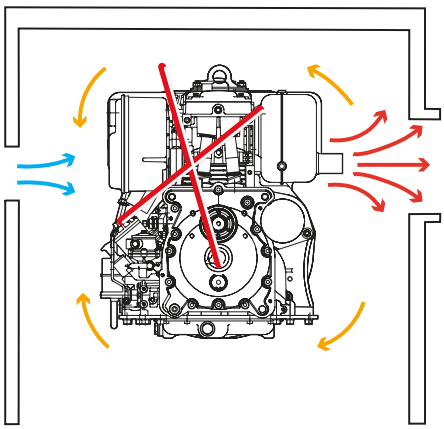


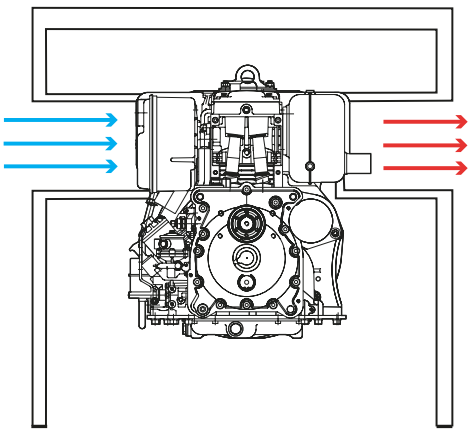


The openings for the radiation heat must be arranged in such a way that a chimney draft occurs that carries away the heat energy. Exhaust silencers must be installed outside of the cover and the exhaust pipe must be routed along the shortest possible path out of the cover. The radiation heat of the driven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

- **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.

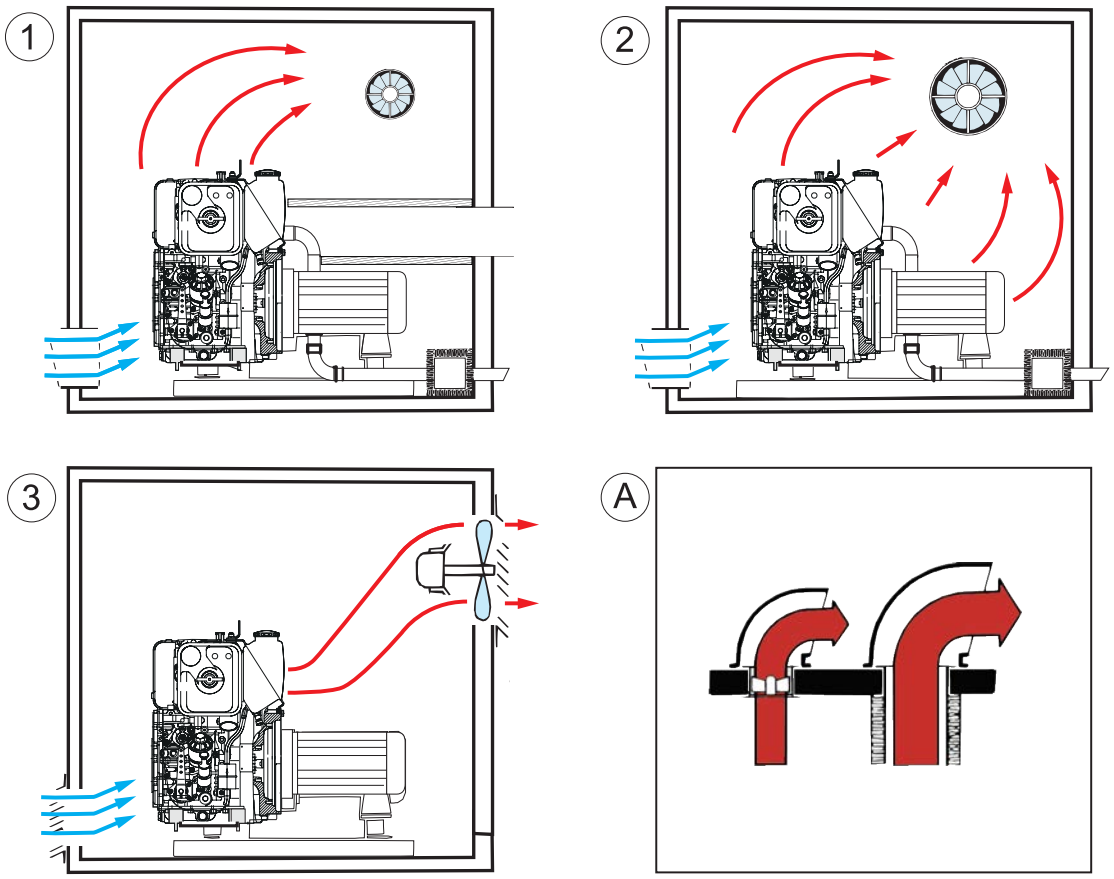
Hatz offers **SILENT PACK**, a fully assembled noise reduction canopy. If you wish to install engines in noise reduction canopies yourself, please contact **Hatz Ruhstorf** if necessary.

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 pipe** is routed to the outside over the shortest possible distance and is **heat insulated**.



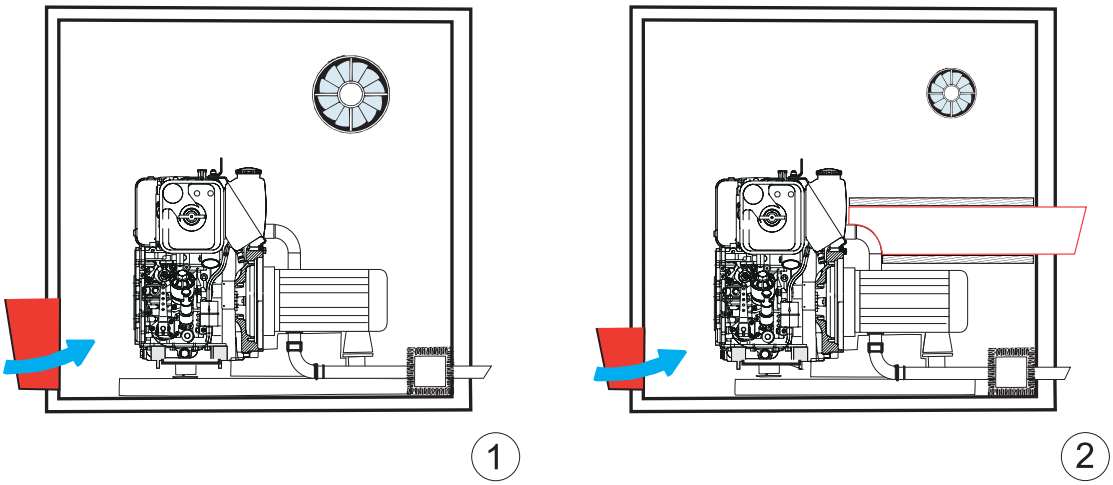
The **outlet openings** of the air outlet ducts and the exhaust air fans must always be installed on the building side facing away from the usual direction of the wind. If wind blows into these openings, the air current will be blocked and the temperature level in the machine room will rise to impermissible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

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

Details on the dimensions of the space fans, supply air cross sections and exhaust pipes are described in the section *8.12 Exhaust gas system, page 77* and of air outlet ducts in section *8.9 Installing the engines in enclosed spaces, page 65*. 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.**

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 type	For engines WITH an air outlet duct (2)		
[mm] x [mm]		Ø [mm]		[mm] x [mm]		Ø [mm]
265 x 265	or	230	**1D42**	120 x 120	or	135
310 x 310	or	350	**1D50**	135 x 135	or	155
380 x 380	or	430	**1D81**	170 x 170	or	190
380 x 380	or	430	**1D90**	170 x 170	or	190
380 x 380	or	430	**1D90E**	170 x 170	or	190

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

At n = 2,300 rpm by the factor 0.9

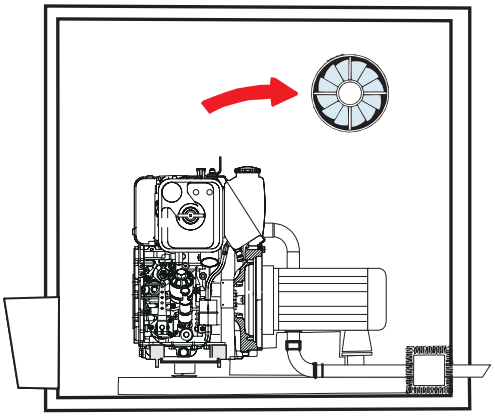
At n = 1,500 rpm by the factor 0.8

When grids are used in the supply air duct, the surface area must be increased by approx. ¼ 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.

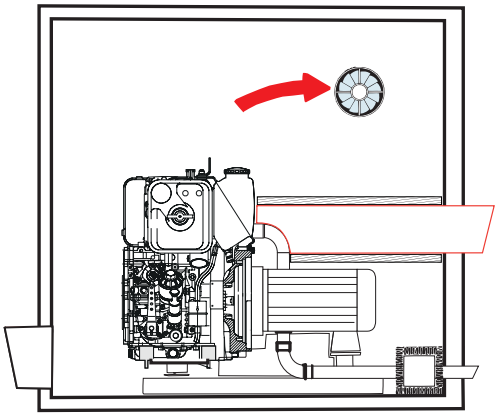
8.9.2 Guide values for the necessary minimum delivery rate of the exhaust air fan m³ per hour

Assumptions:

- Efficiency factor of driven machine: approx. 80%
- Temperature increase compared to ambient air: 10 °C
- Exhaust pipe and air outlet duct are thermally insulated



1



2

	For engines WITHOUT air outlet duct (1) at an engine speed of … rpm				Engine type	For engines WITH air outlet duct (2) at an engine speed of … rpm			
rpm	**1500**	**1800**	**2,300**	**Max.**		**1500**	**1800**	**2,300**	**Max.**
m³/h	1,300	1620	2130	2590	**1D42**	630	790	1040	1270
	1710	2130	2780	3470	**1D50**	840	1040	1360	1695
	2550	3150	3520	4860	**1D81**	1240	1540	1720	2370
	2780	3430	3845	5330	**1D90**	1360	1,670	1880	2600
	2780	3430	3845	5330	**1D90E**	1360	1,670	1880	2600

Approximate guide values for fans, dimensions

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%.

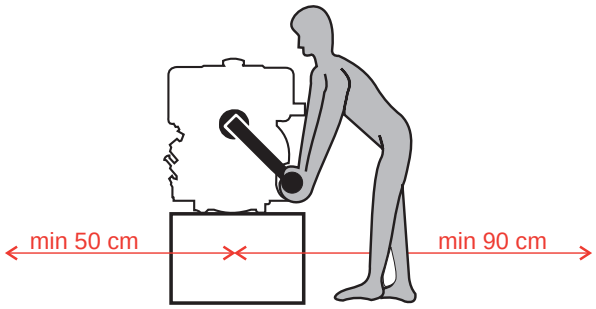
Delivery rate without back pressure [m³/h]	Ø [mm]	Power consumption [kW]
3000	300	0.2
5000	400	0.4
10000	500	1,0
18000	600	2.5
25000	680	4.0

8.10 Crankhandle start

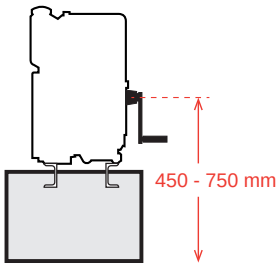
A hand start with a handcrank means that the machinery is started by a person. After the engine meets all of the requirements to ensure easy starting, it is also necessary for the driven machine to meet the necessary requirements so that it can be started with the limited physical power available to a person. See the warning labels and information signs on the engine in section *3.2.5 Labels, page 16*.

Please note the following recommendations:

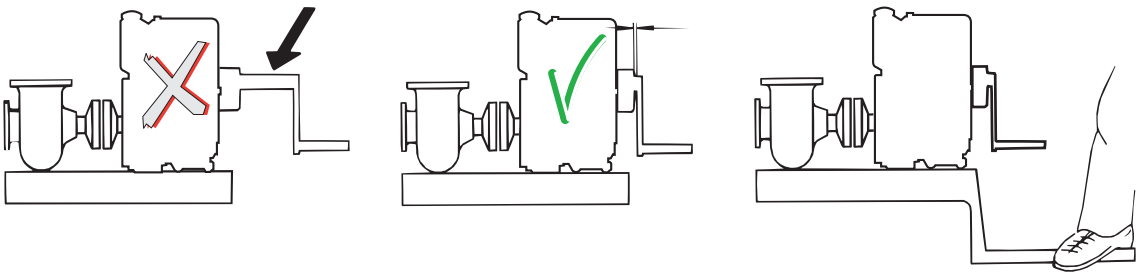
- The operator must have sufficient room for movement during the starting procedure. The movement of the entire body from head to foot must be taken into account, not just the movement of the hands. When starting the engine with the crankhandle, the crankhandle must be able to move freely in the sense of rotation.



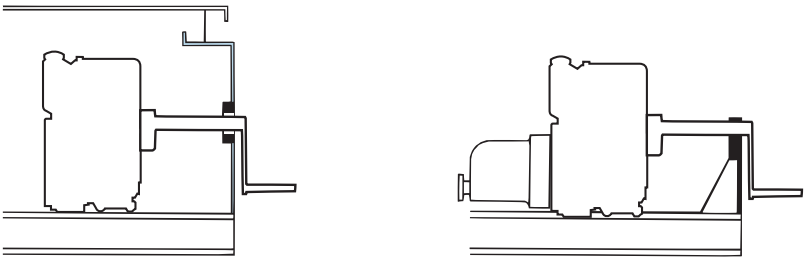
- The best height for the crank pivot point is at approx. 450 to 750 mm. The larger the displacement of the engine, the more important it is to maintain this recommended height. Below this pivot point height and above 1 m, the conditions for the operator become much more difficult. A platform must be available for heights greater than 1 m.



- In particular, lightweight machines, machines on very flexible supports and machines that are not fixed in place (e.g. single-axis machines) need a food pedal to ensure that they are not raised up or shifted sideways when overcoming the compression point.



- Crank handles require good guidance for safety reasons. Longer crank handles require an additional support for safe cranking. As a rule, the crank should be as short as possible as this will keep the leverage effect on the crank guide (attention: increased friction) low.



The European standard DIN-EN 200-1 (applies to movable road construction machinery) defines special safety requirements for the crankhandle start and describes the safety criteria.

EN 500 is also a component of the European Machinery Directive 2006/42/EC.

HATZ has a crankhandle with kick-back damping available for devices with crankhandle start that are subject to the European Machinery Directive.

	CAUTION
	Danger of injury if the crankhandle recoils or turns with the engine. ▪ The use of crankhandles without recoil damping is not permissible within the European Union.

8.10.1 Emergency hand start 1D90E

	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, 1D90E, 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 V
  - 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 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. ▪ Only refuel when the engine is switched off and has cooled down. ▪ Never refuel in the vicinity of open flames or sparks that can cause ignition. ▪ Do not smoke. ▪ Do not spill fuel.

	CAUTION
	Danger of engine damage from low quality fuel. The use of fuel that does not meet the specifications can lead to engine damage. ▪ Only use fuel that is very low in sulfur or that contains no sulfur at all. ▪ The use of fuels that do not meet specifications require approval by Motorenfabrik HATZ (main plant).

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

Metal-sheathed fuel lines are not permitted either.

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

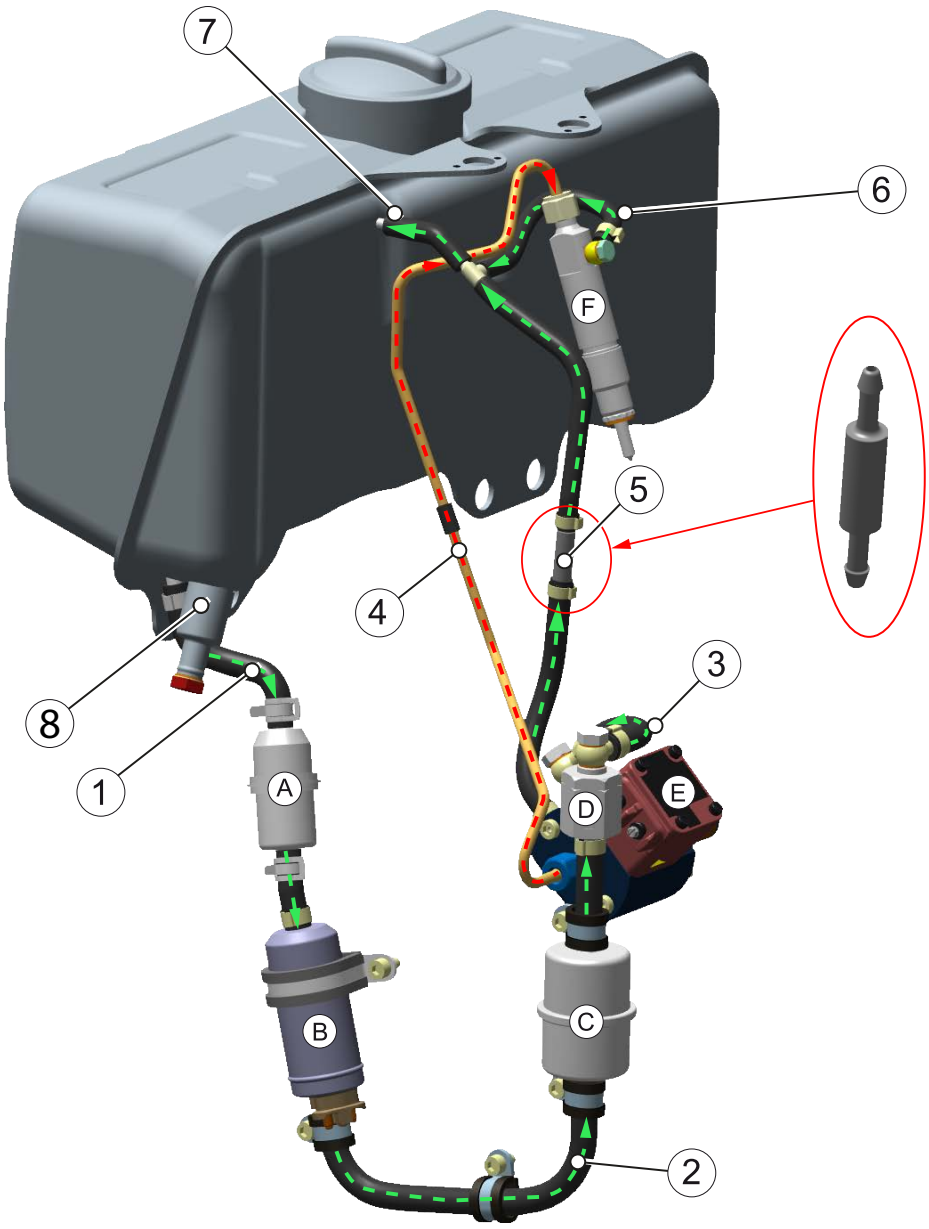
- Zinc ions lead to accelerated clogging of the injection holes in the injectors.
- Copper acts as a catalytic converter and massively lowers the fuel oxidation stability in combination with the FAME (**F**atty **A**cid **M**ethyl **E**ster) content in modern fuels of up to 7 %. This also causes injection 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 1D90E

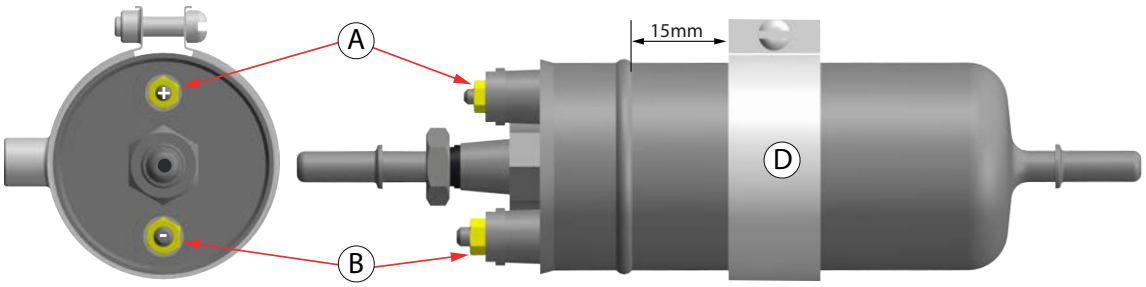


1	Fuel prefilter infeed		
2	Main fuel filter infeed		
3	Injection pump infeed		
4	Fuel pressure tube		
5	Injection pump return feed + check valve		
6	Injector return feed		
7	Tank return feed		
8	Water separator		
A	Fuel prefilter	D	Check valve
B	Electric fuel pump	E	Injection pump
C	Main fuel filter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

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



Tightening torque connections for electrical fuel pump 12 V	
A (M4)	1.4 Nm
B (M5)	1.6 Nm

CAUTION

Attaching the fuel pump with fastening clamps

The fuel feed pump is mounted with a centered fastening clamp (D). If 2 clamps are used for fastening, a distance of approx. 15 mm must be maintained to the rib.

NOTICE

On the intake side of the fuel pump, the screen insert must be removed because problems can occur due to the higher viscosity of diesel fuel at low temperatures. It is replaced by a special fuel prefilter (A) installed in the infeed line upstream of the pump.

NOTICE

Never run the tank empty if possible, as otherwise air can enter the fuel system. This can lead to damage to the injection system.
If the tank is still run empty, proceed as follows:

- Fill the fuel tank with diesel fuel.
- Vent the fuel system.

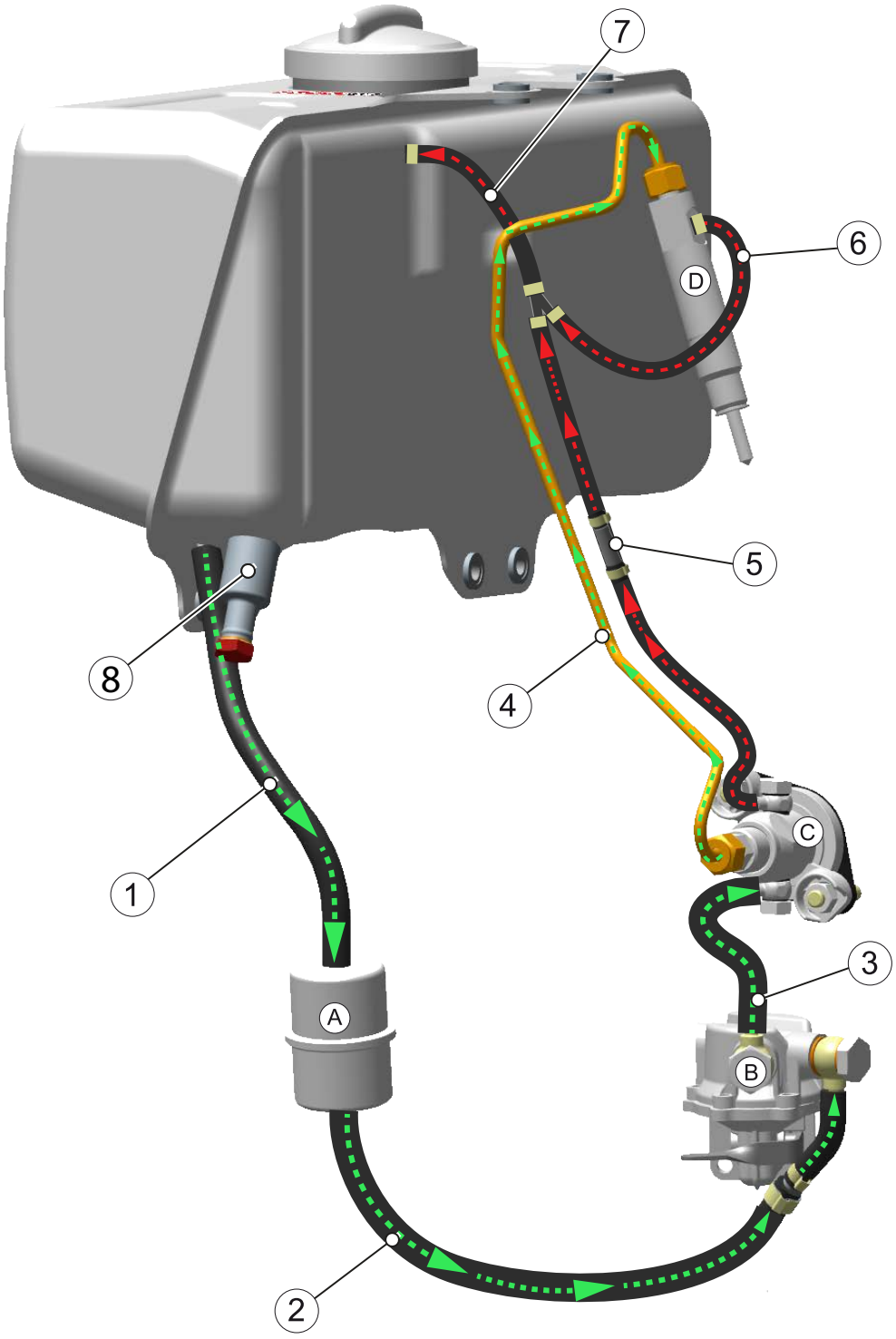
Fuel system ventilation

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. For 1D90E, the fuel prefilter is already mounted at the factory.

8.11.4 Fuel scheme 1D42/1D50/1D81/1D90



1	Main fuel filter infeed	5	Injection pump return feed + check valve
2	Delivery pump infeed		
3	Injection pump infeed	6	Injector return feed
4	Fuel pressure tube	7	Tank return feed
A	Main fuel filter	C	Injection pump (IP)
B	Delivery pump (optional) [1)]	D	Injector

[1)] *Only if the tank is lower than the IP.*

NOTICE

- 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

Fire hazard from fuel.

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

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

CAUTION

Danger of environmental damage from spilled fuel.

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

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

NOTICE

- 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.

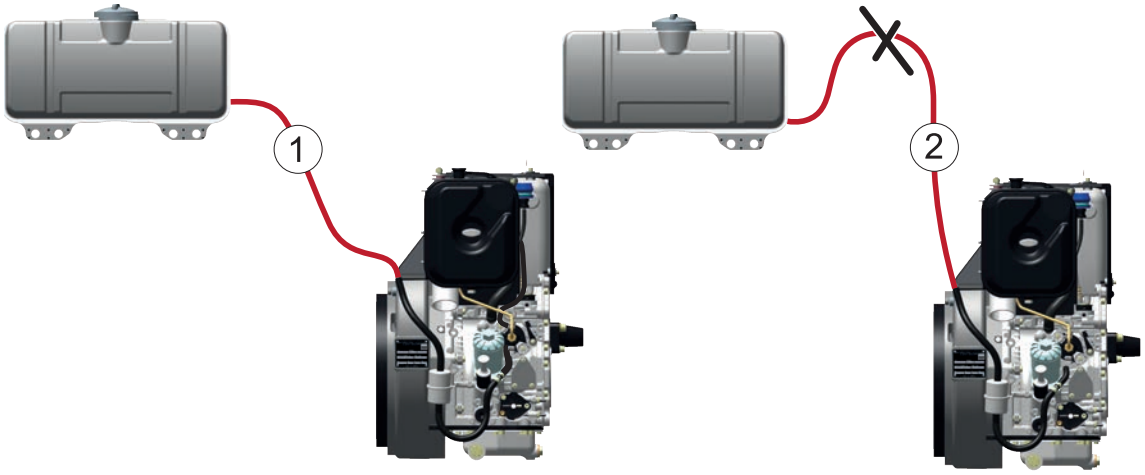
When an external fuel tank is installed, make sure that it does not have any processing residues, impurities, water etc.

A discharge port must be 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.

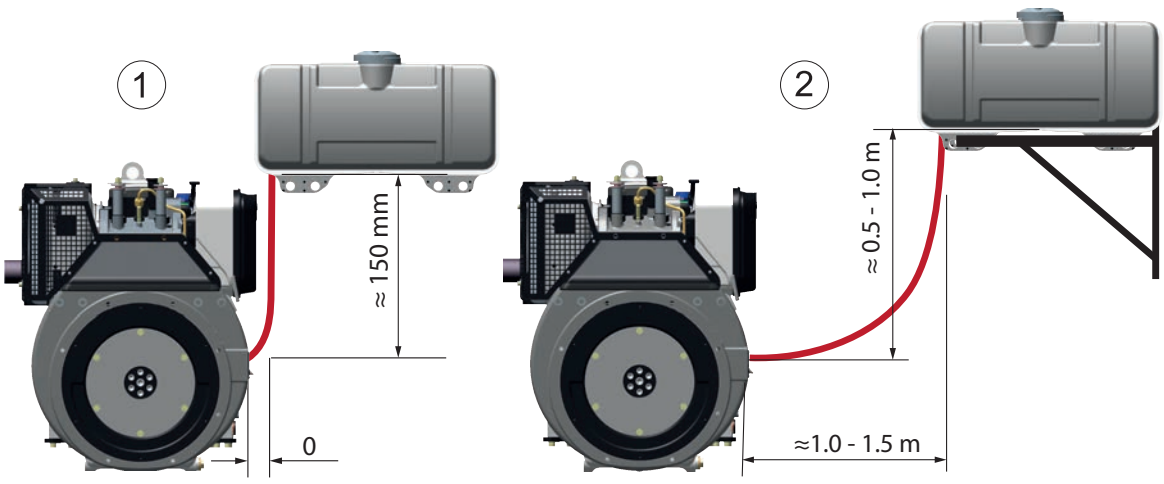
Fuel lines for external fuel tanks

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 upside-down U (2).



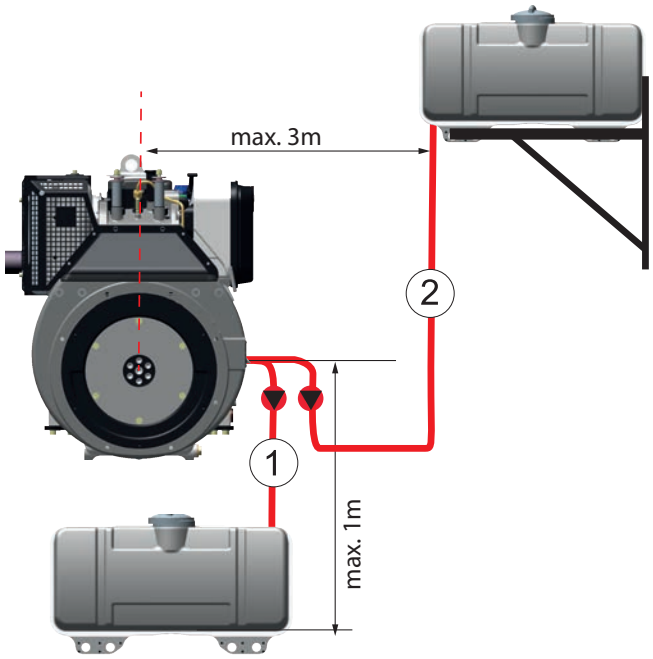
If the fuel tank is installed on the wall and not at the engine, a gradient of 0.5 – 1.0 m must be maintained to overcome the line resistance. If the fuel tank is in the immediate vicinity of the engine, a gradient of approx. 150 mm between the tank outlet and the injection pump is usually sufficient.

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 for1D90E) 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

Danger of injury from hot exhaust gas system.

Hot surfaces on the entire exhaust gas system can lead to serious burn injuries.

- Keep explosives and flammable materials away from the engine.
- Attach safety devices.
- Wear safety gloves.

NOTICE

The machine manufacturer is obligated to ensure that all safety precautions have been taken in the complete machine so that injuries from hot surfaces can be ruled out.

The safety devices are available from HATZ. See chapter Contact protection for machine safety.

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)
1D…	As for exhaust gas flange	75	100	270	343
1D90E		Values on request			

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

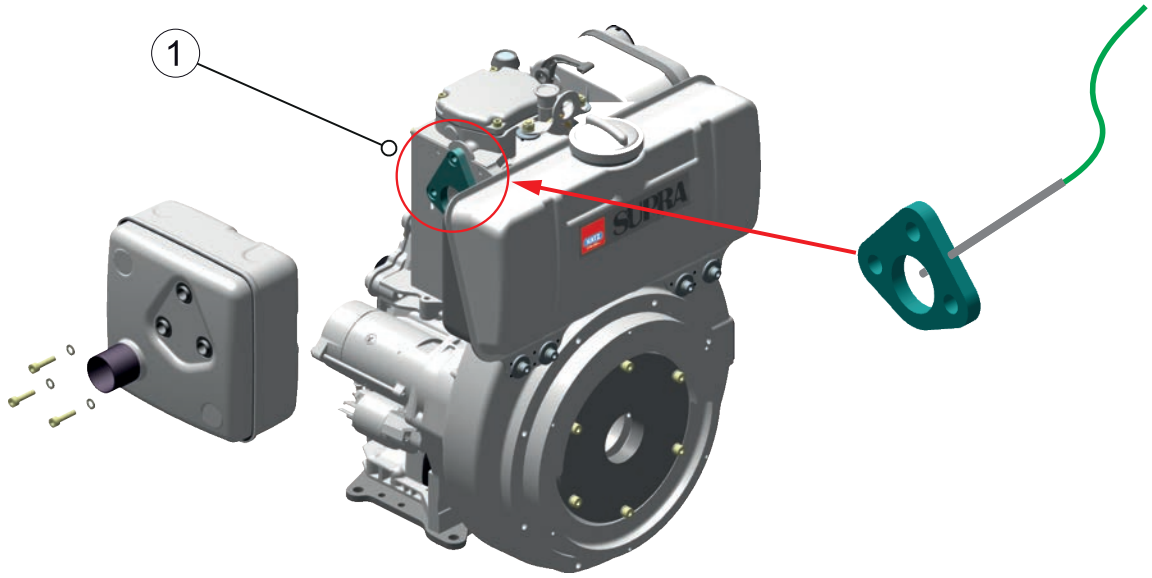
A bend from 45° shortens the permissible straight line length by one meter. If exhaust gas lines are installed on flexibly mounted engines, a flexible intermediate element must be installed in the line to absorb engine movements.

Wherever possible, this flexible intermediate element must be installed close to the fulcrum of the flexible mounting because this is where there 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 elbows 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 silencer.



The following values apply at max. power P[kW] and max. speed [min^{-1}]:

Engine type	Speed [min^{-1}]	Intake vacuum [mbar]	Exhaust gas back pressure [mbar]
1D42/1D50/1D81 1D90/1D90V	-	15	30
1D90E	**3000**	90	50
	2600	90	100
	1500	65	150

8.12.2 Exhaust mass flow rate

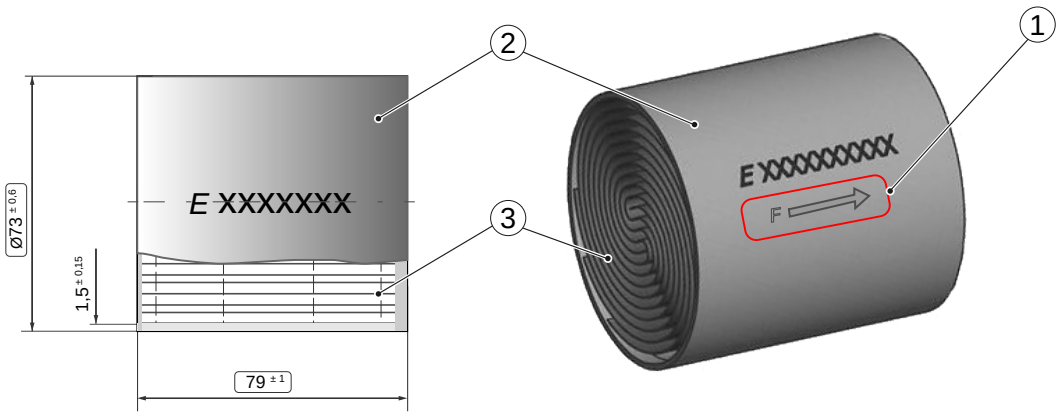
m [kg/h]	1500 [rpm]	1800 [rpm]	2300 [rpm]	3000 [rpm]	3600 [rpm]
1D42	27	32	41	54	64
1D50	31	37	48	63	75
1D81	40	48	62	81	97
1D90	47	56	72	93	
1D90E	44	52	67	88	

8.12.3 Diesel oxidation catalytic converter (DOC)

The engine 1D90E is equipped with a diesel oxidation catalytic converter as standard equipment. 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**.

Instructions for installation of the DOC in the silencer by the customer:

If the DOC is being installed by the customer, ensure that the DOC is installed in the right direction in the silencer, i.e. in the direction in which the exhaust gas flows as shown by the arrow (1) on the surface of the casing pipe. If there is no directional marking, the component can be installed in either direction.



Ensure that the DOC is welded tightly all around inside the silencer.

Penetration welding through the casing pipe (2) onto the matrix (3) must be avoided. The warranty becomes void if the metal foundations become damaged during processing.

Special attention must be paid to the following:

- Grease-free processing: contamination with grease, oil or tensides must be ruled out.
- Stress during handling must not lead to plastic deformations of the foundations. The warranty does not cover damage to the catalytic converter caused by improper operation of the engine and exhaust gas system, or faulty installation, dismantling or re-installation.

If you have any further questions on the installation instructions, please contact your nearest **Hatz service**.

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 information on oil specification and oil viscosity, see the **"Technical data - Engine oil" chapter of the Diesel Engine Manual.**For information on the **oil filling quantity,** see chapter *5.1 Engine information and fill quantities 1D42, 1D50, 1D81, 1D90, 1D90E, page 34*

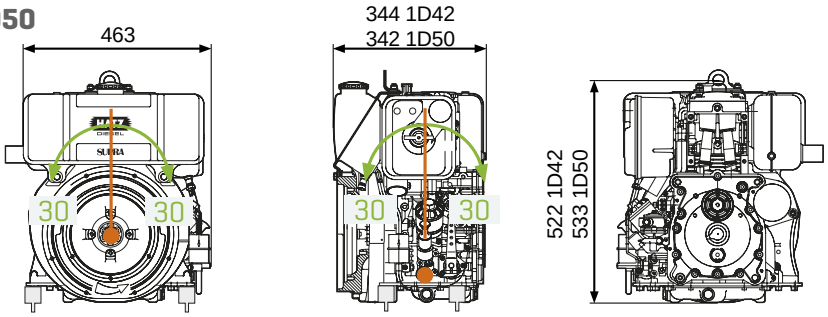
8.13.1 Engine oil service points

Information on the **service points for engine oil** is contained in chapter *13.1 Accessibility of service points, page 108*.

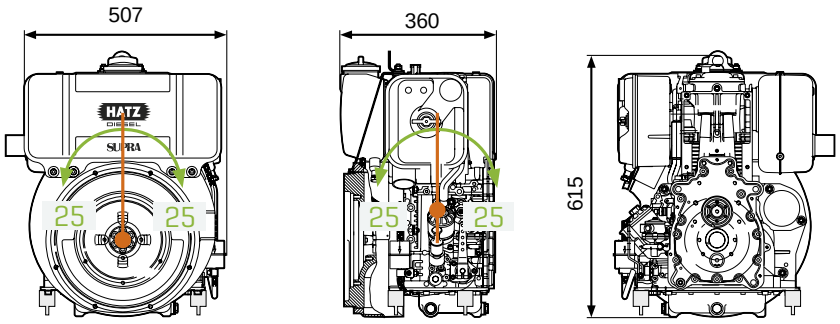
8.13.2 Continuous skewed positions

Dimensions and tilts

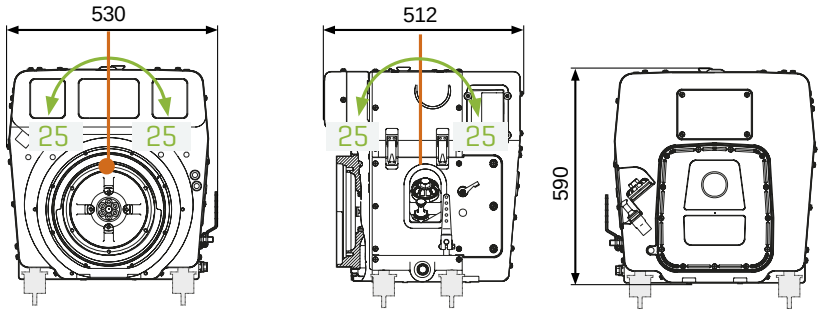
1D42 | 1D50



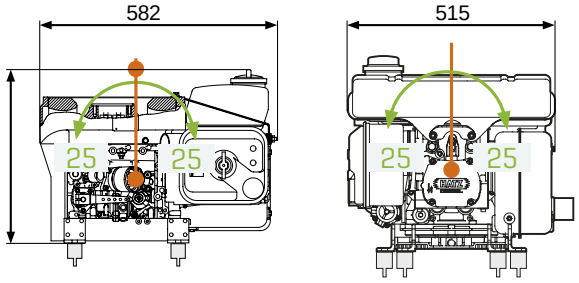
1D81 | 1D90 | 1D90E



1D81C



1D90V



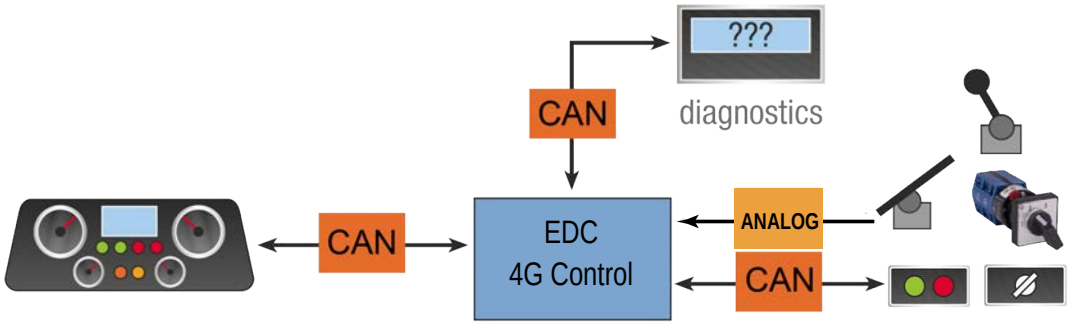
* Max. tilt position [°], dimensions [mm]

The engine oil capacity per type, delta min-max, is found under *5.1 Engine information and fill quantities 1D42, 1D50, 1D81, 1D90, 1D90E, page 34*.

9 Electrical system

9.1 Engine control

1D90E



Completely optional CAN control panel	Machine basic control
Speed check	**CAN** speed adjustment
Speed limiting	**Analog** speed adjustment ▪ Pedal/lever ▪ MSS (2-stage or 3-stage)
Vehicle speed check	**Engine start/stop:** ▪ CAN ▪ Ignition switch ▪ Digital input

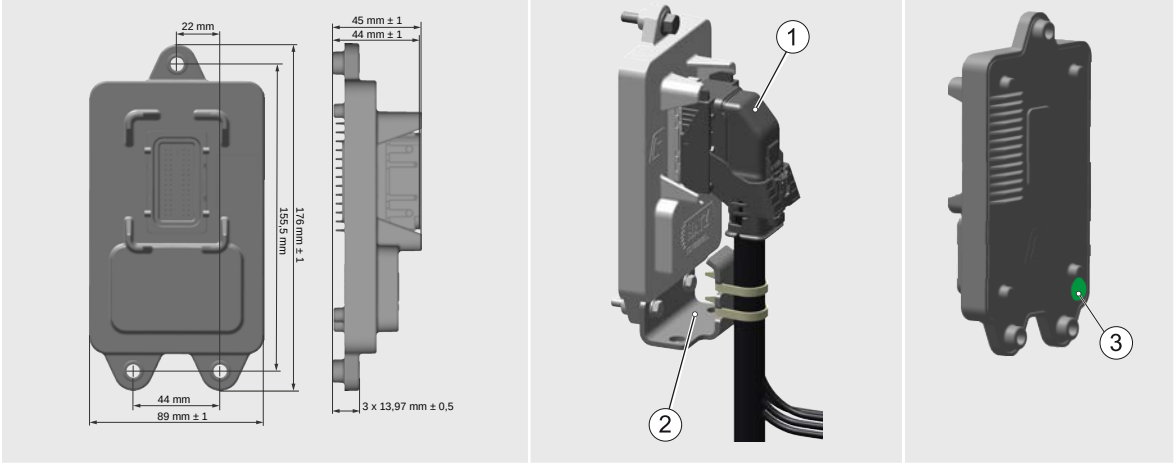
	NOTICE
	When using multiple CAN devices, the resistance between CAN-high and CAN-low must be 60 and 120 ohms.

9.1.1 Setup and installation conditions for control unit

After the control unit is installed (see installation conditions), 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 retension plate (2) with two cable ties (200x 4.8 mm) against pull and vibration forces.

Installation conditions of control unit:	
▪ Ambient temperature -40° to 85° ▪ Spray water protected ▪ Dust tight ▪ Heavy duty ▪ Vibration decoupled from engine separated	▪ Current consumption with ignition off: 2 mA ▪ Nominal voltage 12 V ▪ Permissible voltage range 6–18 V ▪ Installation is vertical as per the following figure



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

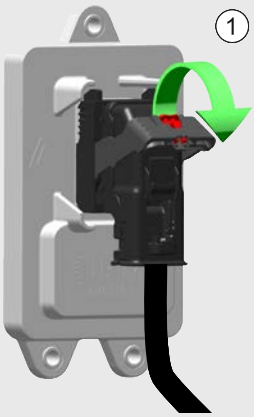
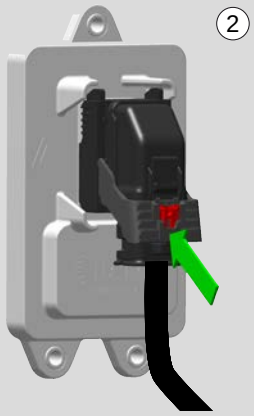
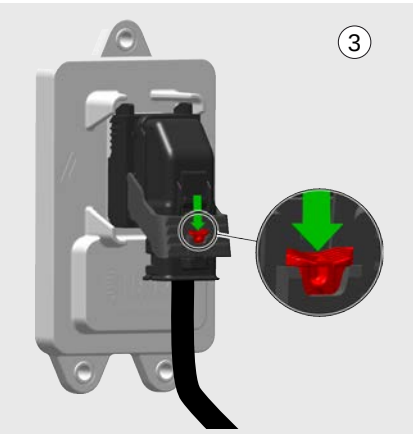
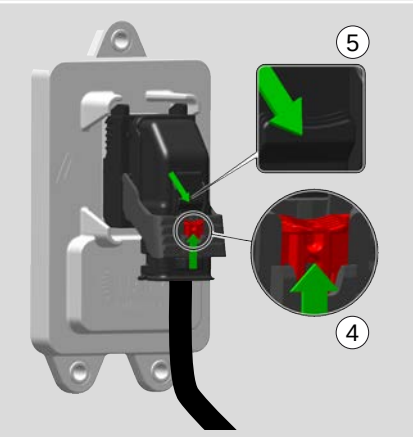
The installation in a vehicle must be executed in such a way that the control unit cannot collide with other vehicle parts or additional fasteners.

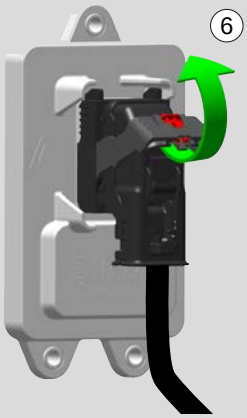
The control unit has been tested for mechanical stress due to shock as per **EN 60068-2-27** and for stress from vibrations as per **EN 60068-2-64**.

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.

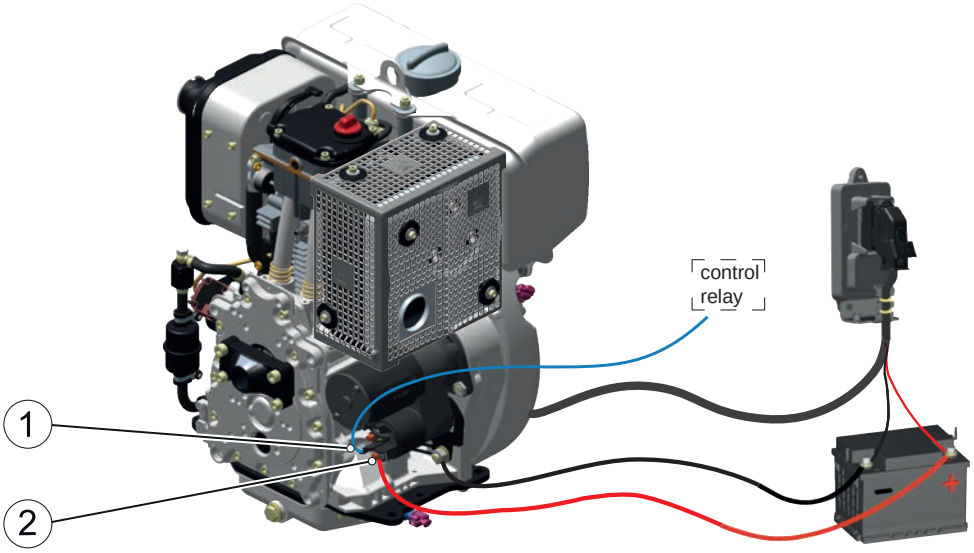
Connect the central connector with the wiring harness on the control unit:

1	Mount the central connector on the control unit. Pull the safety lever down while pressing on the connector lightly.	
2	Press the safety lever down all the way until a slight clicking noise is audible. **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.	
3	The central connector is fully closed by actuating the red lock in the direction of the arrow. **Note:** It must be ensured that the central connector is fully locked.	
4	The central connector can be unlocked by actuating the red lock in the direction of the arrow.	
5	To open the lever, press against the connector with a finger until a slight clicking noise can be heard.	

6	Push up the locking lever; the connector is now fully open again and can be disconnected from the control unit.	

NOTICE

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



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.

Before actuating the battery main switch, wait at least 30 seconds after "ignition off (ignition start switch)" to completely close internal processes in the control unit.

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
	DIGITAL
	▪ 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. The **HDS²lite** is available in addition to the desktop-based diagnostic system. It is connected via a Bluetooth adapter, app and smartphone or tablet. If necessary, please contact **Hatz service** or go to 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.)

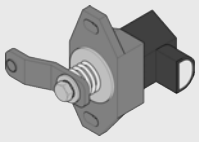
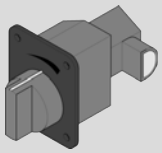
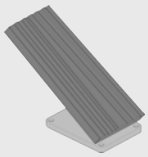
CAN protocol list E1: 05666700

CAN error list E1: 05666800

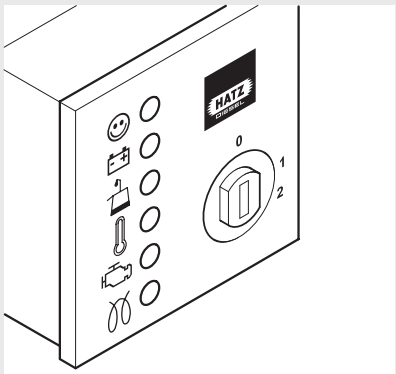
9.2 Engine monitoring

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 control		IP degree of protection
bowden cable (CAN/analog)		IP66
Rotary knob (CAN)		IP66
Pedal (CAN/analog)		IP69K
Manual lever (CAN/analog)		IP66
Stepped speed switch (optional 2 or 3 steps)		IP65

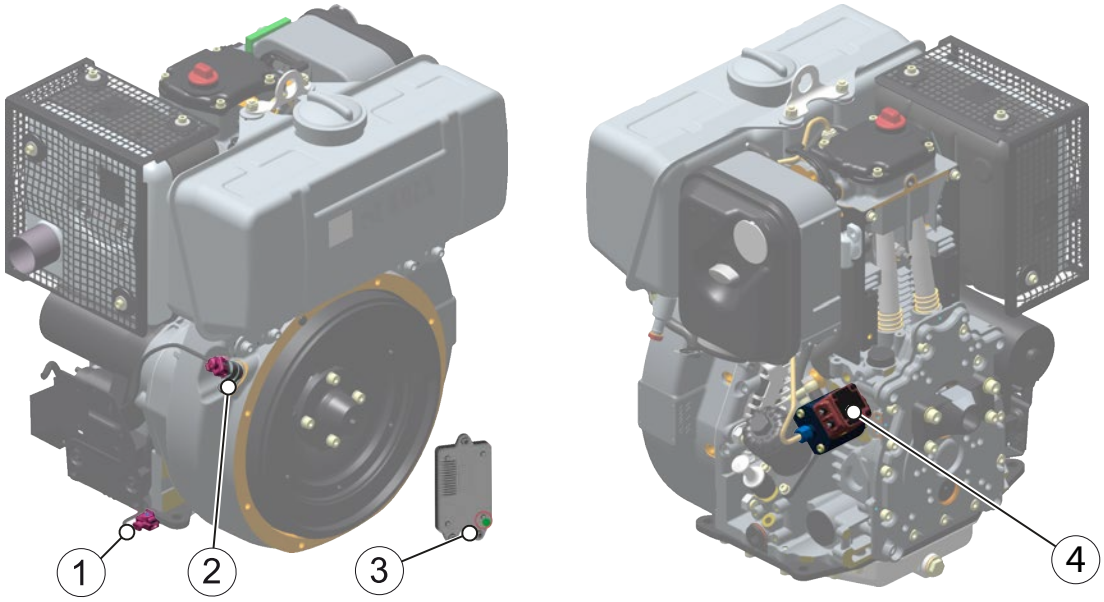
9.2.2 Overview – HATZ instrument boxes

Designation	instrument box	IP degree of protection	Use
Hatz instrument box (short) installed separately, with optical error display only. 12 V		IP65	1D90E
Hatz instrument box removed with pre-glow and automatic switch-off equipment. Optional with operating hours counter 12 V/24 V		IP67	1D42 1D50 1D81 1D90

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

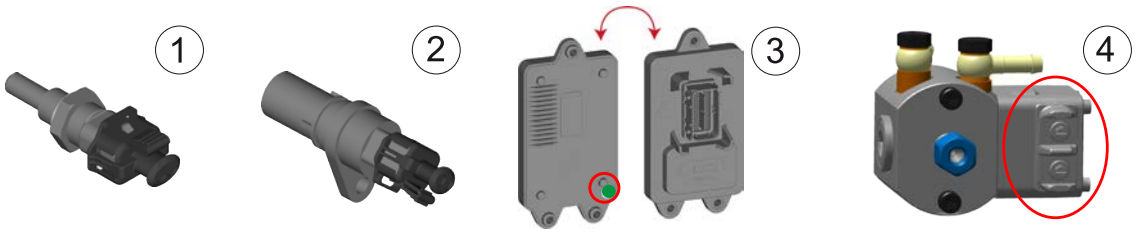
9.2.3 Overview of sensors and actuators

Installation position



Sensors	
1	Oil pressure and 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 plus (+) and negative (–) battery terminals.
- When installing the battery, first connect the **plus cable** and then the **negative cable**.
- When removing the battery, first disconnect the **negative cable** and then the **plus 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 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)]**
1D42/1D50/1D81	1.6 kW	88 Ah	640 A	700 A	395 A	450 A
1D90/1D90V/1D90E	1.6 kW	88 Ah	640 A	700 A	395 A	450 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**
1D42/1D50/1D81	2.5 kW	55 Ah	420 A	450 A	255 A	290 A
1D90/1D90V	2.5 kW	55 Ah	420 A	450 A	255 A	290 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

NOTICE

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

NOTICE

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

9.3.2 Installation location

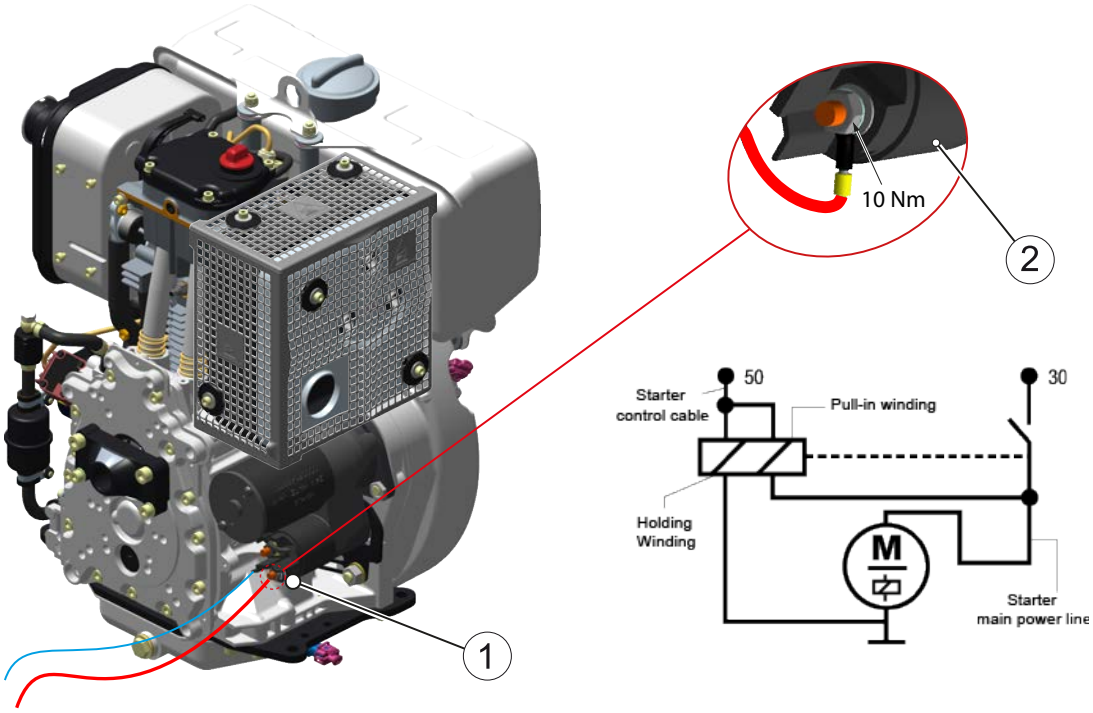
The positioning of the battery installation in the engine space must be verified by temperature measurements.

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



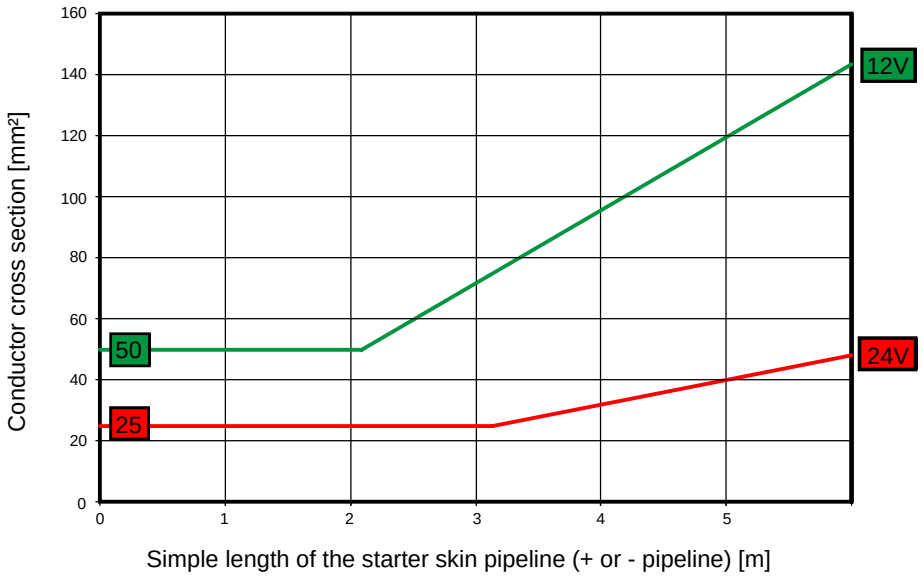
NOTICE
The hexagon nut M8 for fastening the starter line to the starter must be tightened with 10 Nm.

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

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. **45 A** in the pull-in winding and **10 A** in the holding winding). At the end of the pull-in path (starter pinion engaged in the sprocket), the main starter current is switched on (depending on the starter and condition, approx. **1050 to 1200 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



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

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 Hatz CAN bus control panel or CANarmatur, and mounted directly on the engine.

The IPB+ offers the following starter protection function:

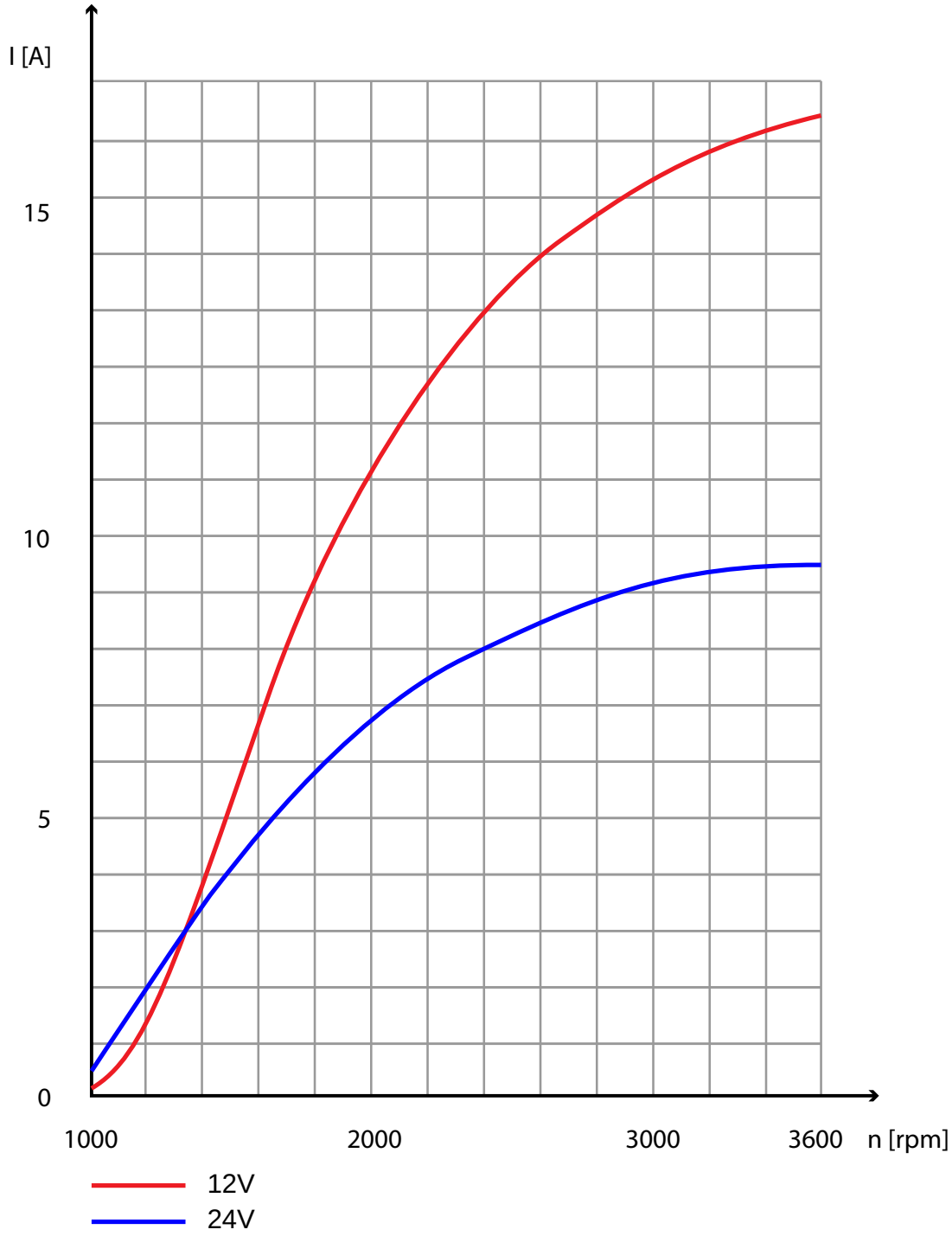
- Beginning at a defined speed (frequency) of the running engine, the main starter line is interrupted. This prevent reactivation of the starter while the engine is running.
- Starting becomes possible again only after the engine comes to a standstill and a fixed time period has expired. This prevents 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 sprocket.

Frequency output of engines										
	Frequency terminal W						Frequency gearring			
Motortyp	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 dissengage starter	recommended frequency [Hz] at dissengage starter	pickup on gearring [p]	frequency [f] at 3000 r.p.m. [Hz]	recommended [n] r.p.m. at dissengage starter	recommended frequency [f] at dissengage starter
1 D 42	12	1	12	600	150	750	105	5250	750	1250
1 D 81	14	1	14	700	170	750	123	6150	750	1450
1 D 81 ext. Gen	10,6	1,72	6	535	125	750	123	6150	750	1450
Frequenzberechnung	$f = \frac{n * p * i}{60}$						$f = \frac{n * p}{60}$			

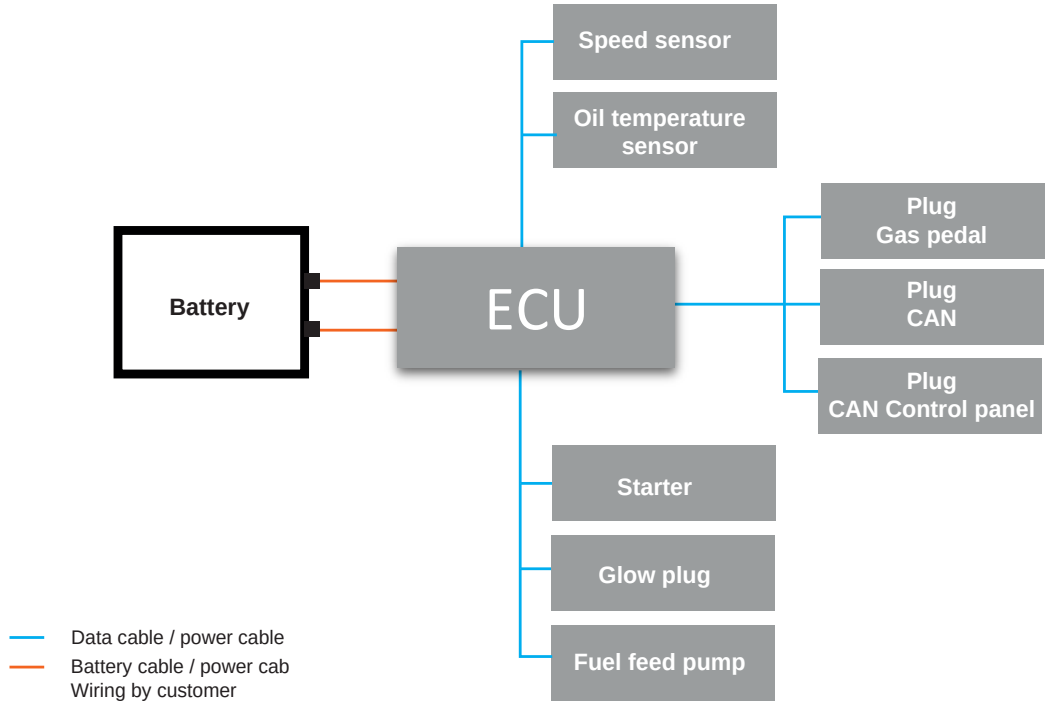
9.5 Alternator

Charging curve 12 V/24 V alternator– 1D42 / 1D50 / 1D81 / 1D90



9.6 Cabling

1D90E



	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 leak-tight plug connections, it must be ensured that the lines extend straight out of the connector for approx. 50 mm. For the single wire seals, the diameter must fit or else the plug connection will not be tight.

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

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

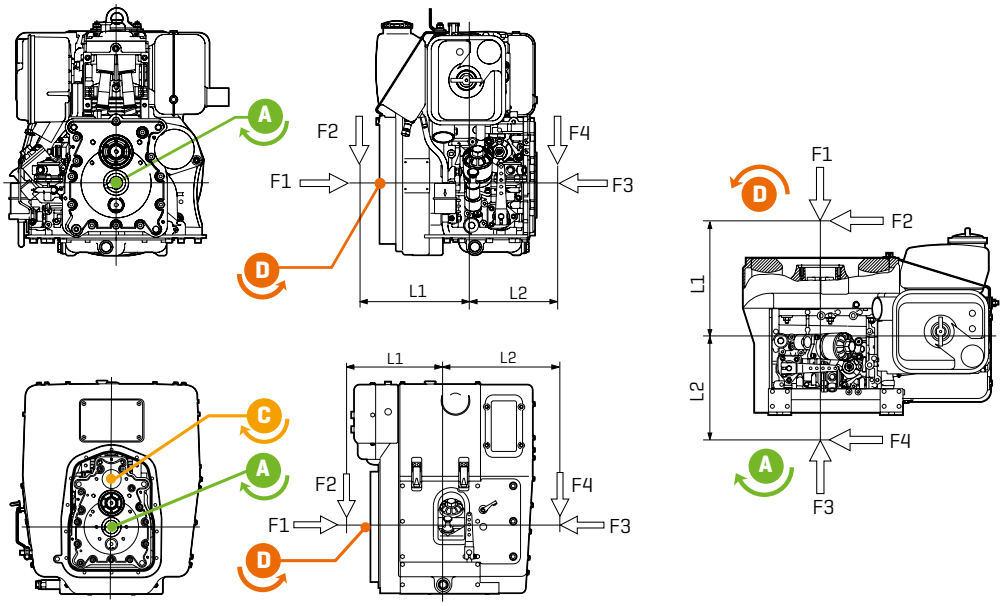
Ensure a good ground connection. Where possible, do not mount the switch box on the engine but attach it to vibration-free components.

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 flywheel side/timing cover side

The load capacity of the power take off on the engine

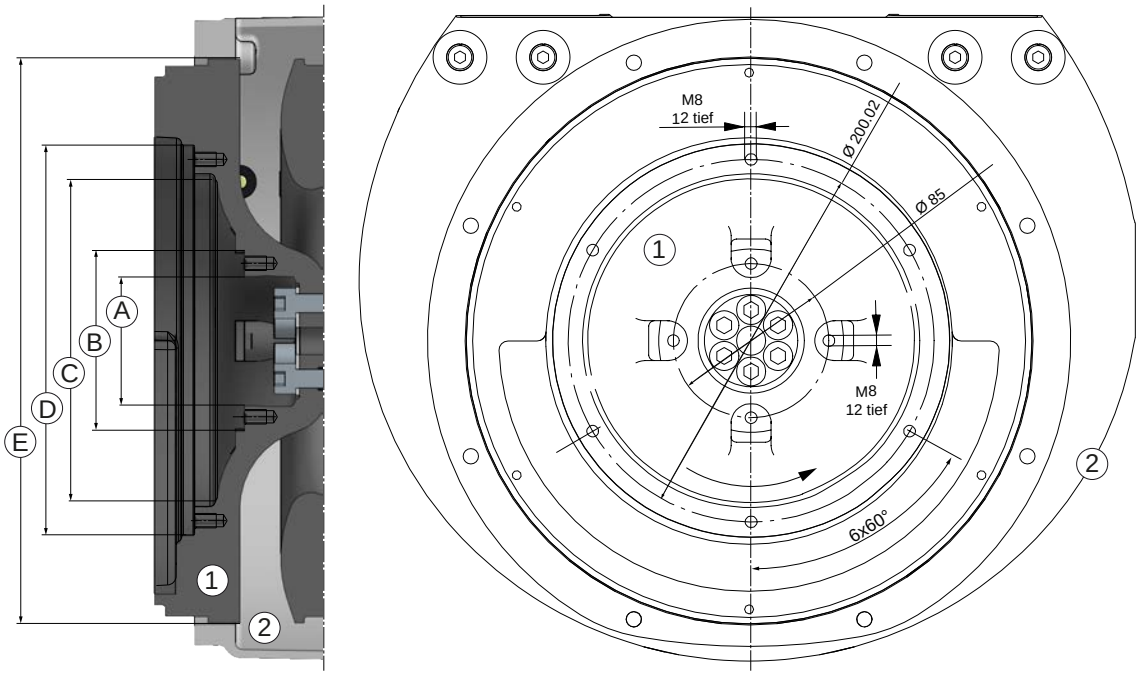


Power take off [PTO]		1D42	1D50	1D81	1D81C	1D90E	1D90	1D90V
Transferable torque	A	100 %						
	C	not available		21,5 Nm [6,8kW@3000min -1]				not available
	D	100 %						
Permissible load	F1	1260 N		2250 N				
	F2	$F2 = \frac{261\,000}{L1\,[mm] - 42}$ [N]		$F2 = \frac{477\,000}{L1\,[mm] - 50,5}$ [N]				
	F3	1080 N		1350 N				
	F4 [3]	$F4 = \frac{67\,500}{L2\,[mm] - 128}$ [N]		$F4 = \frac{67\,500}{L2\,[mm] - 134}$ [N]				

[3] If belt tension is upwards, outboard bearing is necessary

10.2 Main take off (flywheel side)

For the main take off, the connection housings SAE 5 for the engines 1D50, 1D81, 1D90 and 1D90E or SAE 6 for the engine 1D42 are made available, as well as the 6.5" flywheel in each case.



1	Flywheel **SAE 6.5"** for engine type 1D42 to 1D90E
2	Connection housing **SAE 6** for engine type 1D42
2	Connection housing **SAE 5** for engine types 1D50 to 1D90E

Dimensioning Ø [mm]	**Connection housing combined with flywheel**	
	SAE 5/6.5"	**SAE 6/6.5"**
A	72	72
B	100	100
C	184.2	184.2
D	215.9	215.9
E	314.32	266.7

10.3 Power take off - not separable

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

The calculation of the load capacity of the power take off on the engine can be found at *10.1 Power take off on flywheel side/timing cover side, page 98*.

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

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

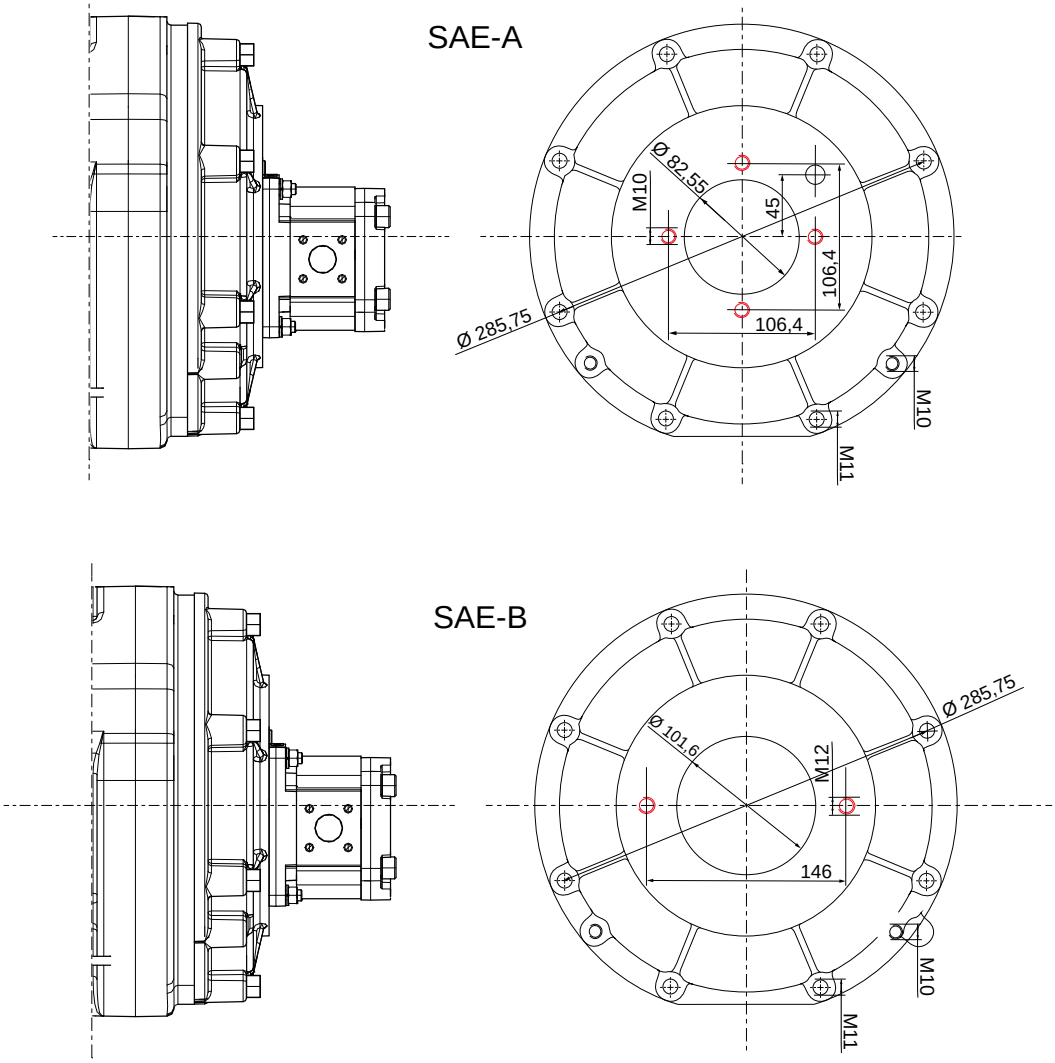
10.3.1 Hydraulic pump

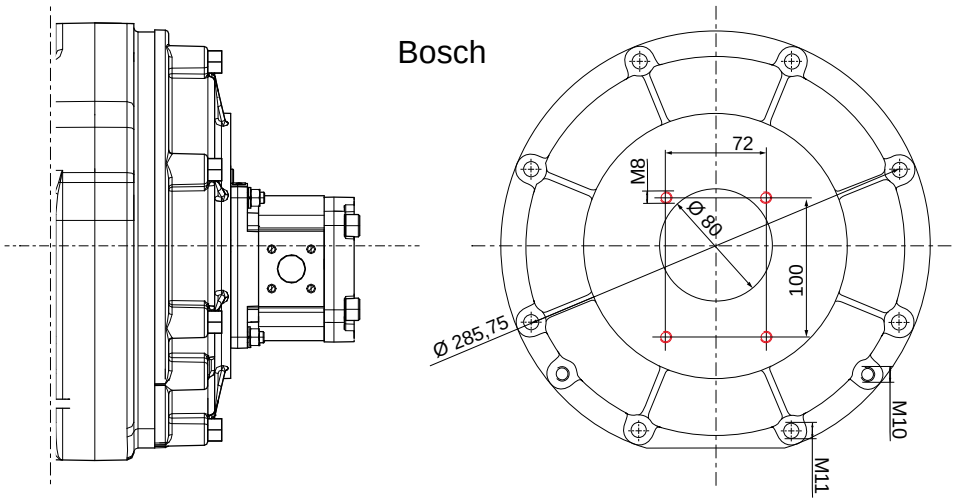
CAUTION
Risk of injury or danger of engine or hydraulic pump damage caused by failure to comply with the installation instructions/Operator's Manual of your hydraulic pump. As the operator of the machine, you must ensure that all people working on the machine are familiar with the content of this manual.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

Depending on the use case, use the hydraulic pump with the suitable permissible transmission powers, see *10.3.1 Hydraulic pump, page 103*.

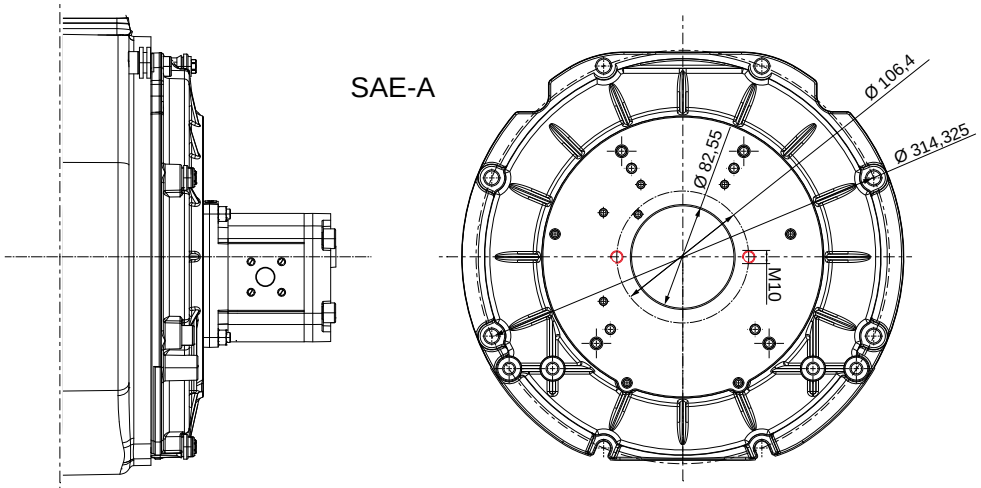
To install the hydraulic pump, only use the screw dimensions and quality recommended by the pump manufacturer. For mounting on the engine, heed the most recent installation instructions for your hydraulic pump. If you have any other questions, please contact the hydraulic pump manufacturer.

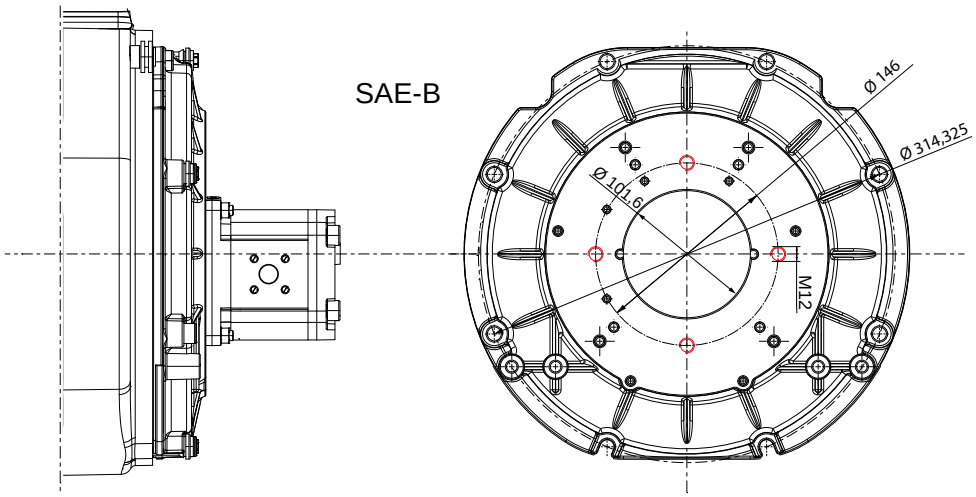
Installation option on the flywheel side on the connection housing for engine type 1D42

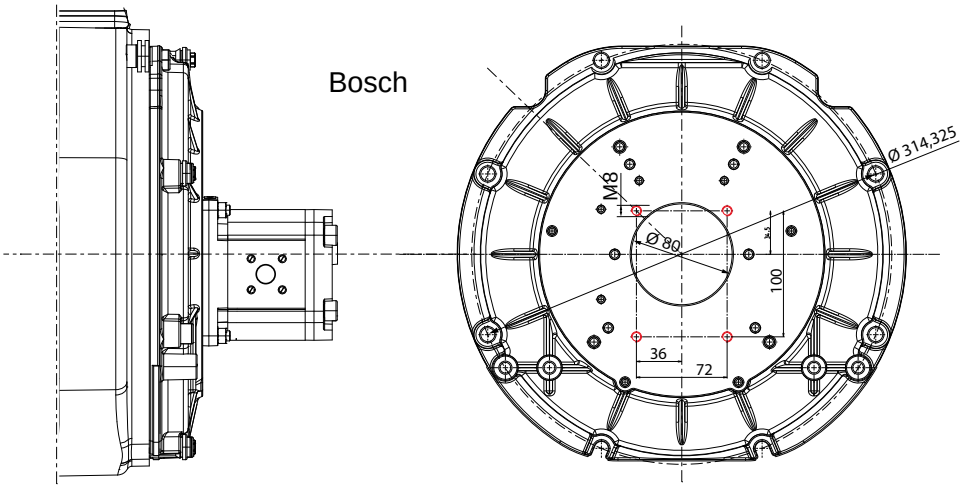




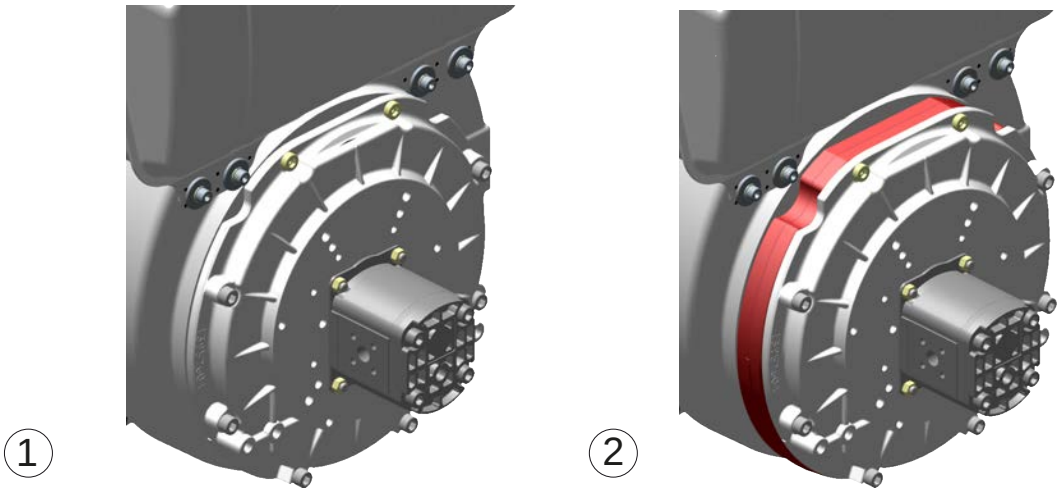
Installation option on the flywheel side on the connection housing for engine types 1D50, 1D81, 1D90, 1D90E







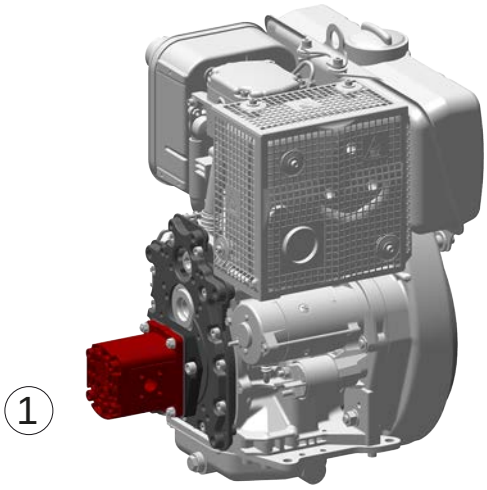
Depending on the model size of the hydraulic pump (HP) and the associated connection shaft, an additional connection ring for the SAE-A, SAE-B or SAE-Bosch connection housing must be used when installing an HP for the engine specifications 1D50 and larger on the SAE 5 engine connection housing (Ø 314 mm).

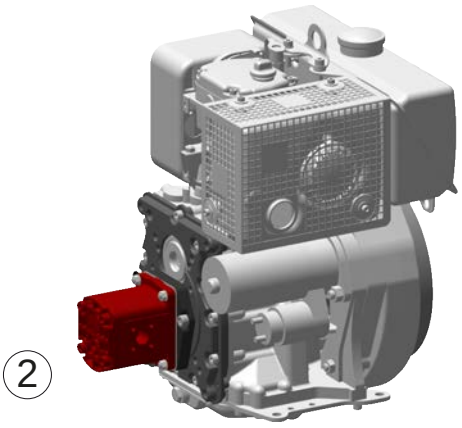


1	Connection housing without connection ring
2	Connection housing with connection ring

Installation option of hydraulic pump on SAE control cover

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





1	1D81, 1D90, 1D90E
2	1D42, 1D50

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**.

Overview of hydraulic pumps

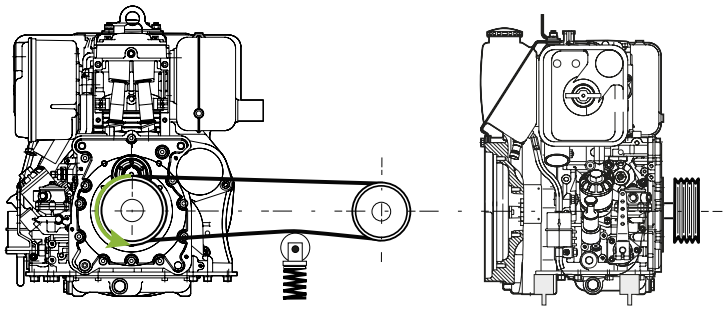
Geometric displacement [cm³/U]	Working pressure [bar]	Max. pressure P3 [bar]	Max. rotation speed [rpm]	Rotation [Left / Right	D 1D42/50/81/90 Flywheel	A 1D42/50	A 1D81/90	C 1D81/90
4.65	240	280	3500	R	■			
				L		■	■	■
6.45	240	280	3500	R	■			
				L		■	■	
8.25	240	280	3500	R	■			
				L		■	■	■
12	240	280	3500	R	■			
				L		■	■	
13.8	210	250	3500	R	■			
				L		■	■	
15.52	210	250	3500	R	■			
				L		■	■	
19.12	170	200	3500	R	■			
				L		■	■	
22.87	150	175	3500	R	■			
				L		■	■	

■ Direkt montiert, PTO-Drehzahl = Motordrehzahl

10.3.2 Belt drives

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

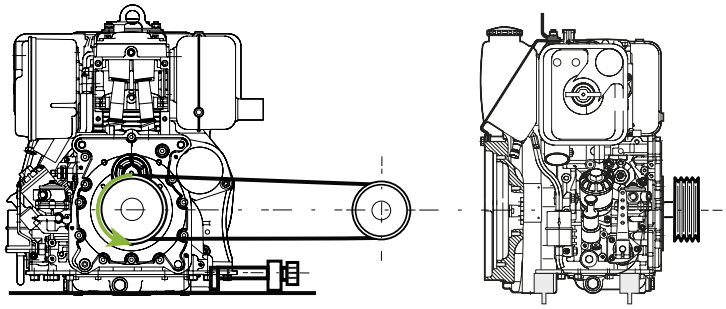
- **Controllable belt tensioners guarantee** that bearings and shafts are not overloaded and do not break. The belt tension is controllable by a spring-loaded idler pulley or hydraulic belt tensioner, for example.



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

$$Fges = (33\ x\ Pmax)/(n/1000\ x\ dw)$$

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



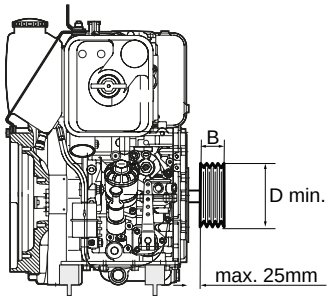
The **actual force effect** in case of **flexible** belt tension can be calculated as follows:

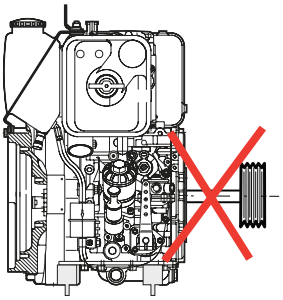
$$Fges = (47.8\ x\ Pmax)/(n/1000\ x\ dw)$$

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

Two further recommendations for belt drives:

- Mount the pulley as close as possible to the bearing to keep the bearing load low.
- The pulley on the engine must be as large as possible in order to keep the belt tension low. The diameter of the pulley should not be smaller than the value specified in the following table.



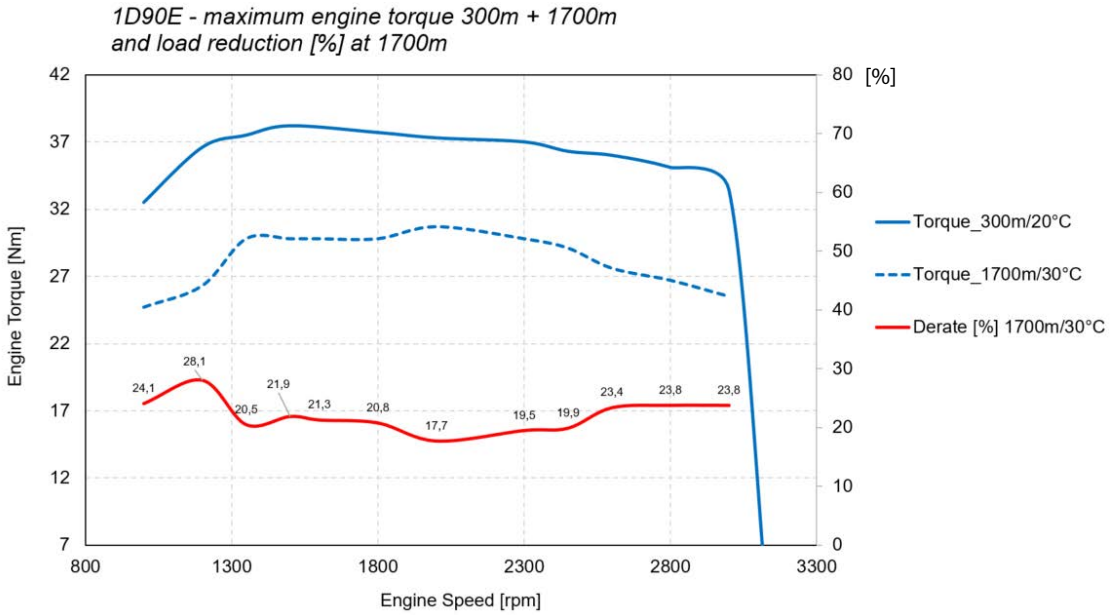


Engine	Min. Ø D [mm]	Pulley width B approx. [mm]	Remark	Number of belts	Belt size
1D42	90	75		2	SPA
1D50	90	75		2	SPA
1D81	90	80	Outside bearing is recommended	4	SPA at D >125
1D90 1D90E	90	80	Outside bearing is recommended	4	SPA at D >125

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 engine 1D90E is 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

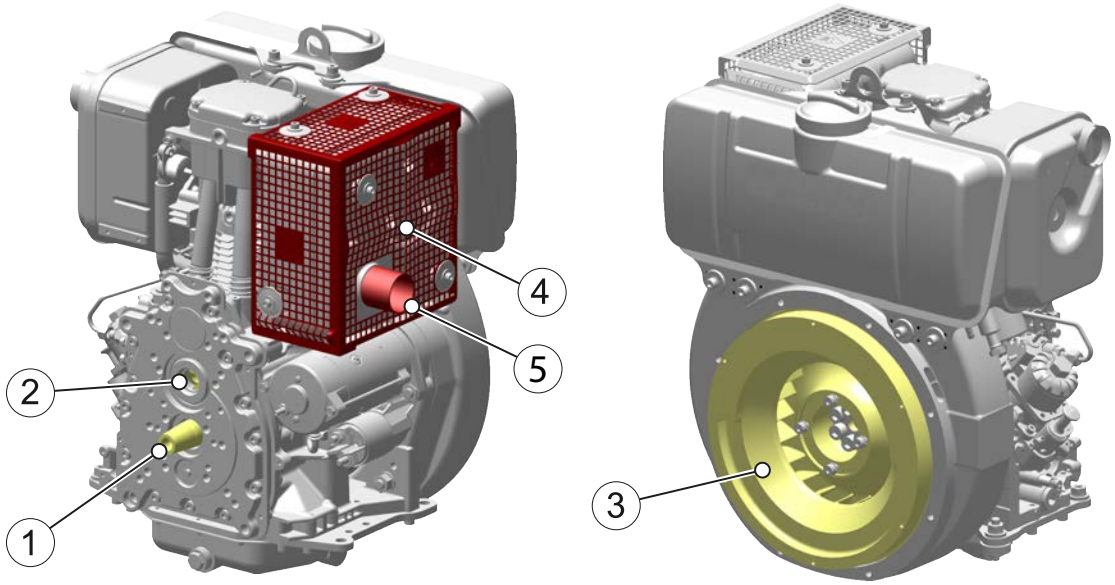
It is the responsibility of the manufacturer to heed and comply with the safety rules that apply to an engine in a finished machine.

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. safety 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 *8.1 Installation notes – general information, page 48*.

12.1 Hot surfaces and rotating parts



Pos	Rotating parts
1	crankshaft
2	Camshaft (crankhandle start)
3	flywheel

Pos	Parts with hot surfaces
4	Silencer (optional with contact guard)
5	exhaust pipe

13 Maintenance

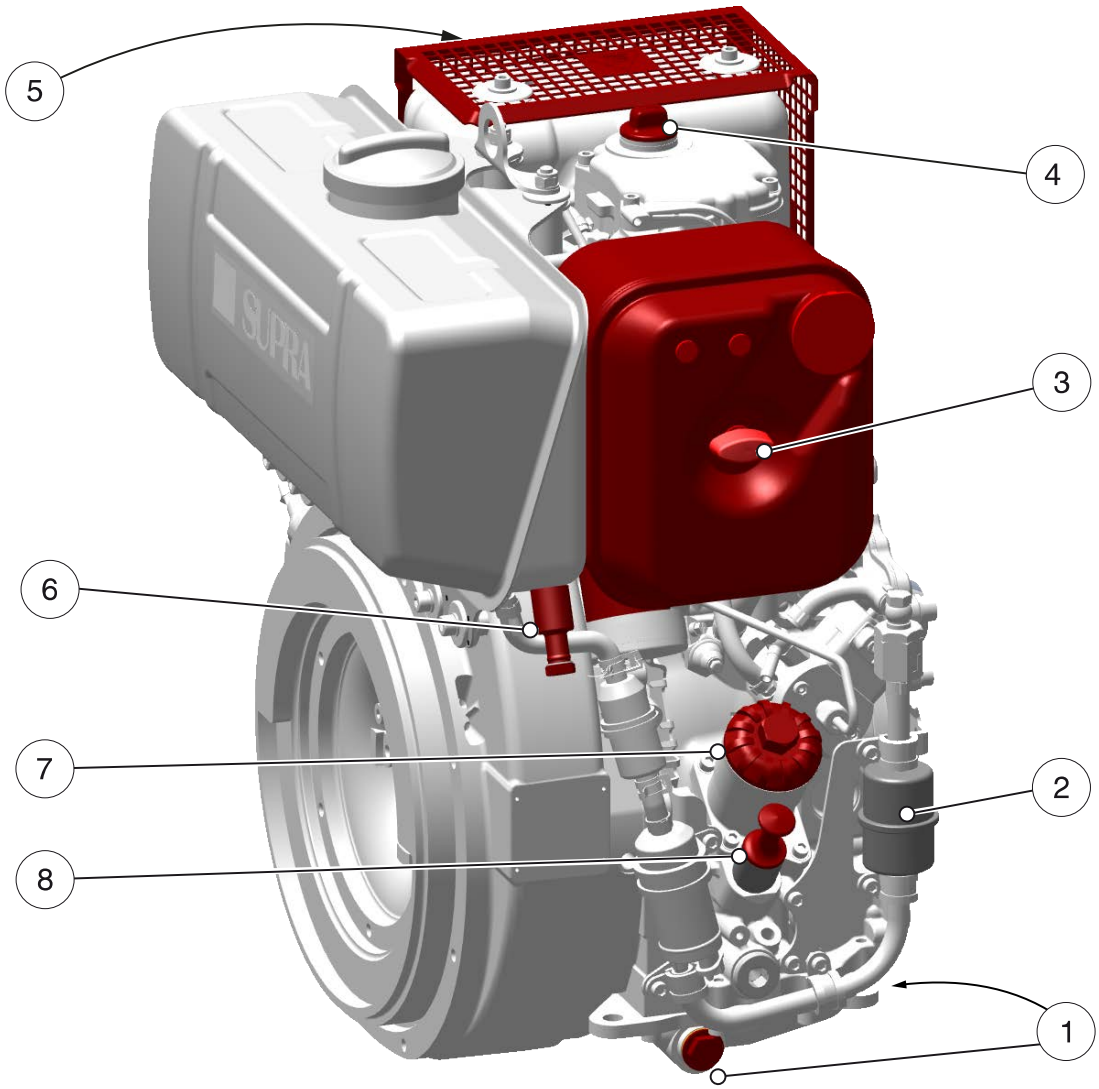
13.1 Accessibility of service points

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 access is encumbered, 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 screws M18x1.5/M22x1.5 with **50 Nm** tightening torque	5	Silencer with contact protection
2	Main fuel filter	6	water separator
3	Dry air filter	7	Screw plug for oil filter
4	Open oil filling opening (option)	8	Oil filling opening and dipstick

13.2 Maintenance intervals

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

14 Engine preservation

NOTICE	
	If an extended storage period 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 an adhesive label should become detached or difficult to read, it must be replaced promptly. For this purpose, contact your nearest Hatz service.
- Any improper modification of the engine will result in a loss of liability coverage for resulting damage.

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

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

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

15.2 Initial startup

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

⚠ DANGER

Danger to life from inhaling exhaust gases.

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

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

⚠ CAUTION

Danger of injury and danger of engine damage from the use of starting fluid.

- 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.

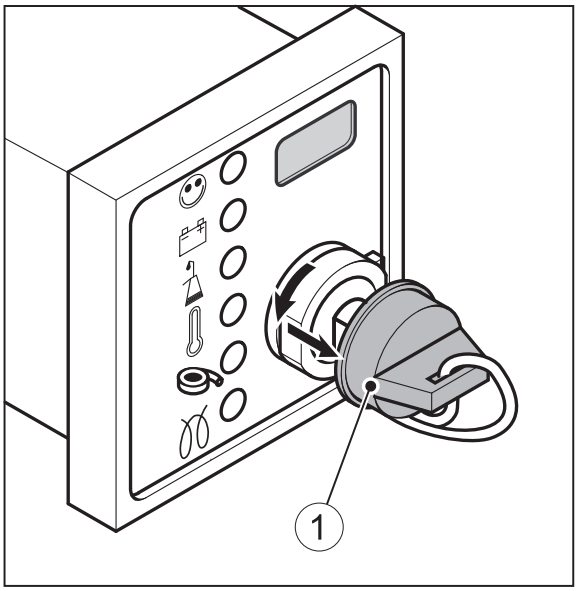
Before starting

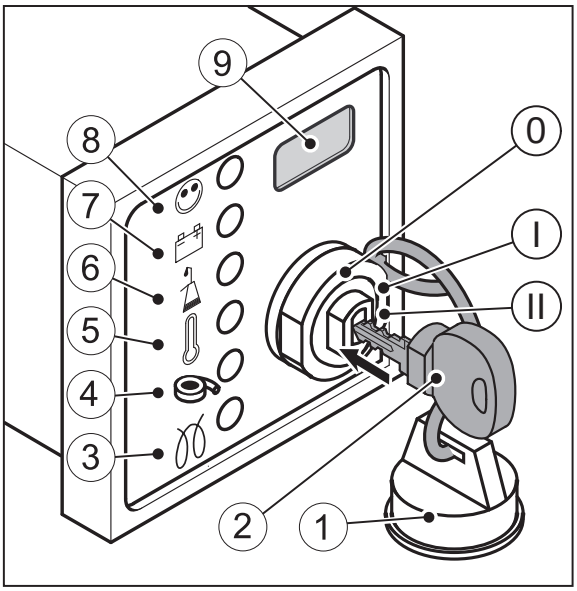
Before starting the engine, several tests need to be performed to ensure the machine is working properly.

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.

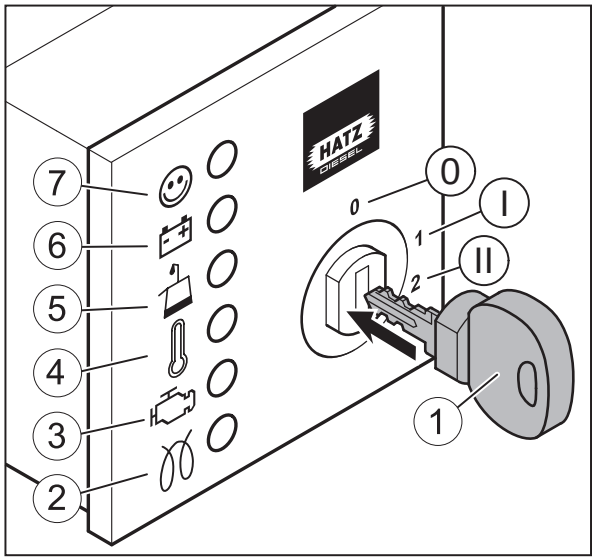
15.3 Overview - instrument box 1D42, 1D50, 1D81, 1D90





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

15.4 Overview - instrument box 1D90E



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
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!

Symbol	Meaning
	**Engine fault** This indicator is lights up steadily or flashes if there are engine faults. Depending on the engine specification, the engine controller reacts as follows in case of a malfunction: ▪ **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.
	**Pre-glow indicator** Lights at temperatures below 0 °C. Start the engine after the indicator has gone out.

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 cover 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 and hoses laid without chafing and are they free of collision?
- Was the correct fault compensation response option chosen?

- Has the exhaust pipe (if present) been selected so 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 tilt ≤ the max. engine tilt?
- 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
- Air filter
- Cylinder head cover
- Cooling air passages
- Battery
- Main fuel filter
- Fuel prefilter (1D90E)
- Diagnostics interface (1D90E)

15.10 Installation log

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

15.10.1 Prerequisite for carrying out the installation check

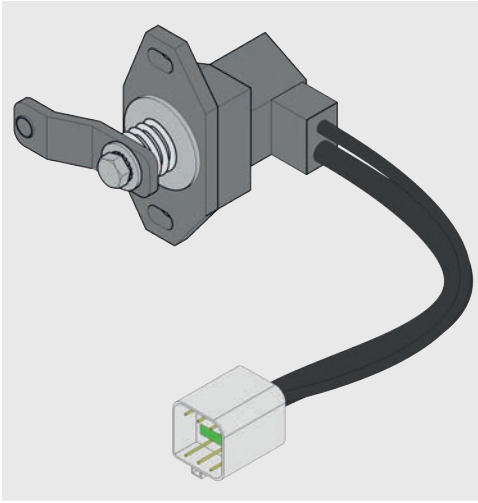
Before an installation check with cooling capacity measurement is carried out, the following prerequisites must be fulfilled by the machine manufacturer:

- The application should correspond as close as possible to the series condition
- The application must be operational for the measurements

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

16 Functional safety

16.1 Speed control



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

If the speed is specified via a speed selection switch (multi-state switch) or a control facility with a simple potentiometer, no redundant setpoint is required.

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

16.2 Fault replacement reaction

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

Emergency running

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

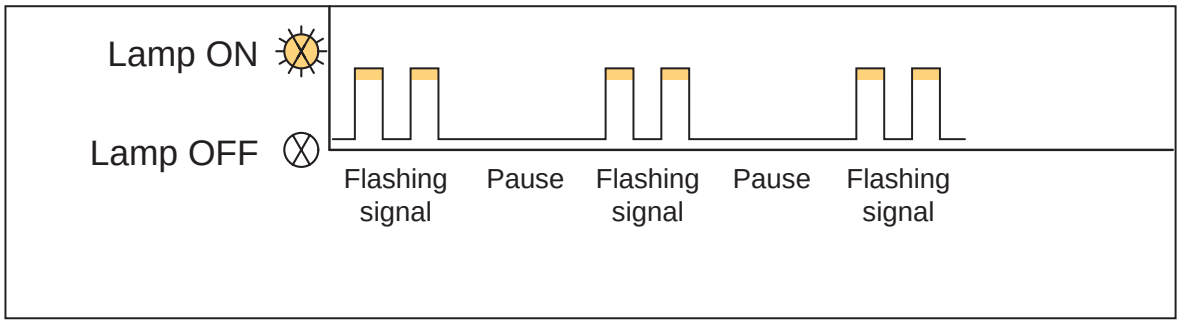
Only in exceptional cases for engines that are not emissions-compliant

16.3 Flash code table for engine faults

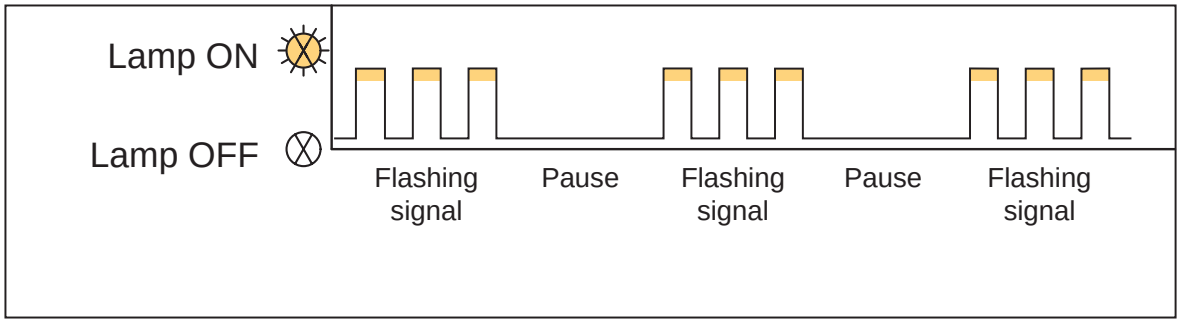
The "engine malfunction" indicator lights up in case of engine malfunctions (see the **Diesel Engine Manual** - *Symbol explanation*, *5.2 HATZ instrument box section, page 29*. If the engine is switched off and the starting key is set to "I", a flashing signal is output on the engine control indicator. 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).

Bllink code table

Flashing signal	Possible causes	Remedy	Chapter
1 *Area affected:* **Engine oil pressure**	Engine oil pressure too low.	Check the oil level.	
2 *Area affected:* **Overtemperature**	Engine temperature is too high.	Clean the cooling air area.	
	Oil temperature too high.	Reduce the engine load.	
3 *Affected area:* **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 control is faulty.	Contact HATZ service.	
	Supply voltage for sensors is faulty.	Check the cabling.	
4 *Area affected:* **Analog setpoint or CAN communication**	Cabling is faulty.	Check the cabling.	
	Speed control is faulty.	Contact HATZ service.	
5 *Area affected:* **Ambient pressure sensor**	Sensor is faulty.	Contact HATZ service.	
7 *Area affected:* **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 *Area affected:* **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 *Area affected:* **Control unit**	Cabling to the control unit is faulty.	Check the cabling.	
	Faulty control unit.	Contact HATZ service.	

17 Compliance with emission regulations

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

17.1 Delegated Assembly

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

See chapter *8.12 Exhaust gas system, page 77*.

17.2 Separate Shipment

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

See chapter *8.12 Exhaust gas system, page 77*.

17.3 Delegated Assembly & Separate Shipment

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

See chapter *8.12 Exhaust gas system, page 77*.

18 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:
1D42=13311; 1D42=15510; 1D50=10920;
1D50=15610; 1D81=07327; 1D81=17927;
1D81C=18027; 1D90=10820; 1D90E=18505
1D90V/W=11317; 1D90V/W=18117

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

- General principles no. 1
  - Nr. 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
Ernst-Hatz-Str. 16
94099 Ruhstorf a. d. Rott
Deutschland
Tel. +49 8531 319-0
Fax. +49 8531 319-418
marketing@hatz-diesel.de
www.hatz-diesel.com

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