



# Online oil analysis MSENSE<sup>®</sup> DGA 2/3

## Operating instructions

4001150/12 EN



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We reserve the right to change the technical data, design and scope of supply.

Generally the information provided and agreements made when processing the individual quotations and orders are binding.

The original operating instructions were written in German.



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## 1 Introduction

This technical file contains detailed descriptions on the safe and proper installation, connection, commissioning and monitoring of the product.

This technical document is intended solely for specially trained and authorized personnel.

### 1.1 Manufacturer

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MR Reinhausen customer portal: <https://portal.reinhausen.com>

Further information on the product and copies of this technical file are available from this address if required.

### 1.2 Subject to change without notice

The information contained in this technical file comprises the technical specifications approved at the time of printing. Significant modifications will be included in a new edition of the technical file.

The document number and version number of this technical file are shown in the footer.

### 1.3 Completeness

This technical file is incomplete without the supporting documents.

The following documents apply to this product:

- MSENSE® DGA 2/3 operating instructions
- MESSKO® MSET parameterization software operating instructions
- Works certification

### 1.4 Safekeeping

Keep this technical file and all supporting documents ready at hand and accessible for future use at all times.

### 1.5 Notation conventions

This section contains an overview of the symbols and textual emphasis used.

## 1.5.1 Hazard communication system

Warnings in this technical file are displayed as follows.

### 1.5.1.1 Warning relating to section

Warnings relating to sections refer to entire chapters or sections, sub-sections or several paragraphs within this technical document. Warnings relating to sections have the following format:

**▲ WARNING**



#### Type of danger!

Source of the danger and its consequences.

- ▶ Action
- ▶ Action

### 1.5.1.2 Embedded warning information

Embedded warnings refer to a particular part within a section. These warnings apply to smaller units of information than the warnings relating to sections. Embedded warnings use the following format:

**▲ DANGER!** Instruction for avoiding a dangerous situation.

### 1.5.1.3 Signal words

Depending on the product, the following signal words are used:

Signal word	Meaning
DANGER	Indicates a hazardous situation which, if not avoided, will result in death or serious injury.
WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Indicates measures to be taken to prevent damage to property.

Table 1: Signal words in warning notices

## 1.5.2 Information system

Information is designed to simplify and improve understanding of particular procedures. In this technical file it is laid out as follows:



Important information.



### 1.5.3 Instruction system

This technical file contains single-step and multi-step instructions.

#### Single-step instructions

Instructions which consist of only a single process step are structured as follows:

Aim of action

- ✓ Requirements (optional).
- ▶ Step 1 of 1.
  - ⇒ Result of step (optional).
- ⇒ Result of action (optional).

#### Multi-step instructions

Instructions which consist of several process steps are structured as follows:

Aim of action

- ✓ Requirements (optional).
- 1. Step 1.
  - ⇒ Result of step (optional).
- 2. Step 2.
  - ⇒ Result of step (optional).
- ⇒ Result of action (optional).

### 1.5.4 Typographic conventions

Typographic convention	Purpose	Example
UPPERCASE	Operating controls, switches	ON/OFF
[Brackets]	PC keyboard	[Ctrl] + [Alt]
<b>Bold</b>	Software operating controls	Press <b>Continue</b> button
...>...>...	Menu paths	Parameter > Control parameter
<i>Italics</i>	System messages, error messages, signals	<i>Function monitoring</i> alarm triggered
[▶ Number of pages]	Cross reference	[▶ Page 41].
<u>Dotted underscore</u> .....	Glossary entry, abbreviations, definitions, etc.	<u>Glossary entry</u> .

Table 2: Typographic conventions used in this technical file





## 2 Security

- Read this technical file through carefully to familiarize yourself with the product.
- This technical file is a part of the product.
- Read and observe the safety instructions provided in this chapter in particular.
- Observe the warnings in this technical file to avoid function-related dangers.
- The product is manufactured based on state-of-the-art technology. Nevertheless, danger to life and limb for the user or impairment of the product and other material assets may arise in the event of improper use.

### 2.1 Intended use

The product is designed solely for use in stationary large-scale systems.

It is designed to detect and report emerging, potentially harmful trends in the monitored equipment (e.g. transformer) in good time by measuring the concentration of gases and moisture in the equipment's insulating oil.

The device is not designed and is not suitable for detecting rapidly developing faults and therefore is not intended to protect the equipment from such faults (e.g. through shutdown). For this, please use safety devices that have been designed for this purpose.

If used as intended and in compliance with the requirements and conditions specified in this technical file as well as the warning notices in this technical file and attached to the product, then the product does not present any danger to people, property or the environment. This applies throughout the service life of the product, from delivery, installation and operation to removal and disposal.

The following is considered intended use:

- Operate the product in accordance with this technical document, the agreed-upon delivery conditions and the technical data.
- Ensure that all necessary work is performed by qualified personnel only.
- Only use the devices supplied for the intended purpose and in accordance with the specifications in this technical document.
- Observe the notices in this technical document regarding electromagnetic compatibility and the technical data.

### 2.2 Fundamental safety instructions

To prevent accidents, malfunctions and damage as well as unacceptable adverse effects on the environment, those responsible for transport, installation, operation, maintenance and disposal of the product or parts of the product must ensure the following:



### Personal protective equipment

Loosely worn or unsuitable clothing increases the danger of becoming trapped or caught up in rotating parts and the danger of getting caught on protruding parts. This results in danger to life and limb.

- All necessary devices and personal protective equipment required for the specific task, such as a hard hat, safety footwear, etc. must be worn. Observe the "Personal protective equipment" [► Section 2.4, Page 12] section.
- Never wear damaged personal protective equipment.
- Never wear rings, necklaces or other jewelry.
- If you have long hair, wear a hairnet.

### Work area

Untidy and poorly lit work areas can lead to accidents.

- Keep the work area clean and tidy.
- Make sure that the work area is well lit.
- Observe the applicable laws for accident prevention in the relevant country.

### Explosion protection

Highly flammable or explosive gases, vapors and dusts can cause serious explosions and fire.

- Do not install or operate the product in areas where a risk of explosion is present.

### Safety markings

Warning signs and safety information plates are safety markings on the product. They are an important aspect of the safety concept. Safety markings are depicted and described in the chapter "Product description".

- Observe all safety markings on the product.
- Make sure all safety markings on the product remain intact and legible.
- Replace safety markings that are damaged or missing.

### Ambient conditions

To ensure reliable and safe operation, the product must only be operated under the ambient conditions specified in the technical data.

- Observe the specified operating conditions and requirements for the installation location.



### **Modifications and conversions**

Unauthorized or inappropriate changes to the product may lead to personal injury, material damage and operational faults.

- Only modify the product after consultation with Maschinenfabrik Reinhausen GmbH.

### **Spare parts**

Spare parts not approved by Maschinenfabrik Reinhausen GmbH may lead to physical injury, damage to the product and malfunctions.

- Only use spare parts that have been approved by Maschinenfabrik Reinhausen GmbH.
- Contact Maschinenfabrik Reinhausen GmbH.

### **Working during operation**

You must only operate the product when it is in a sound operational condition. Otherwise it poses a danger to life and limb.

- Regularly check the operational reliability of safety equipment.
- Perform the inspection tasks described in this technical document regularly.

## **2.3 Personnel qualification**

The person responsible for assembly, commissioning, operation, maintenance and inspection must ensure that the personnel are sufficiently qualified.

### **Electrically skilled person**

The electrically skilled person has a technical qualification and therefore has the required knowledge and experience, and is also conversant with the applicable standards and regulations. The electrically skilled person is also proficient in the following:

- Can identify potential dangers independently and is able to avoid them.
- Is able to perform work on electrical systems.
- Is specially trained for the working environment in which (s)he works.
- Must satisfy the requirements of the applicable statutory regulations for accident prevention.

### **Electrically trained persons**

An electrically trained person receives instruction and guidance from an electrically skilled person in relation to the tasks undertaken and the potential dangers in the event of inappropriate handling as well as the protective devices and safety measures. The electrically trained person works exclusively under the guidance and supervision of an electrically skilled person.



**Operator**

The operator uses and operates the product in line with this technical file. The operating company provides the operator with instruction and training on the specific tasks and the associated dangers arising from improper handling.

**Technical Service**

We strongly recommend having maintenance, repairs and retrofitting carried out by our Technical Service department. This ensures that all work is performed correctly. If maintenance is not carried out by our Technical Service department, please ensure that the personnel who carry out the maintenance are trained and authorized to do so by Maschinenfabrik Reinhausen GmbH.

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**2.4 Personal protective equipment**

Personal protective equipment must be worn during work to minimize risks to health.

- Always wear the personal protective equipment required for the job at hand.
- Never wear damaged personal protective equipment.
- Observe information about personal protective equipment provided in the work area.

<b>Protective clothing</b>	Close-fitting work clothing with a low tearing strength, with tight sleeves and with no protruding parts. It mainly serves to protect the wearer against being caught by moving machine parts.
<b>Safety shoes</b>	To protect against falling heavy objects and slipping on slippery surfaces.
<b>Safety glasses</b>	To protect the eyes from flying parts and splashing liquids.
<b>Visor</b>	To protect the face from flying parts and splashing liquids or other dangerous substances.
<b>Hard hat</b>	To protect against falling and flying parts and materials.



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<b>Hearing protection</b>	To protect against hearing damage.
<b>Protective gloves</b>	To protect against mechanical, thermal and electrical hazards.

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Table 3: Personal protective equipment



### 3 IT security

Observe the following recommendations to operate the product safely.

- Ensure that only authorized personnel have access to the device.
- Only use the device within an ESP (electronic security perimeter).
- Ensure that the device is only operated by trained personnel who are familiar with IT security.
- All protocol interfaces (Modbus RTU, Modbus TCP, DNP3 TCP and IEC 61850-8-1 MMS) only have read-access to the MSENSE® DGA 2/3. Changing parameters or data via this is not possible.
- Access to the parameterization via the MESSKO® MSET parameterization software can be protected through the use of passwords. Change the passwords regularly.



Observe the information of access rights, user levels and password settings in the MESSKO® MSET parameterization software operating instructions.



### 4 Product description

The detection of dissolved gases in transformer oil is generally considered to be the first indication of emerging faults in transformers. Several international standards highlight the relevance of this examination method, including the IEEE Std C57.104™-2008, IEC 60422, IEC 60567 and IEC 60599 standards.

The Dissolved Gas Analysis (DGA) method is fast, low-cost and possible without disconnecting the transformer. The composition of the gases provides initial key information on fault events such as partial discharges, overheating, arcs and overload. This knowledge enables sound risk assessment and the early initiation of measures for corrective action.

The standards listed above recommend that oil samples be taken at regular intervals and that they be analyzed by a laboratory. In addition to a DGA, further examinations are usually performed, such as the determination of the moisture in oil, the dielectric strength and the turbidity.

Two gases in particular are to be considered during a DGA: hydrogen (H<sub>2</sub>) and carbon monoxide (CO), since these are generated in virtually all occurring faults. The occurrence of hydrogen is an indication of electrical faults in the transformer, and carbon monoxide is generated during the decomposition of the paper insulation, which is caused by overheating.

Increased moisture in the oil significantly reduces the dielectric strength of the insulating oil and also promotes paper decomposition; thus, monitoring the water content (H<sub>2</sub>O) in the oil provides essential additional information for the assessment of risks.

Continuous online monitoring of these two gases and the moisture enables early detection of emerging, potentially harmful trends. As soon as defined warning thresholds are exceeded, further analyses can be carried out and countermeasures can be taken at an early stage. The costs for quickly implemented measures are generally much lower than those implemented at a later date, and especially after a failure of the transformer with the resulting consequential costs.

Messko has developed the MSENSE® DGA 2/3 online DGA device for precisely this purpose. It continuously monitors the gas concentrations of hydrogen and carbon monoxide (MSENSE® DGA 3) as well as the moisture in oil, and issues warning or alarm messages if defined gas or moisture concentrations are exceeded or if the rates of increase are too high.

This chapter contains an overview of the design and function of the product.



The device is available in two device versions:

	Measured variables			
	Hydrogen (H <sub>2</sub> )	Carbon monoxide (CO)	Moisture (H <sub>2</sub> O)	Oil temperature
MSENSE® DGA 2	Yes	No	Yes	Yes
MSENSE® DGA 3	Yes	Yes	Yes	Yes

MSENSE® DGA 2 for measuring and analyzing the fault gas hydrogen (H<sub>2</sub>) present in the transformer oil, for detecting the oil moisture content and for measuring the oil temperature.

MSENSE® DGA 3 for measuring and analyzing the fault gases hydrogen (H<sub>2</sub>) and carbon monoxide (CO) present in the transformer oil, for detecting the oil moisture content and for measuring the oil temperature.

The following options are available for both device versions:

- 2-line display and 3 operating keys
- Housing color RAL 7033 or 7038
- Various mounting flanges DN50 / DN80
- Two measuring pipe lengths for optimal mounting position
- Communication protocols DNP3 TCP, 61850-8-1 MMS or Modbus TCP (all via MESSKO® protocol converter, available separately)
- Offshore version

#### 4.1 Scope of delivery



Upon receipt, check the delivery for completeness.

- MSENSE® DGA 2 or 3
- Operating instructions and works certification
- Ball valve with mounting flange, safety chain and dummy plug
- Chain connector for safety chain
- USB storage medium with MESSKO® MSET parameterization software
- USB connection cable for connecting a computer to the device
- 5-pole plug for assembling an RS485 connection cable (Modbus RTU)
- Oil extraction adapter
- Two sets for extracting and shipping oil samples
- With the offshore model: One tube of grease





### 4.2 Function description

The MSENSE® DGA 2/3 measuring head is positioned in the transformer insulating oil. There is often a large distance between the measuring head and the origin of the gases. It is therefore important for the early detection of gases that the oil at the installation position is in motion, either due to natural convection or due to artificially generated oil circulation. Observe the additional information regarding this in the chapter "Installation recommendations" [► Section 6.1, Page 23].

The gases dissolved in the oil are dissolved out via a capillary membrane in the device measuring head. Sensors for hydrogen and carbon monoxide (depending on the version) convert the concentrations of gas present into electrical signals. A gold coating prevents unwanted chemical reactions that could distort the measured results.

The device controller converts the electrical signals into gas concentration values in the unit ppm (parts per million). To improve the measurement results under different operating conditions, factors such as the oil temperature and ambient temperature as well as the flow velocity of the oil at the sensor head are taken into account.

In addition, the device is equipped with a sensor for measuring the level of moisture in the oil. This measurement is also taken at the measuring head directly in the oil.

The measured values determined are stored in the internal device database and, if the device is equipped with a display, they are also displayed on it. The current and historical measured data can be called up and analyzed further with the MESSKO® MSET parameterization software.

The measured values, along with warning and alarm information, can be transmitted remotely via the analog interfaces and relay outputs on the device. Furthermore, communication via various in-part optional protocol interfaces for connection with SCADA systems is also possible.

### 4.3 Design/versions

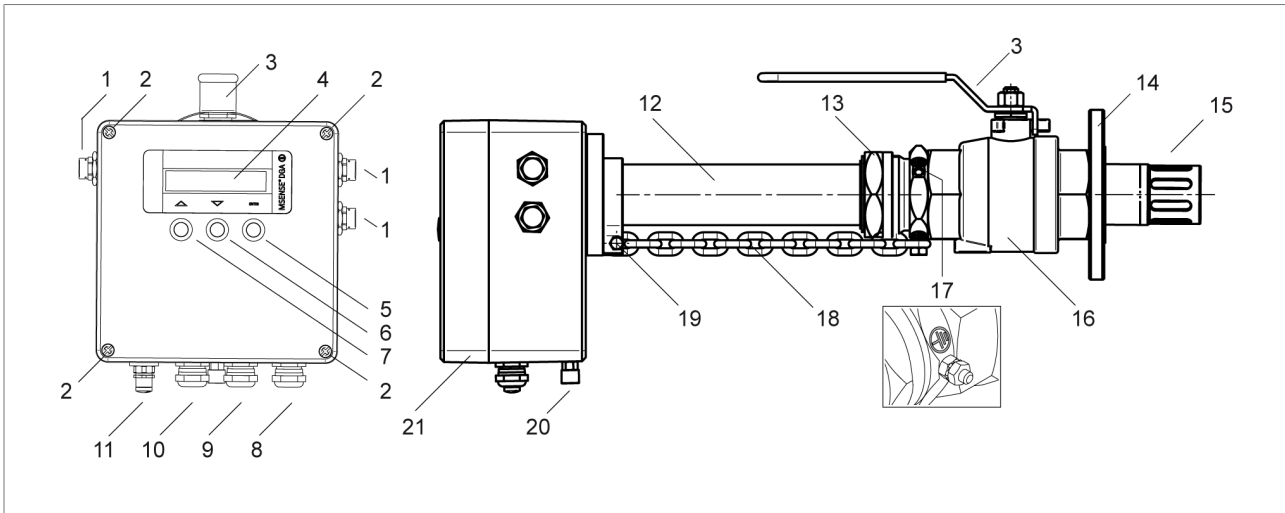


Figure 1: MSENSE® DGA 2/3

DGA 2	Measurement components H <sub>2</sub> , moisture in oil and oil temperature (for mineral oils)	DGA 3	Measurement components H <sub>2</sub> , CO, moisture in oil and oil temperature (for mineral oils)
1	Ventilation	2	Housing cover screw connection
3	Ball valve locking lever	4	Display (optional)
5	ENTER key	6	DOWN key
7	UP key	8	Supply voltage cable screw connection (3x M20 x 1.5 WAD1 or 3x ½" NPT)
9	Signaling relay cable screw connection	10	Analog outputs cable screw connection
11	Interface (5-pole) for service PC and Modbus RTU communication	12	Measuring pipe (285 mm / 507 mm)
13	Ball valve clamp connection	14	Mounting flange o-ring gasket: DN50 PN6/PN16 and DN80 PN16 Mounting flange any gasket: DN50 PN16 and DN80 PN16
15	Measuring head	16	Ball valve
17	Grounding screw	18	Safety chain
19	Fixing screw for safety chain	20	Connection for venting and taking samples
21	Housing cover		

Additional signal protocols (with additional protocol converter)	DNP 3.0; Modbus TCP; IEC 61850-8-1 MMS (optional)
Accessories (optional)	Power supply unit for protocol converter
Offshore version	Offshore

#### 4.4 Safety markings and nameplate

The following safety markings are used on the product:

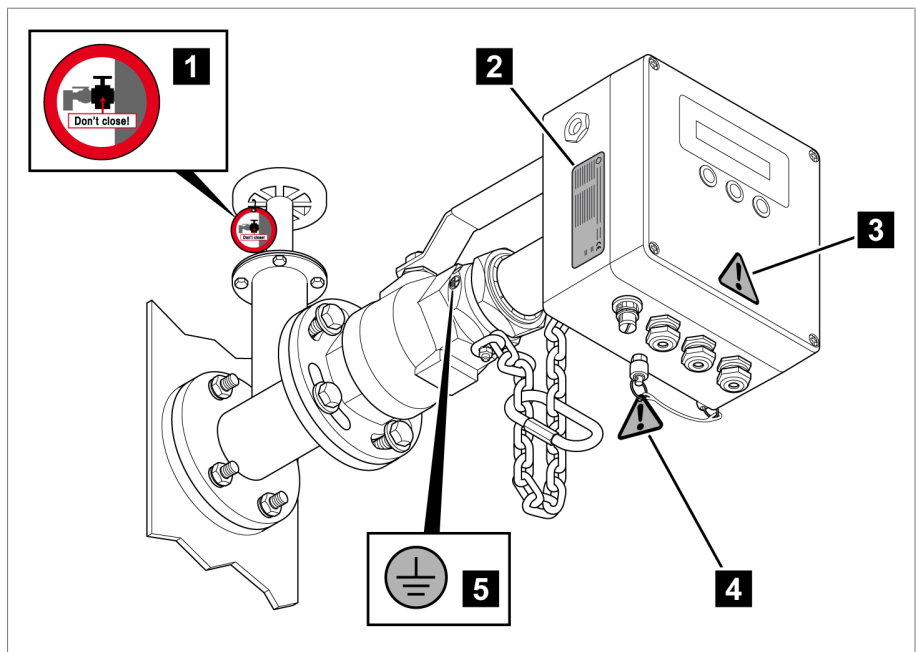


Figure 2: Safety markings and nameplate

	Description
1	Warning sign "Do not close!" on the slide valve
2	Nameplate
3	Observe the documentation
4	Observe the documentation: See the note about the oil extraction adapter in the chapter "Mounting the MSENSE® DGA 2/3" [► Section 6.2.2, Page 29]
5	Ground connection on the ball valve

Table 4: Safety markings and nameplate

## 5 Packaging, transport and storage

### 5.1 Purpose

The packaging is designed to protect the packaged product during transport, loading, unloading and during periods of storage in such a way that no detrimental changes occur. The packaging must protect the goods against permitted transport stresses such as vibration, knocks and moisture (rain, snow, condensation).

The packaging also prevents the packaged goods from moving impermissibly within the packaging.

### 5.2 Suitability, structure and production

The goods are packaged in a sturdy cardboard box. This ensures that the shipment is secure when in the intended transportation position and that none of its parts touch the loading surface of the means of transport or touch the ground after unloading.

Inlays inside the box stabilize the goods, preventing prohibited changes in position, and protecting them from vibration.

### 5.3 Markings

The packaging bears a signature with instructions for safe transport and correct storage. The following symbols apply to the shipment of non-hazardous goods. Adherence to these symbols is mandatory.



				
Protect against moisture	Top	Fragile	Attach lifting gear here	Center of mass

Table 5: Shipping pictograms

### 5.4 Transportation, receipt and handling of shipments

In addition to vibrations, jolts must also be expected during transportation. To prevent possible damage, avoid dropping, tipping, knocking over and colliding with the product.

If the packaging tips over or falls, damage is to be expected regardless of the weight.



Every delivered shipment must be checked for the following by the recipient before acceptance (acknowledgment of receipt):

- Completeness based on the delivery slip
- External damage of any type.

The checks must take place after unloading when the cartons or transport container can be accessed from all sides.

### **Visible damage**

If external transport damage is found upon receipt of the shipment, proceed as follows:

- Immediately record the transport damage found in the shipping documents and have this countersigned by the carrier.
- In the event of severe damage, total loss or high damage costs, immediately notify the sales department at Maschinenfabrik Reinhausen GmbH and the relevant insurance company.
- After identifying damage, do not modify the condition of the shipment further and retain the packaging material until an inspection decision has been made by the transport company or the insurance company.
- Record the details of the damage immediately on site together with the carrier involved. This is essential for any claim for damages.
- If possible, photograph damage to packaging and packaged goods. This also applies to signs of corrosion on the packaged goods due to moisture inside the packaging (rain, snow, condensation).
- Be absolutely sure to also check the sealed packaging.

### **Hidden damage**

When damage is not determined until unpacking after receipt of the shipment (hidden damage), proceed as follows:

- Make the party responsible for the damage liable as soon as possible by telephone and in writing, and prepare a damage report.
- Observe the time periods applicable to such actions in the respective country. Inquire about these in good time.

With hidden damage, it is very hard to make the transportation company (or other responsible party) liable. Any insurance claims for such damage can only be successful if relevant provisions are expressly included in the insurance terms and conditions.



### 5.5 Storage of shipments

When selecting and setting up the storage location, ensure the following:

- Store the product and accessories in the original packaging until installation.
- Protect stored goods against moisture (rain, flooding, water from melting snow and ice), dirt, pests such as rats, mice, termites etc. and against unauthorized access.
- Store crates and boxes on pallets, timber beams or planks as protection against ground moisture and for improved ventilation.
- Ensure that the foundation has sufficient load-bearing capacity.
- Keep entrance paths clear.
- Check the stored goods at regular intervals. Also take appropriate action after storms, heavy rain or snow etc.

### 5.6 Further transport

Use the original product packaging for further transport.

If you transport the product to the final installation site in a mounted state, observe the following information in order to protect the product against mechanical damage due to external influences.

#### Transport packaging requirements

- Select packaging suitable for the duration of transport or storage, taking the climatic conditions into consideration.
- Ensure that the packaging protects the product against transport stress such as shaking, vibrations and impacts.
- Ensure that the packaging protects the product against moisture such as rain, snow and condensation.
- Ensure that the packaging allows for sufficient air circulation in order to prevent the formation of condensation.

## 6 Mounting

This chapter describes how to correctly mount and connect the device.

### **⚠ DANGER**



#### **Electric shock!**

Risk of fatal injury due to electrical voltage. Always observe the following safety regulations when working in or on electrical equipment.

- ▶ Disconnect the equipment.
- ▶ Lock the equipment to prevent an unintentional restart.
- ▶ Make sure all poles are de-energized.
- ▶ Ground and short-circuit.
- ▶ Cover or cordon off adjacent energized parts.

### **NOTICE**

#### **Damage to the device!**

Electrostatic discharge can lead to damage to the device.

- ▶ Take precautionary measures to prevent the build-up of electrostatic charges on work surfaces and personnel.

### 6.1 Installation recommendation



Figure 3: Installation recommendation

#### **Recommended installation position**

- |   |   |
|---|---|
| 1 | Side wall of the transformer, half way up |
|---|---|

#### **Alternative installation positions**

- |   |   |
|---|---|
| 2 | Connection pipe from the cooling system to the transformer tank |
|---|---|

**Less recommended installation positions**

- 3 On the side in the lower area; so long as oil circulation is ensured at the intended position, installing the device here may be considered.
- 4 Connection pipe from the transformer tank to the cooling system: the oil temperatures here can be very high and influence the quality of the measurements

**Impermissible installation positions**

- 5 On top of the transformer cover, installed vertically (display faces upwards)



Ensure that the ventilation openings (see chapter "Design" [▶ Section 4.3, Page 18] and drawing "Electrical connection" [▶ Section 14.4, Page 97] in the appendix) are not covered and have at least 2 cm clearance to neighboring devices.

## 6.2 Mounting the device

**NOTICE**

**Danger of damaging the device measuring pipe!**

Closing a slide valve when the device is inserted can damage the measuring pipe.

- ▶ Do not close a slide valve when the device is inserted.
- ▶ Observe Mounting and Disassembly Instructions!
- ▶ Attach the warning sign "Do not close!" included in the delivery to the slide valve.
- ▶ Remove the warning sign after removing the device.

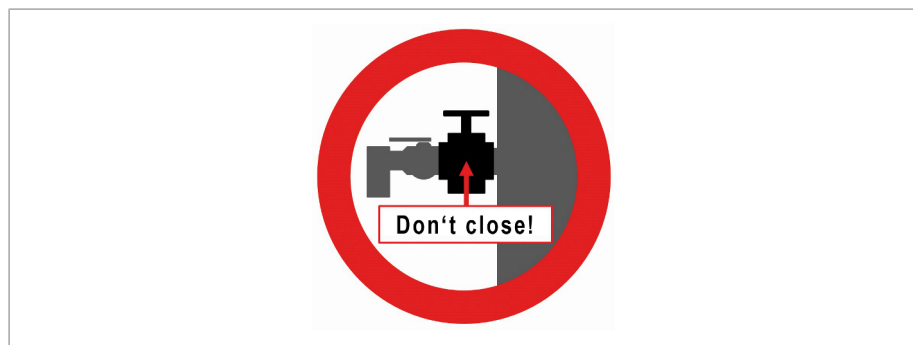


Figure 4: Warning sign on the ball valve



### 6.2.1 Preparing the transformer and ball valve

✓ A flange is mounted on the transformer that matches the device ball valve flange.

1. Carefully remove the ball valve from the packaging and protect it against damage.
2. Remove the fixing screw from the dummy plug.

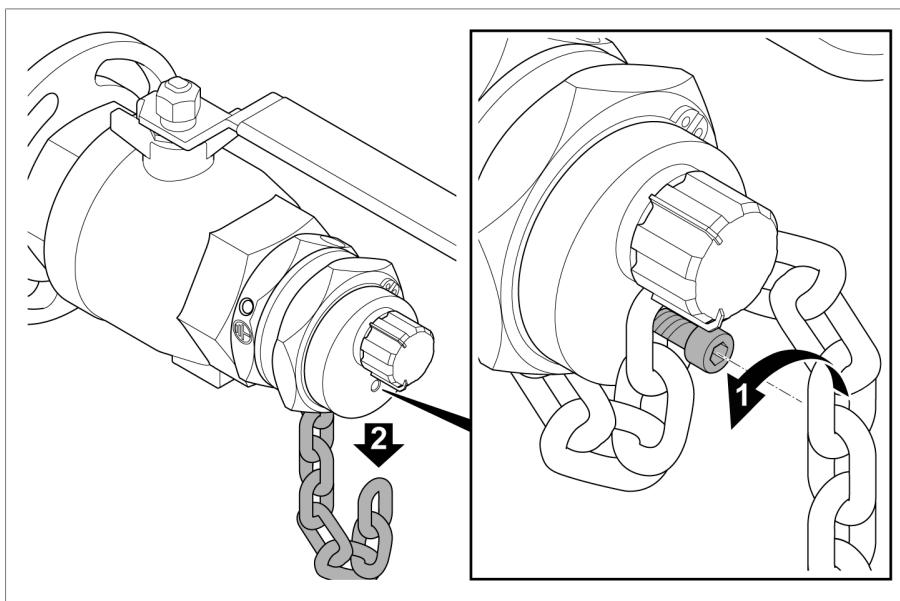


Figure 5: Unchaining the dummy plug

3. Release the clamp connection.

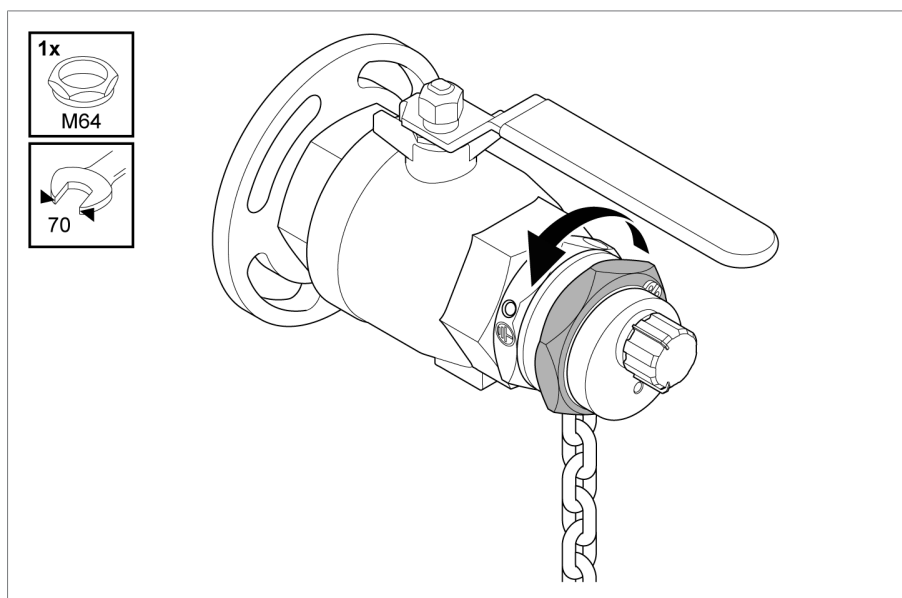


Figure 6: Releasing the clamp connection

4. Pulling the dummy plug out

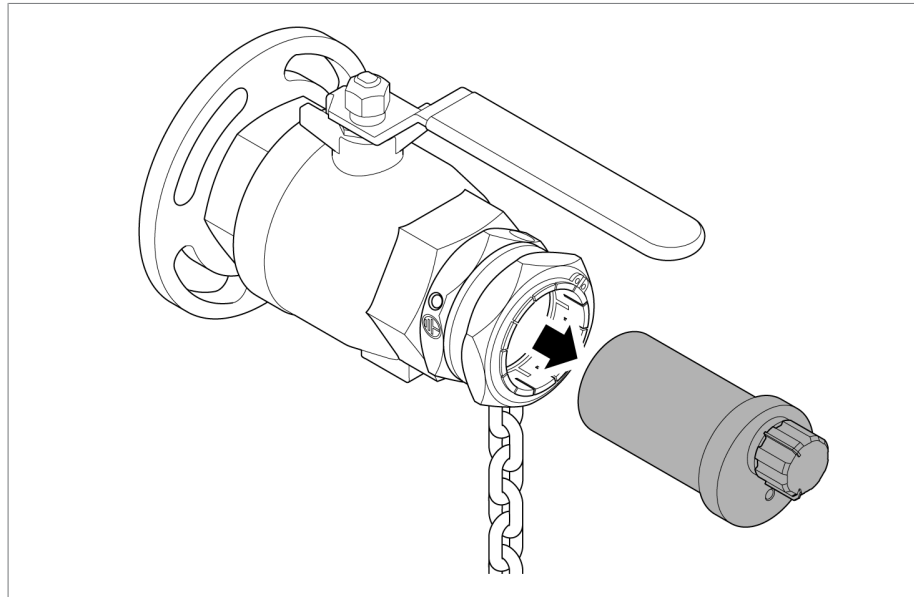


Figure 7: Pulling the dummy plug out



Package the dummy plug and store safely in case the device is to be removed at a later date.

5. Turn the ball valve lever to the "closed" position.

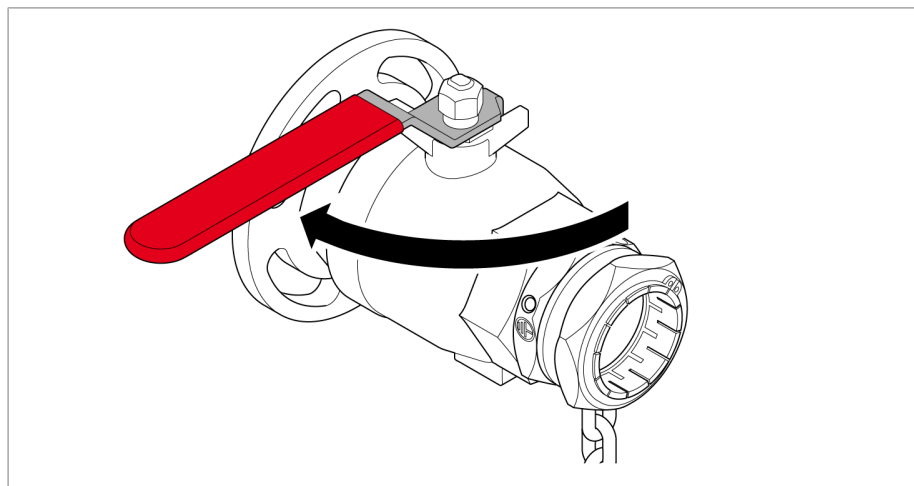


Figure 8: Closing the ball valve

**NOTICE**

**Missing or incorrectly positioned round gasket**

Non-tight seal and possible oil leakage.

- ▶ Ensure that all round gaskets remain in position in the ball valve when lubricating.

6. Lubricate the two round gaskets at the front of the ball valve.

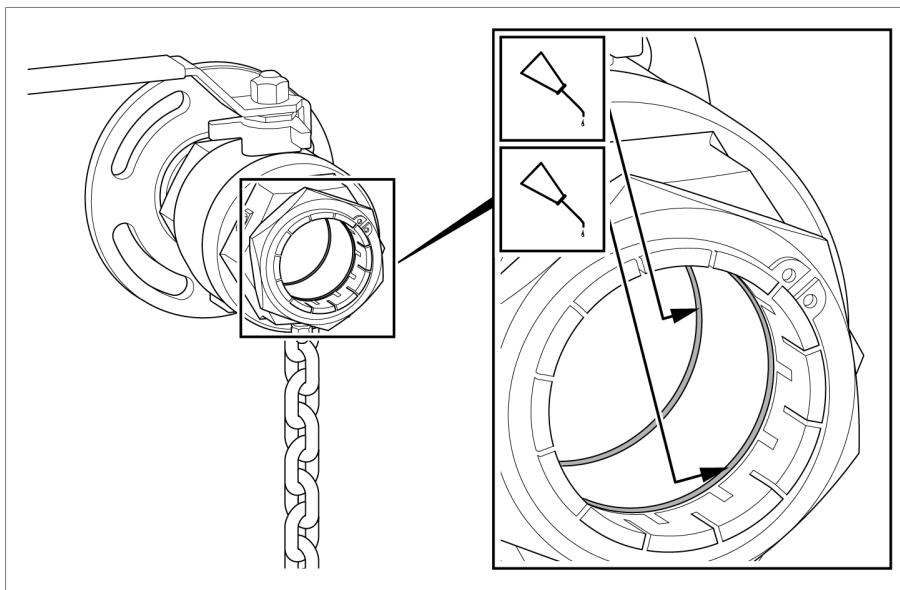


Figure 9: Lubricating the ball valve gaskets

7. Lubricate the two round gaskets at the rear of the ball valve.

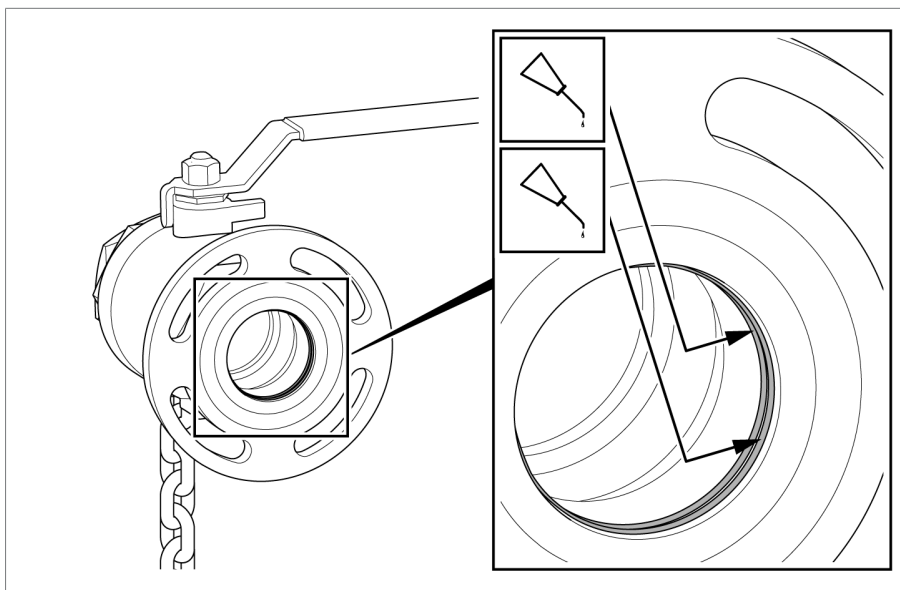


Figure 10: Lubricating the ball valve gaskets

8. **NOTICE!** Mounting errors can lead to non-tight seals and thus uncontrolled oil leakage. Ensure that the supplied flange gasket is inserted and that it remains in the groove between the flanges. In the flange version without groove, a flat gasket that is not included in the delivery is necessary (see Connecting flange dimensions [► Section 14.3, Page 95]).

9. Mount the closed ball valve on the transformer and align via the elongated holes so that the locking lever is at the **top**. Use fastening materials made of stainless steel A4 in the strength category -70.

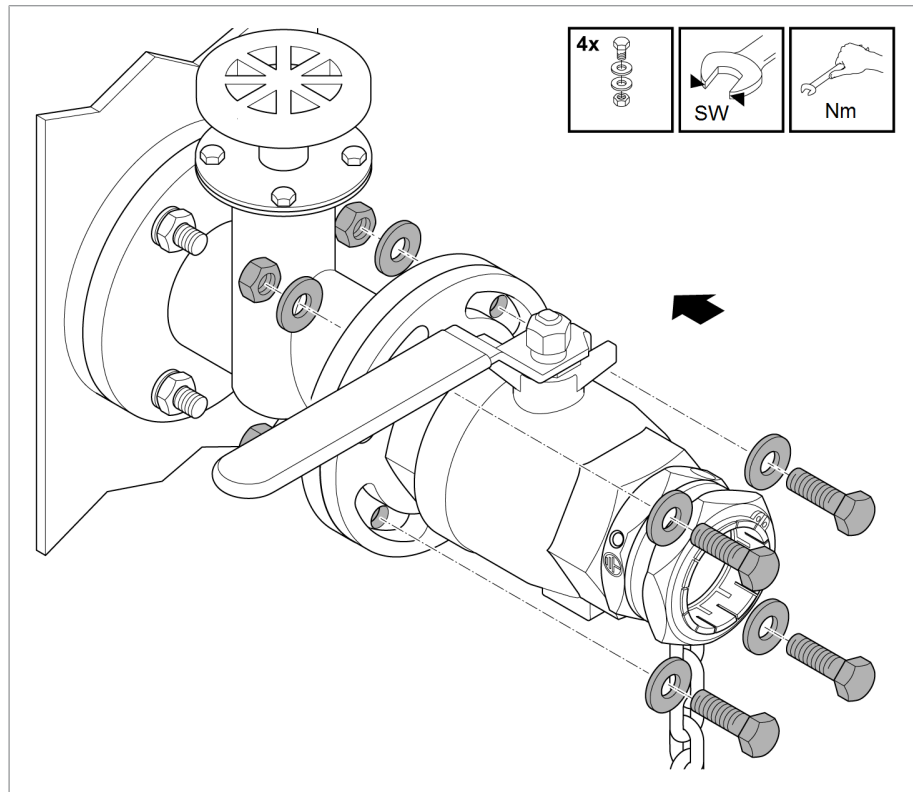


Figure 11: Mounting the closed ball valve

Flange	Screws	WAF	Nm
DN50 PN6	M12 A4-70	19/18	62
DN50 PN16	M16 A4-70	24	150
DN80 PN16	M16 A4-70	24	150



Grease the steel clamping ring regularly with Vaseline or the grease supplied to protect it against corrosion; see also chapter Ensuring offshore capability [► Section 6.4, Page 47].

### 6.2.2 Mounting the MSENSE® DGA 2/3

1. Remove the device from the packaging and place it securely on a scratch-resistant and non-slip level surface.

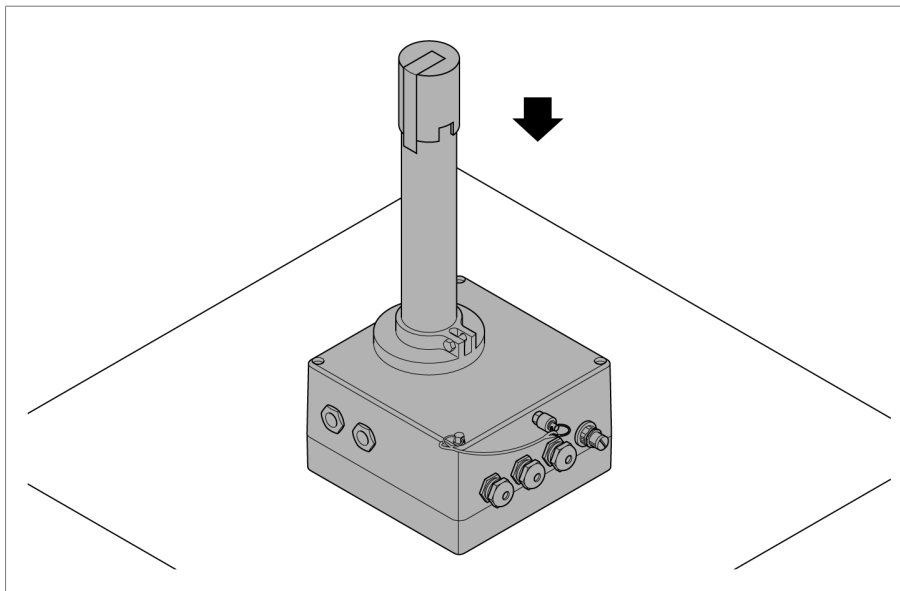


Figure 12: Setting the device down securely



When doing so, ensure that the display of the device version with display is not damaged.

2. Remove the adhesive strip from the protective cap and pull the protective cap off of the device.

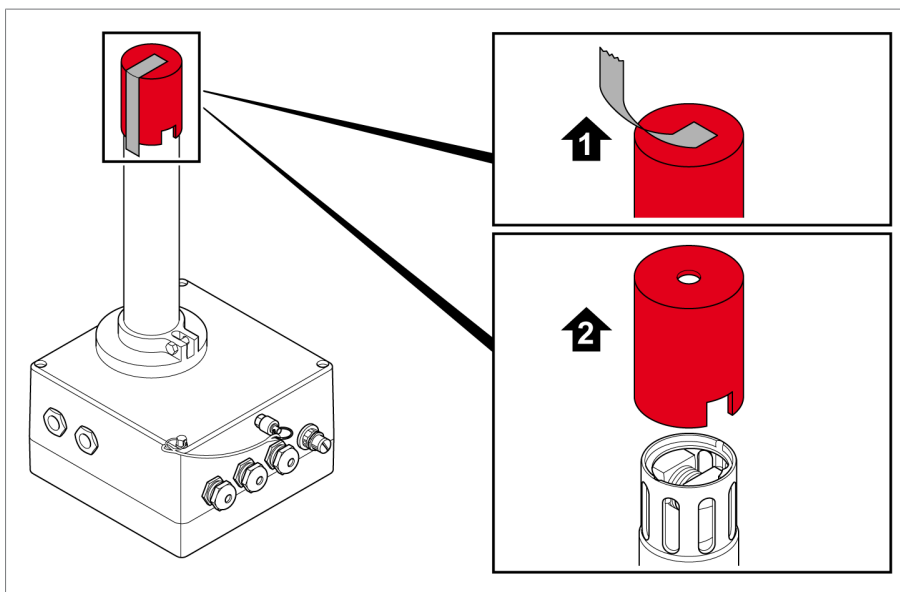


Figure 13: Removing the protective cap



Store the protective cap in case the device is to be removed at a later date.

3. Open the connection for taking oil samples. To do so, push the bayonet connector toward the device, hold down and pull the sealing plug out. Release the bayonet connector.

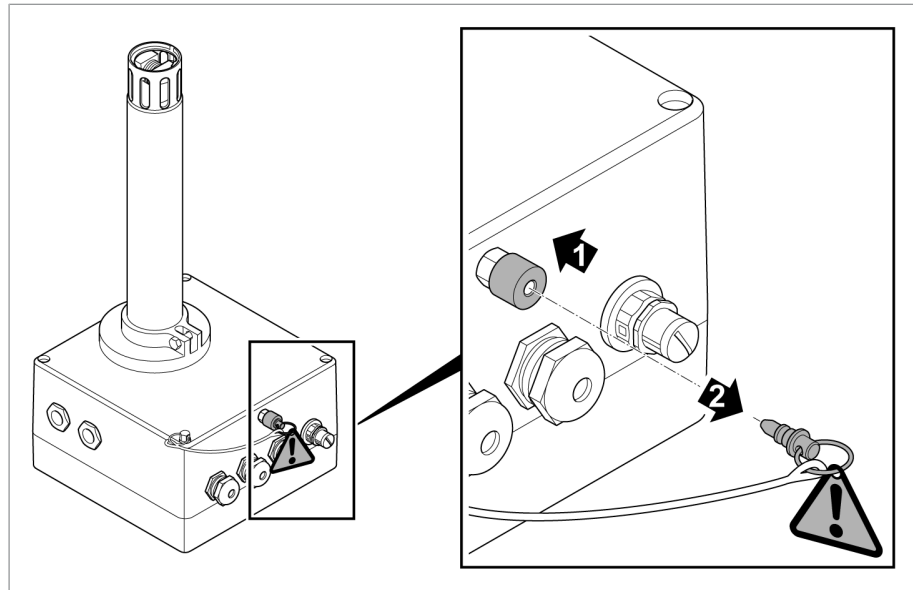


Figure 14: Opening the connection for venting and taking oil samples



4. **NOTICE!** Make sure the oil extraction adapter belongs to this device. If the standard version and the offshore version are mixed up, the oil extraction connection and the adapter can become damaged. Push the supplied oil extraction adapter into the opening until it audibly snaps into place.

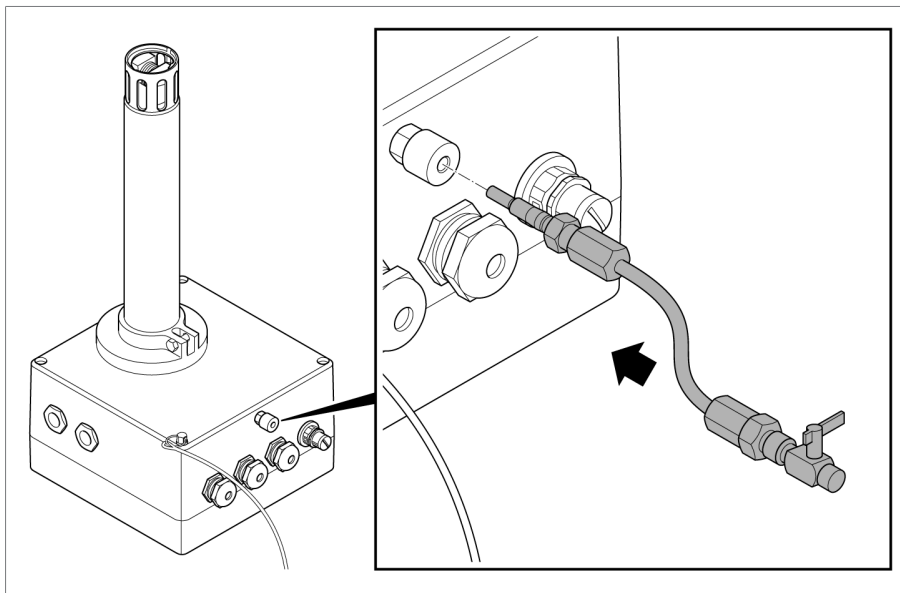


Figure 15: Connecting the oil extraction adapter

5. Open the oil extractor valve so that the air present can dissipate during further assembly.

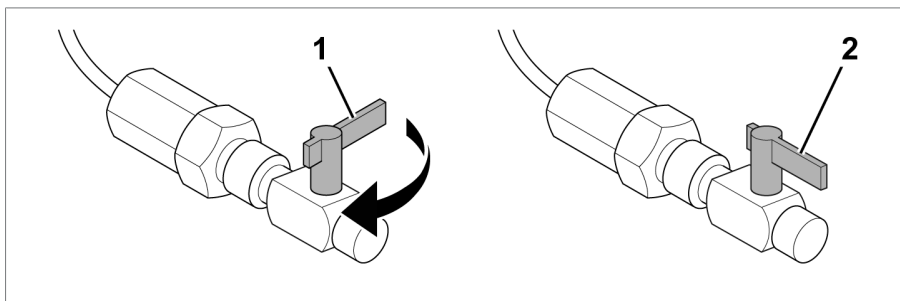


Figure 16: Opening the oil extraction adapter

6. Insert the measuring pipe into the closed ball valve.



If the device is an offshore version, the steel clamping ring on the ball valve is to be greased prior to mounting the device (see chapter Ensuring offshore capability [► Section 6.4, Page 47]).

**NOTICE**

**Risk of damage**

The device measuring pipe can become tilted when it is inserted into the ball valve.

- Support the weight of the device by hand and push the pipe into the ball valve with even pressure up to the stop (tangible resistance).

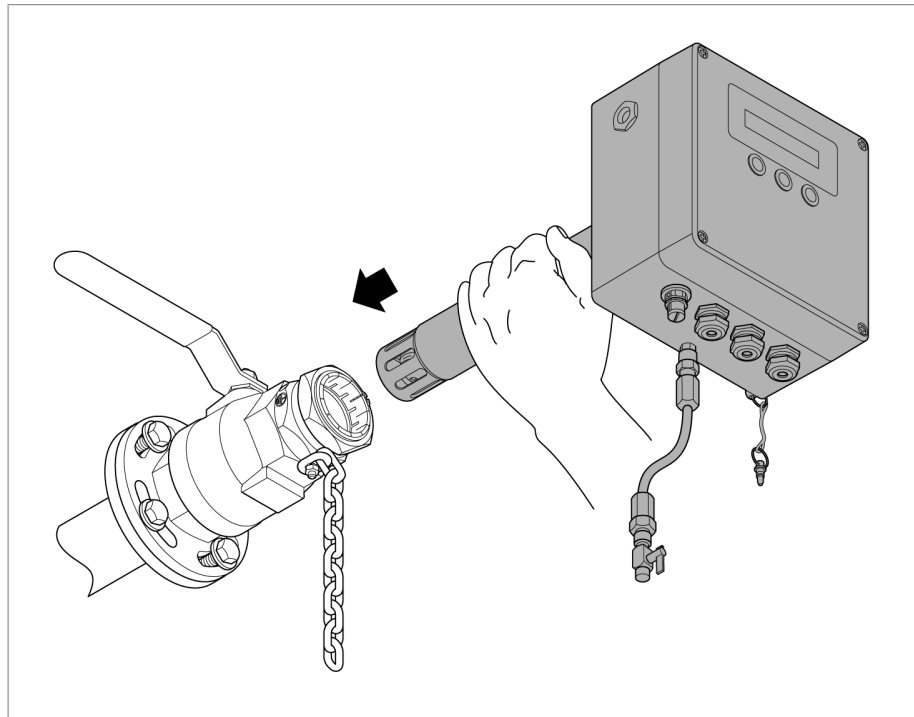


Figure 17: Inserting the device into the ball valve

7. Unscrew the fixing screw for the safety chain on the device until the opening for the chain is free. Insert the last link of the safety chain into the opening, hold it in this position, thread the fixing screw through the chain link and tighten with a torque of 7 Nm.

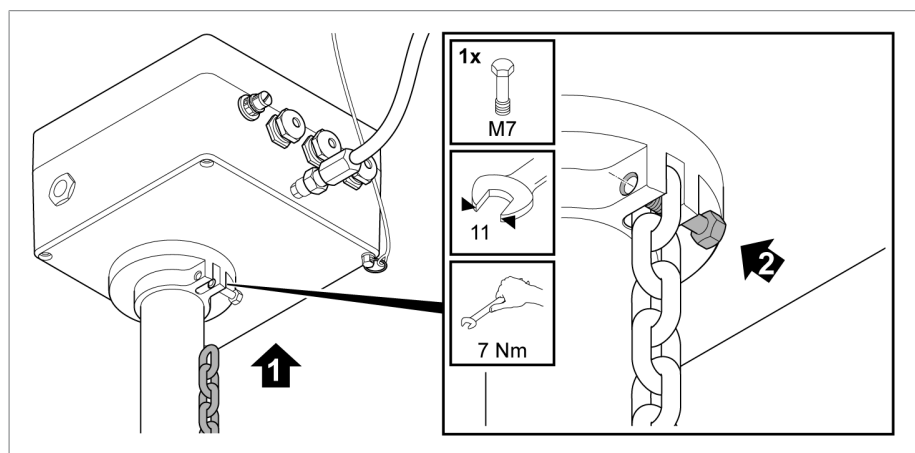


Figure 18: Inserting and securing the safety chain



**▲ CAUTION**



**Risk of burns**

Hot oil can push the device out of the ball valve and spray out.

- ▶ Ensure that the safety chain is correctly bolted in place and does not sag.

8. Position a collecting tray below the valve opening in the oil extraction adapter and open the ball valve by aligning the lever up to the stop parallel to the measuring pipe.

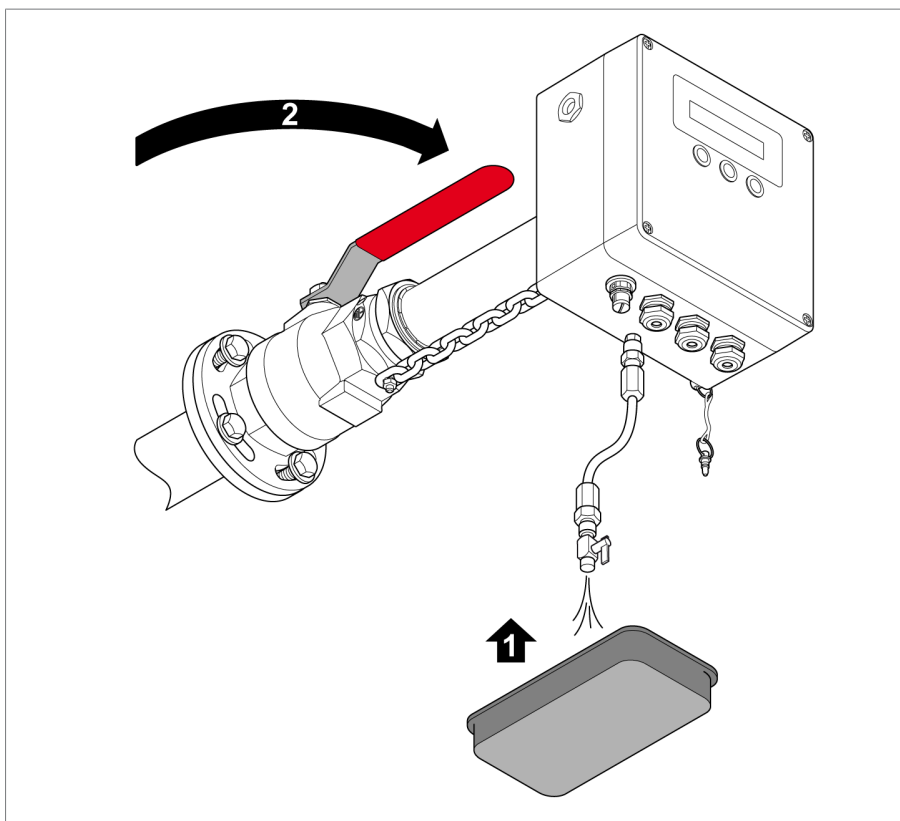


Figure 19: Venting the device

9. Open any upstream valves and slides.



Excess air will be purged from the system via the oil extraction adapter due to the pressure of the oil.

10. Vent the system until only oil flows out of the adapter.

11. Close the oil extraction adapter valve.

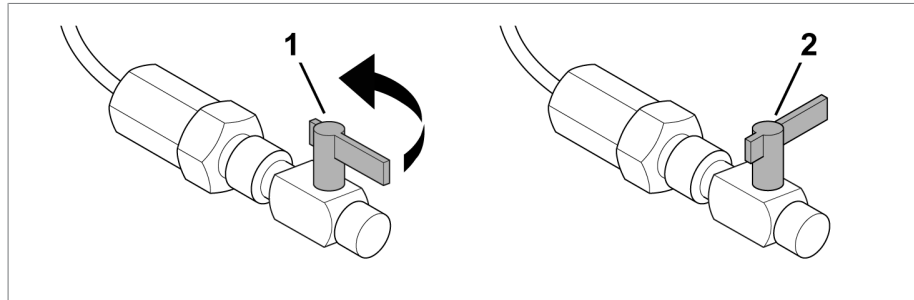


Figure 20: Closing the oil extraction adapter

12. Remove the adapter from the device. To do so, push the bayonet connector toward the device, hold down and pull the adapter out. Release the bayonet connector.

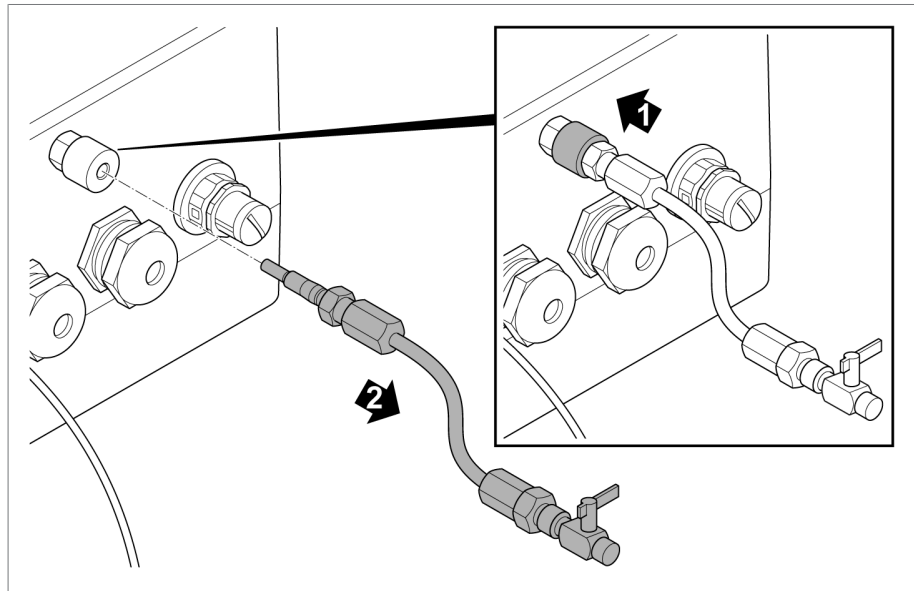


Figure 21: Removing the oil extraction adapter

13. Put the sealing plug back on the bayonet connector for venting and taking oil samples and push it in until it snaps into place.

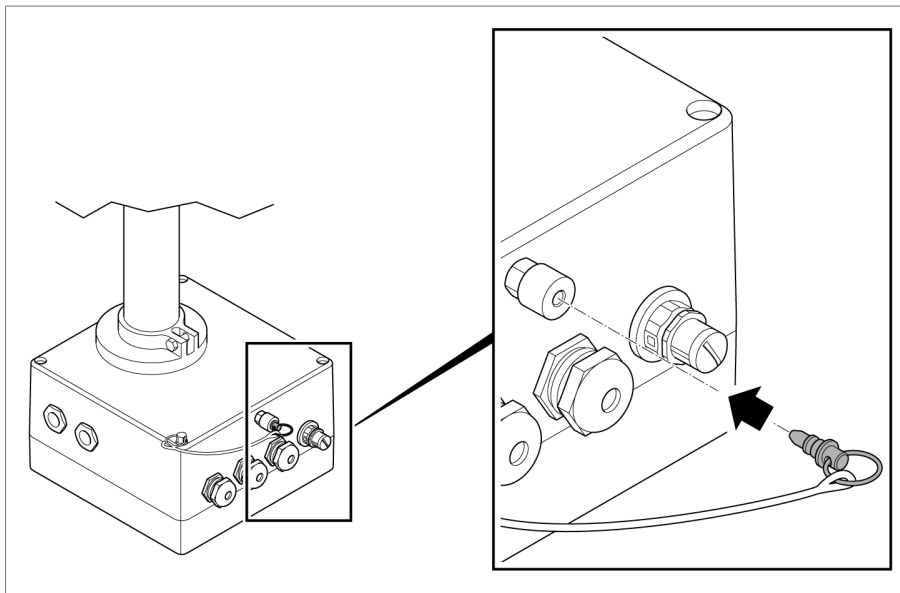


Figure 22: Inserting the sealing plug



Ensure that the connection is tightly sealed.

14. Push the device as far as possible into the system.

**▲ WARNING**



**Electric shock**

Risk of fatal injury due to electrical voltage.

- ▶ Maintain the necessary distance from the active part of the transformer (see Device dimensions with 285 mm measuring pipe length [▶ Section 14.1, Page 93] and Device dimensions with 507 mm measuring pipe length [▶ Section 14.2, Page 94]).

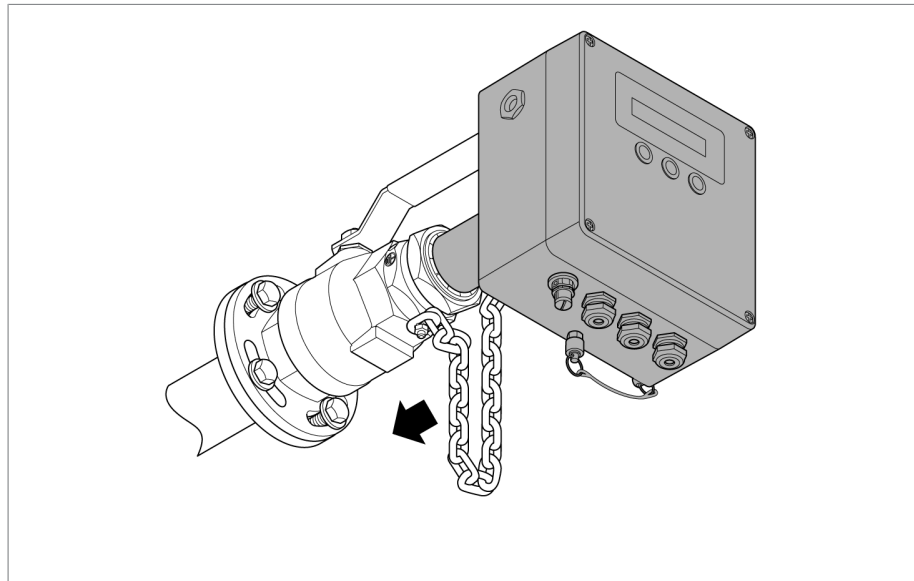


Figure 23: Pushing the device into the system

15. Tighten the ball valve clamp connection using a wrench (wrench size 70) with a torque of 140 Nm.

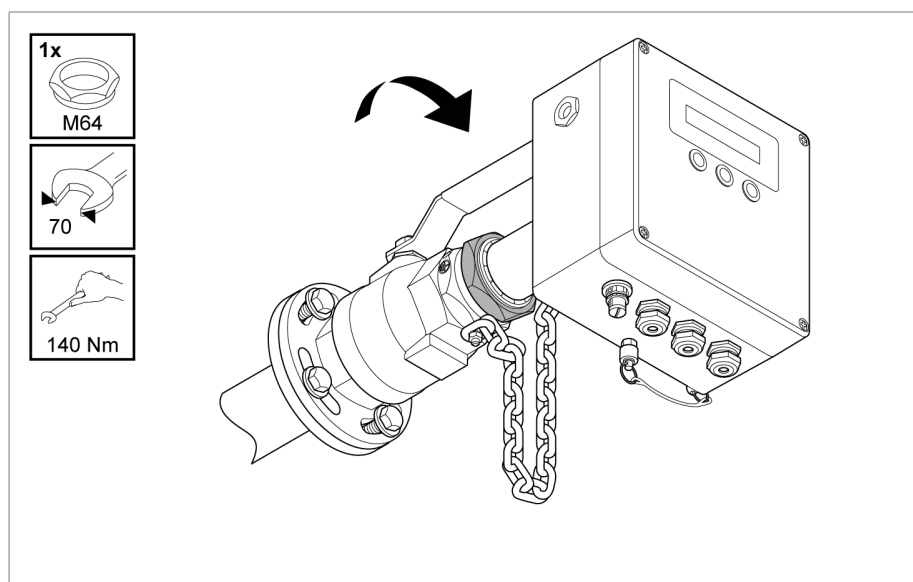


Figure 24: Securing the MSENSE

16. Reduce the length of the sagging safety chain by inserting the supplied chain connector through two links in the chain and closing it.

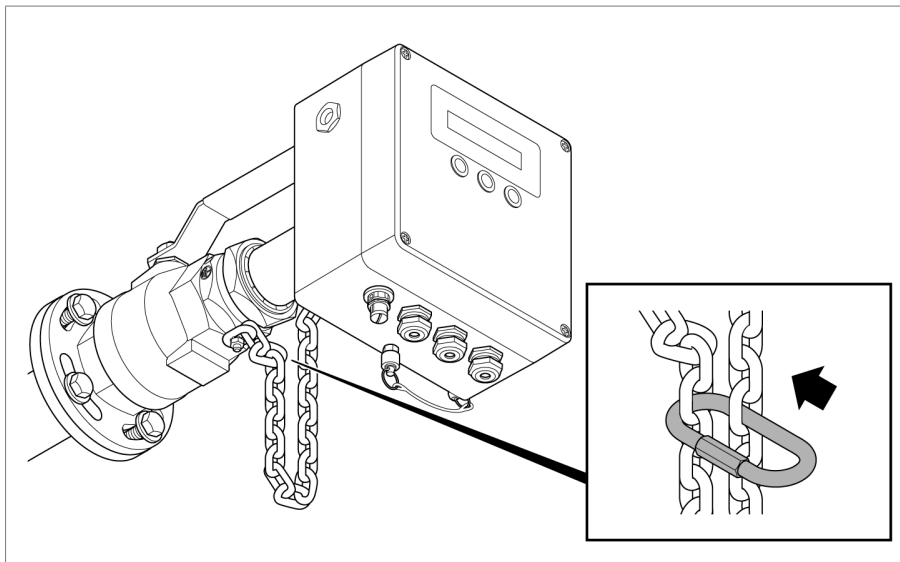


Figure 25: Locking the safety chain



Alternatively, a padlock can be used to secure the device against unauthorized removal.

#### Affixing the warning sign

► Attach the warning sign "Do not close!" to the shutter valve using the cable tie included.

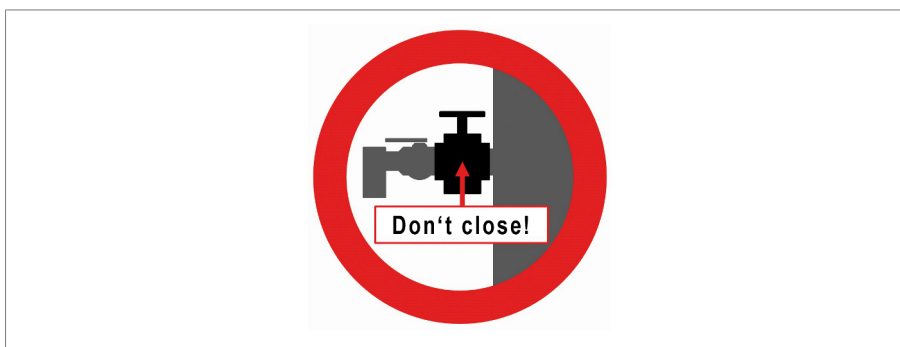


Figure 26: Warning sign

### 6.3 Electrical connection

This chapter describes the correct electrical connection of the device.

#### ▲ WARNING



#### Electric shock

Risk of fatal injury due to electrical voltage.

- ▶ De-energize the device and system peripherals and take measures to ensure that they cannot be switched back on.

Only connect the device to circuits with an external overcurrent protection device and an all-pole isolating device so that the equipment can be fully de-energized if required (for service, maintenance, etc.).

Suitable equipment includes isolating devices in accordance with IEC 60947-1 and IEC 60947-3 (e.g. circuit breakers). Note the properties of the relevant circuits (voltage, maximum currents) when selecting the circuit breaker type. In addition, observe the following:

- It must be easy for the operator to access the isolating device
- The isolating device must be labeled for the device and circuits to be isolated
- The isolating device may not be a part of the power line
- The isolating device may not interrupt the main protective conductor

#### Miniature circuit breaker

We recommend the use of a miniature circuit breaker for protecting the supply circuit:

- Rated current: 16 A
- Triggering characteristic: C

#### Conductor cross-section

For the supply circuit, use a conductor cross-section suitable for the overcurrent protective device that you have selected and the selected cable length, but at least 1.5 mm<sup>2</sup> (AWG 15).

#### Wiring information

Note this procedure for the wiring:

- ✓ To obtain a better overview when connecting cables, only use as many leads as necessary.
- ✓ Note the connection diagram [▶ Section 14.4, Page 97].
- ✓ Only use specified cables for wiring. Note the cable recommendation [▶ Section 6.3.2, Page 39].
- ✓ Wire the system periphery leads.
  1. Strip insulation from leads and wires.
  2. Crimp stranded wires with wire end sleeves.



### 6.3.1 Electromagnetic compatibility

The device has been developed in accordance with applicable EMC standards. The following points must be observed in order to maintain the EMC standards.

- The system's overvoltage protection must be effective.
- The system's ground connection must comply with all technical regulations.
- For signal transmission, use shielded leads with individual conductors (outgoing conductor / return conductor) twisted in pairs.
- Connect full surface of shielding to device or to a nearby grounding bar.

### 6.3.2 Cable recommendation

Please note the following Maschinenfabrik Reinhausen GmbH recommendation when wiring the device.



Excessive line capacitance can prevent the relay contacts from interrupting the contact current. In control circuits operated with alternating current, take into account the effect of the line capacitance of long control cables on the function of the relay contacts.



The connection cables used must comply with a temperature resistance within the permissible ambient temperature range of -40...+60 °C.

Cable	Terminal**	Cable type	Max. length
Power supply	1, 2, 3	Unshielded	
Analog outputs	4...12	Shielded	400 m (<25 Ω/km)
Relay*	13...27	Unshielded	

Table 6: Recommendation for connection cables

\*) Observe line capacitance.

\*\* ) Also refer to Terminal technical data [► Section 13, Page 90].

### 6.3.3 Routing and preparing the cables

Consider the position of the connections when preparing the cables (see chapter Electrical connection [► Section 14.4, Page 97]).



Ensure that the length of the PE conductor (terminal 3) is at least 50 mm longer than the supply voltage conductors (terminals 1 and 2).

To prepare the cable correctly, proceed as follows:

1. Open the device connection area. To do so, unscrew the 4 captive screws on the housing cover. The cover is connected to the device via hinges and can be flipped open.
2. Remove the supply voltage cable jacket and cut the cable so that the length of the PE wire is 50 mm longer than the wires for L and N. Strip 7 mm (1/4") of the insulation from the wires and cap them off with ferrules.

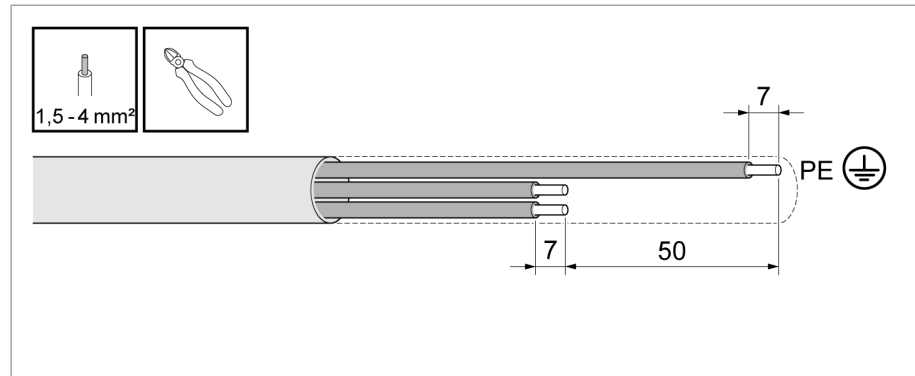


Figure 27: Preparing the cable

3. Remove the jacket from the cable for the relay and analog outputs. Strip off 7 mm (1/4") of insulation from the wires and cap them off with ferrules.
4. Unscrew the required cable screw connections (M20x1.5).
5. Insert a sufficient length of cable through the cable gland and rubber gasket and tighten the cable gland so that moisture cannot penetrate into the connection area from outside.
6. Insert locking screws into the unused cable connections or replace the entire cable connection with a locking screw so that the pass-through is watertight.

### 6.3.4 Supply voltage and protective conductor

To connect the cable for the supply voltage and the protective conductor, proceed as follows:

1. Insert wire for the protective conductor into terminal 3 (PE) and tighten the screw terminal with 0.5 Nm.
2. Insert wires for the supply voltage into terminal 1 and terminal 2 and tighten the screw terminals with 0.5 Nm.

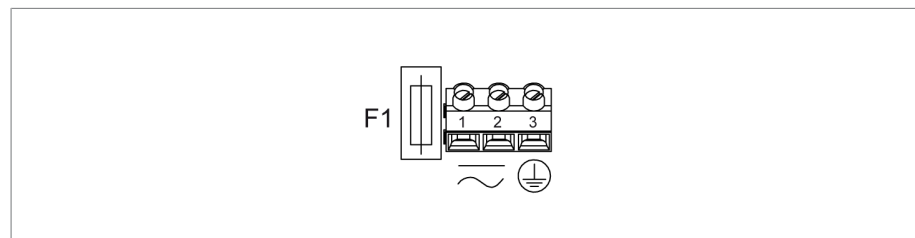


Figure 28: Supply voltage and protective ground connection





Ensure that the protective conductor cross-section is at least the same as all other connection conductors.

### 6.3.5 Device grounding

Connect the ground connection on the device ball valve to the transformer ground connection.

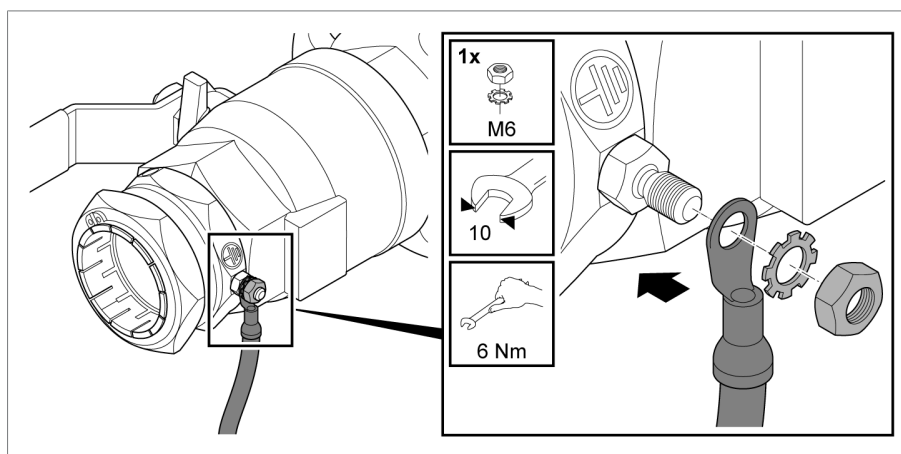


Figure 29: Ground connection

With offshore devices, the grounding point of the ball valve is to be greased (see chapter Ensuring offshore capability [► Section 6.4, Page 47]).

### 6.3.6 Analog outputs

The device has **passive**, electrically isolated 4...20 mA analog outputs for the remote transmission of the measured values.

The output signals can be configured using the MESSKO® MSET parameterization software.

The terminal strip is assigned by default (factory setting) as follows:

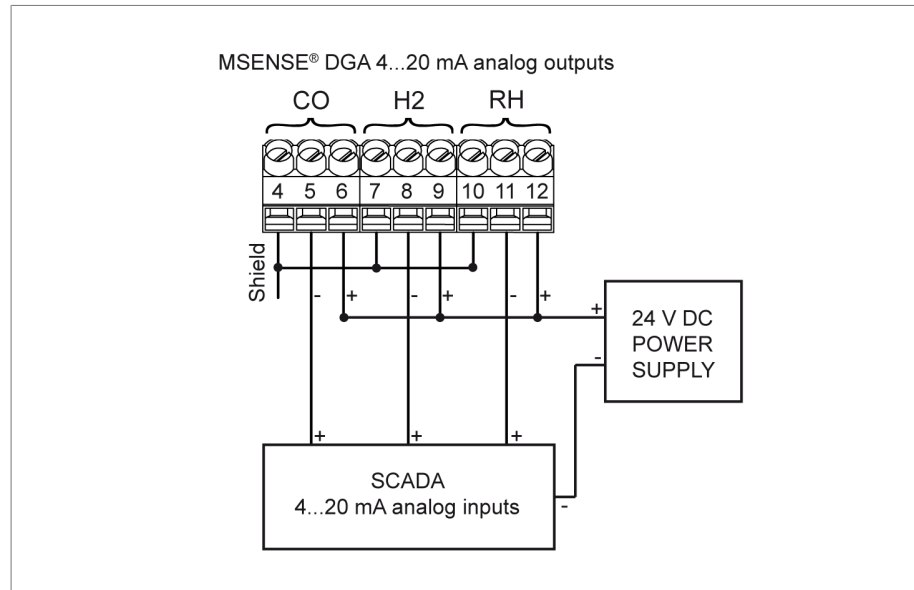


Figure 30: Analog outputs

- CO concentration: terminals 4, 5, 6 (MSENSE® DGA 3 only)
- H2 concentration: terminals 7, 8, 9
- RH relative humidity: terminals 10, 11, 12

To connect the cables, proceed as follows:

1. Insert the wires into the terminals.
2. Twist the shielding and insert it into the respective "Shield" terminal.
3. Tighten the screw connections with a maximum of 0.5 Nm.

### 6.3.7 Main switching contacts

The device has 5 floating main switching contacts: S1, S2, S3, S4 and one safety switching contact = fail-safe relay (FSR) for status signaling. These contacts are designed as change-over contacts and are connected to the terminals 13/14/15 (S1), 16/17/18 (S2), 19/20/21 (S3), 22/23/24 (S4) and 25/26/27 (FSR).

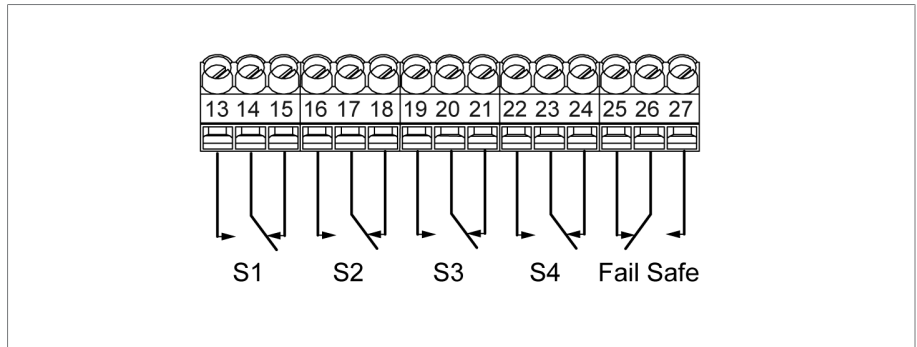


Figure 31: Main switching contacts

The main switching contacts are shown in the idle state in the figure. Using the fail-safe relay as an example, this means:

State	Contact 25-26	Contact 26-27
Idle state	Closed	Open
Fault	Open	Closed

The contact current capacity is max. 5 A / 250 AC or 5 A / 30 V DC.

S1...S4:

The assignment can be configured via the MESSKO® MSET parameterization software. The relay triggers when the configured threshold value is exceeded.

FSR:

The fail-safe relay serves as a safety contact for signaling errors in the event of a voltage failure or an internal device error.

#### **▲ WARNING**



#### **Electric shock!**

When a dangerous electrical voltage is applied to one of the main switching contacts S1, S2, S3, S4 or the fail-safe relay, the neighboring main switching contacts may not be operated with safety extra-low voltage.

- ▶ Operate all main switching contacts uniformly, either with safety extra-low voltage only or with higher voltages only.
- ▶ Also observe the specifications in the chapter "Technical data" [▶ Section 13, Page 90].

To connect the system periphery cables to the main switching contacts, proceed as follows:

- ✓ Only use specified cables. Note the cable recommendation.
- 1. Connect the leads that are to be wired to the device in accordance with the illustration of the main switching contacts. When doing so, also observe the illustration "Electrical connection" [► Section 14.4, Page 97] in the appendix.
- 2. Tighten all screw connections with a maximum of 0.5 Nm.

### 6.3.8 SCADA connection

#### 6.3.8.1 Standard interface Modbus RTU

The device can be connected with a SCADA system via the Modbus interface. This is designed as a 4-conductor system [► Section 6.3.8.4, Page 45], but can also be integrated into a 2-conductor system [► Section 6.3.8.5, Page 46].

The following signals are available in the 4-conductor system via the M12 socket:

#### M12 socket / Modbus (RTU) interface assignment

PIN	4-conductor system	2-conductor system
1	TXD0 / TX+ / Y	D0 / D+ / A
2	TXD1 / TX- / Z	D1 / D- / B
3	RXD1 / RX- / B	D1 / D- / B
4	RXD0 / RX+ / A	D0 / D+ / A
5	Common	Common

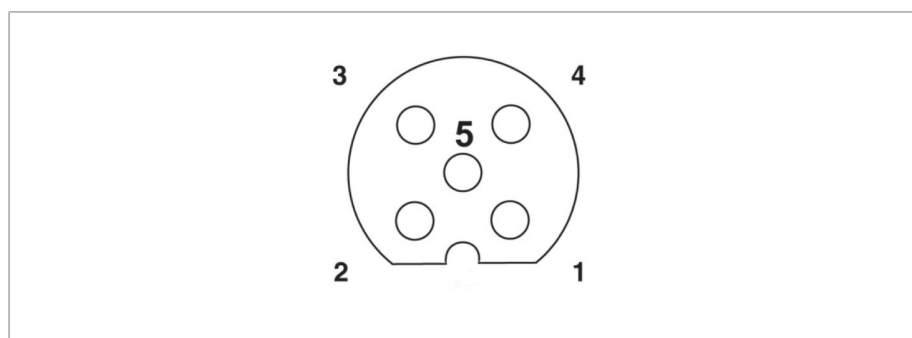


Figure 32: Integrated device socket (schematic)

#### 6.3.8.2 Setting the Modbus RTU transmission speed

You can configure the following settings for the Modbus RTU interface using the MESSKO® MSET parameterization software:



Device address: 1 to 247

Baud rate: 4800, 9600, ...115200

Parity: even

Detailed information is available in the MESSKO® MSET parameterization software operating instructions.

**6.3.8.3 Modbus RTU protocol**

The data point table for the Modbus RTU protocol is available in the Appendix [► Section 14.5, Page 98].

Comprehensive information on Modbus is available on the Internet: <http://www.modbus.org/>.

**6.3.8.4 Integration of the device into a 4-conductor system**

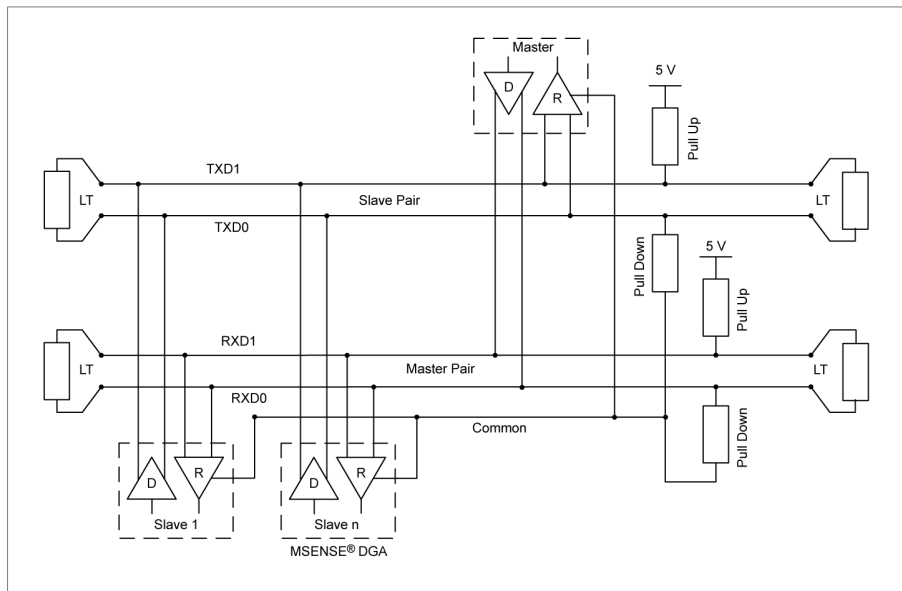


Figure 33: 4-conductor system

### 6.3.8.5 Integration of the device into a 2-conductor system

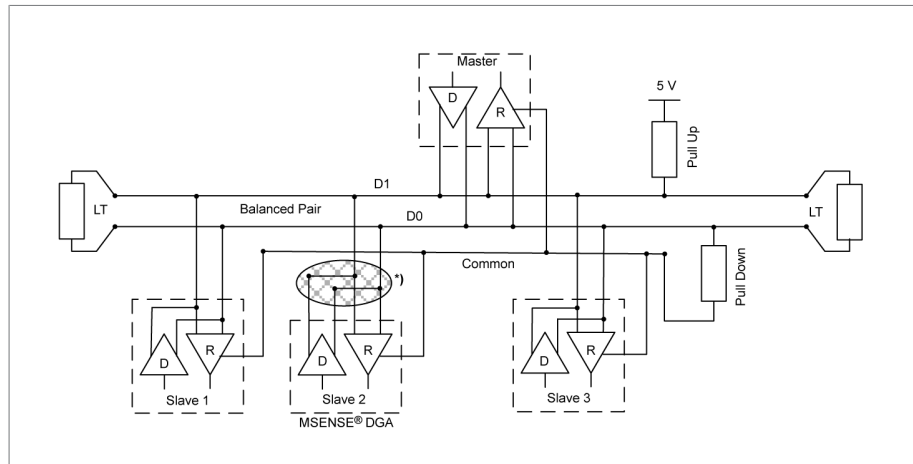


Figure 34: 2-conductor system

\*) When integrating the device into a 2-conductor system, the following conductors are to be bridged in the external supply line:

- Conductors TXD0 (pin 1) and RXD0 (pin 4)
- Conductors TXD1 (pin 2) and RXD1 (pin 3)

### 6.3.8.6 MESSKO® Protocol Converter for SCADA connection

With the MESSKO® Protocol Converter, which is available as an option, you can also connect the device to a SCADA system via the protocols DNP3 TCP, 61850-8-1 MMS or Modbus TCP.

For further instructions, please refer to the corresponding operating instructions for the MESSKO® Protocol Converter, which are available upon request.

### 6.4 Ensuring offshore capability

To prevent corrosion in offshore applications, greasing the following points is recommended (tube of grease included in delivery):

1. Cover the housing cover screws with grease.

**Time period:** After opening the housing cover; at least every 2 years.

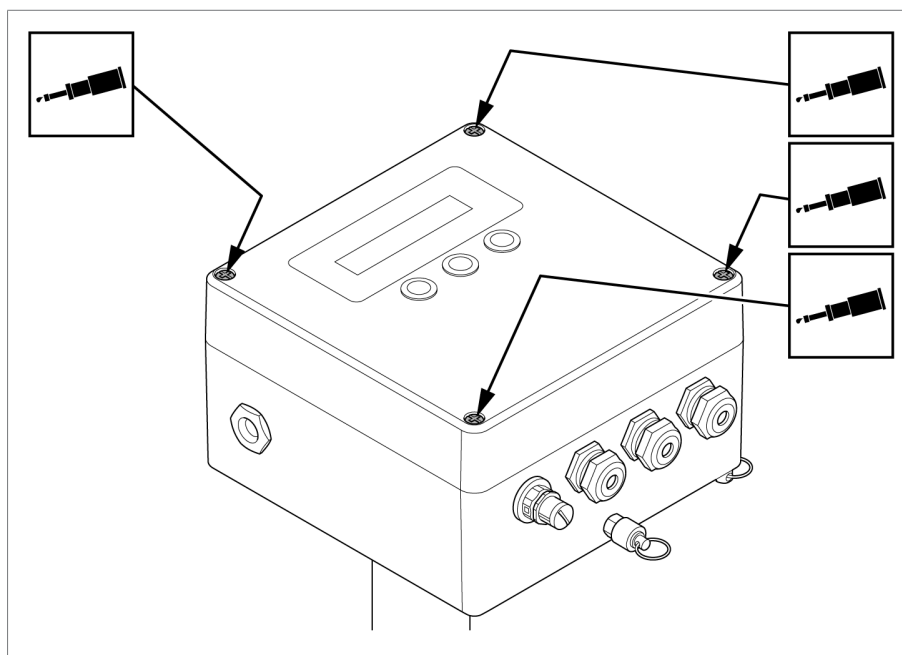


Figure 35: Greasing the housing cover screws

2. Fill the holes in the housing base with grease.  
**Time period:** At least every 2 years.

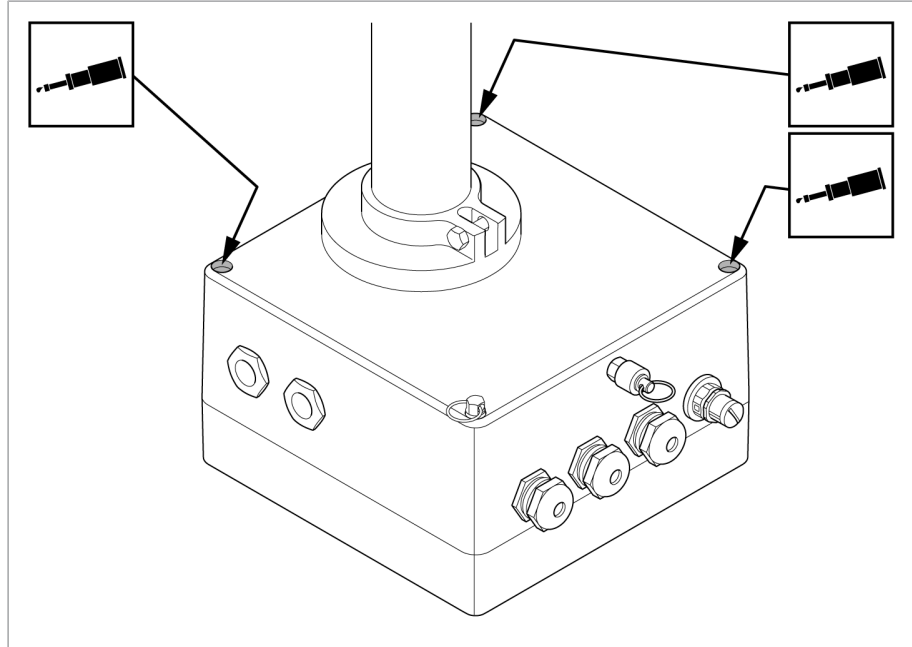


Figure 36: Holes in the housing base

3. Apply grease to the ball valve steel clamping ring liberally.  
 Avoid greasing the interior of the ball valve.  
**Time period:** After each mounting or removal process; at least every 2 years.

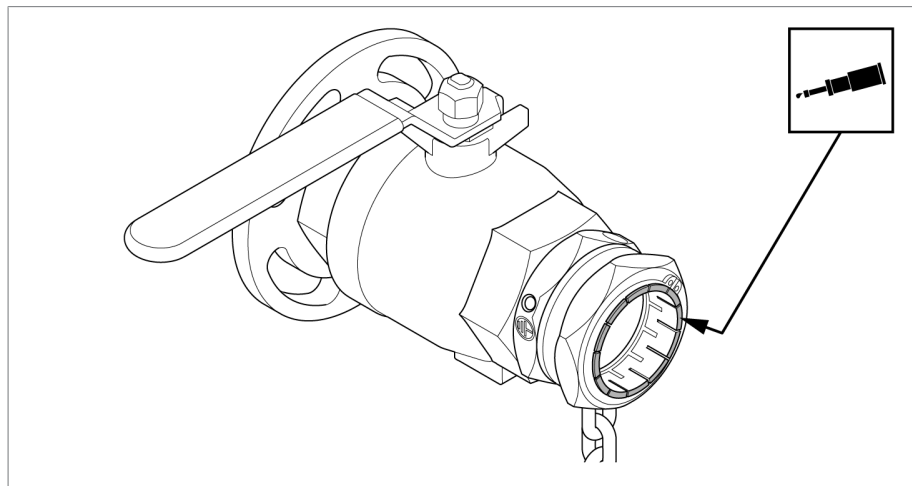


Figure 37: Ball valve steel clamping ring

4. Completely cover the grounding point on the ball valve with grease.  
**Time period:** After grounding the ball valve; at least every 2 years.



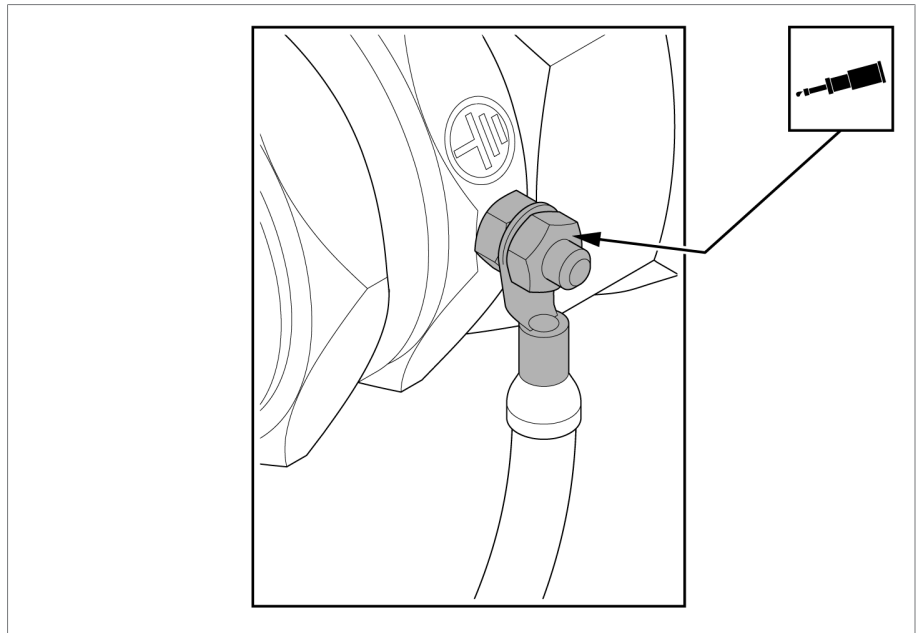


Figure 38: Grounding point on the ball valve



## 7 Commissioning

### NOTICE

#### Damage to the device!

Damage to the electronics of the device due to incorrect supply voltage!

- ▶ Provide the correct supply voltage in accordance with the nameplate on an external isolating device.

The device is ready for operation once it has been connected to the supply voltage and completed a run-in period of at least 24 hours. Measured values displayed during the run-in period do not reflect the true gas or moisture concentrations. For this reason, alarms and warnings can be ignored during the run-in period. The run-in period is to ensure the thermal stabilization of the measuring system and is indicated on devices with a display by an "!" in the display of the gases H<sub>2</sub> and CO (MSENSE® DGA 3).

The device takes measurements four times within 24 hours by default. This measurement interval can be changed using the MESSKO® MSET parameterization software (see corresponding operating instructions).



The device is calibrated at the factory for fresh mineral-based insulating oils (Standard **ASTM D3486-091** or **IEC 60422**).

#### Also refer to

- ▣ Safety markings and nameplate [▶ 19]

### 7.1 Service interface

The system is equipped with a service interface for configuring extended settings via the MESSKO® MSET parameterization software supplied.

### NOTICE

#### Damage to the device and PC/laptop

Potential differences can cause the devices to be destroyed.

- ▶ Ensure that the device supply voltage and the PC/laptop supply voltage have the same ground potential (PE).
- ▶ Use the outlet in the control cabinet.
- ▶ Operate a laptop in battery mode wherever possible.

Proceed as follows:

1. Plug the screw connection of the USB service adapter onto plug connector 11 in accordance with the figure in the chapter "Design" [► Section 4.3, Page 18] and tighten the screw connection by hand.
2. Connect the device service adapter USB plug to the PC or laptop on which the MESSKO® MSET parameterization software is installed (see corresponding operating instructions).

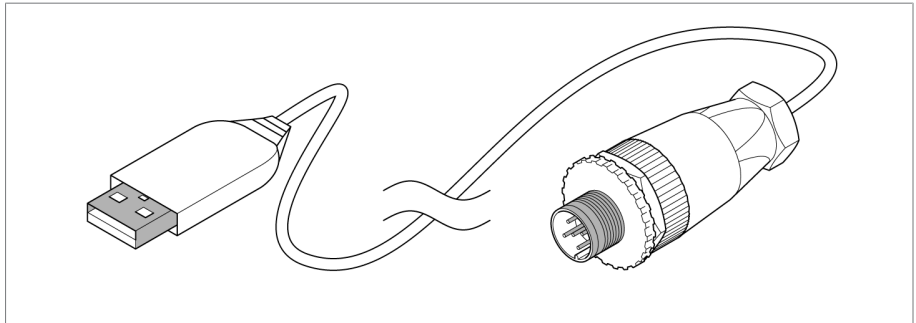


Figure 39: USB service adapter

⇒ The device can now be parameterized via the MESSKO® MSET parameterization software.

## 7.2 Installing the MESSKO® MSET parameterization software

You can download the latest version of the MESSKO® MSET parameterization software from the MR Reinhausen customer portal.

1. Register for download in the customer portal:  
<https://portal.reinhausen.com>.
2. Create your ECOSENSE® ACTIVE PART under **myEquipment > Components**.
3. Then enter the serial number under **mySelfServices > Software updates**.



The Microsoft Windows 10 operating system or later is necessary for installing the MESSKO® MSET parameterization software.

To install the MESSKO® MSET parameterization software, proceed as follows:

1. Start the MSETSetup.exe setup file.
2. Select the language in which you want to run the installation process.
3. Follow the instructions in the setup wizard.
4. Upon successful installation, the program can be started via Start > All programs > MESSKO > MSET > MSET program icon.



Detailed information on using the MESSKO® MSET parameterization software can be found in the corresponding operating instructions.

### 7.3 Commissioning in existing systems

The manufacturer recommends a field calibration of the device parameters to ensure optimum operation, in particular with:

- Aged insulating oils
- Modified oils (e.g., the addition of additives)
- Oils that do not satisfy the standards ASTM D3486-091, IEC 60296 or IEC 60422.

Here, an oil sample must be taken in accordance with the chapter "Oil extraction" [► Section 10.3, Page 69] and sent to Messko GmbH together with the "SAMPLE DATA SHEET – OIL ANALYSIS". You will then receive a recommendation for action from Messko for readjustment via the MESSKO® MSET parameterization software.

### 7.4 Parameterization

Parameterization of the device is only possible in combination with the MESSKO® MSET parameterization software, and is described in detail in the corresponding operating instructions.

The set values for the gas carbon monoxide (CO) are only available for the device version MSENSE® DGA 3.

**The following settings can be configured for the parameters CO, H2 and H2O (as relative or absolute):**

- Concentration warning limit
- Concentration alarm limit
- Gas formation rate warning limit
- Gas formation rate alarm limit
- Value for 4 mA signal
- Value for 20 mA signal
- Concentration action warning limit
- Concentration action alarm limit
- Gas formation rate action warning limit
- Gas formation rate action alarm limit

**Further settings**

- H2O reference
- Measurement interval
- Time stamp



- UNIX time stamp
- Service code
- Action maintenance information
- Modbus baud rate
- Modbus address
- Service database
- Field calibration
- Default calibration

#### 7.4.1 Settings for carbon monoxide (DGA 3 only), hydrogen and H2O concentrations in the oil

The upper warning and alarm values for the carbon monoxide content (CO) (MSENSE® DGA 3 only), the hydrogen content (H2) and the H2O concentration can be specified.

Along with the limit values specified in the standards, you have the option here of determining system-specific limits based on data collected or empirical values.

In the event of a limit value being exceeded (e. g. gas concentration in the oil or gas formation rate), a warning message can be issued via the relay contact. You can configure the respective settings using the MESSKO® MSET parameterization software in accordance with the corresponding operating instructions.

##### Carbon monoxide CO limit values (MSENSE® DGA 3 only)

Limit value	Default*)	Minimum	Maximum
Concentration too high warning	350 ppm	0 ppm	2,000 ppm
Concentration too high alarm	570 ppm	0 ppm	200 ppm
Gas formation rate too high warning	30 ppm/d	0 ppm/d	80 ppm/d
Gas formation rate too high alarm	50 ppm/d	0 ppm/d	80 ppm/d
4 mA signal setting	25 ppm	25 ppm	1,999 ppm
20 mA signal setting	1,000 ppm	26 ppm	2,000 ppm

Table 7: Carbon monoxide (CO) limit values

\*) Recommended values based on IEEE C57.104, Condition 1

##### Hydrogen (H2) limit values

Limit value	Default*)	Minimum	Maximum
Concentration too high warning	500 ppm	0 ppm	2,000 ppm
Concentration too high alarm	700 ppm	0 ppm	2,000 ppm
Gas formation rate too high warning	30 ppm/d	0 ppm/d	80 ppm/d



Limit value	Default*)	Minimum	Maximum
Gas formation rate too high alarm	50 ppm/d	0 ppm/d	80 ppm/d
4 mA signal setting	15 ppm	15 ppm	1,999 ppm
20 mA signal setting	1,000 ppm	16 ppm	2,000 ppm

Table 8: Hydrogen (H2) limit values

\*) Recommended values based on IEEE C57.104, Condition 1

**Moisture (H2O) limit values**

Limit value	Default	Minimum	Maximum
Concentration too high warning	30% RH	0% RH	100% RH
Concentration too high alarm	45% RH	0% RH	100% RH
Gas formation rate too high warning	10% RH/d	0% RH/d	100% RH/d
Gas formation rate too high alarm	15% RH/d	0% RH/d	100% RH/d
4 mA signal setting	3% RH	3% RH	99% RH
20 mA signal setting	100% RH	1% RH	100% RH

Table 9: Moisture (H2O) limit values

**7.4.2 General settings**

Proceed in accordance with the description in the MESSKO® MSET parameterization software operating instructions in order to adjust the following listed settings where necessary.

**Measurement interval setting**

The measurement interval is the time between 2 measurements (in hours). The shortest measurement interval is 3 hours.

Measurement interval	
Standard value	6 hours
Maximum value	24 hours
Minimum value	3 hours

**H2O reference setting**

The analysis results of the MESSKO® oil laboratory or an equivalent laboratory can be entered here in order to make a comparison between the water content (H2O in ppm) of the MSENSE® DGA 2/3 analysis and that of the laboratory. A field comparison for the gases H2 and CO is performed in the service area of the MSET software (see chapter Maintenance [► Section 10, Page 67]).



**Time stamp**

Make a note of the time stamp of the oil sample extraction for the laboratory. This is needed for the water content (H2O in ppm) calibration. The time stamp is updated with service code 1: sample extraction.

Once the sample has been analyzed by a laboratory, the time stamp must be entered together with the analysis results for adjustment via the MESSKO® MSET parameterization software. To do so, use the service code 33.

**Service code**

Proceed in accordance with the description in the MESSKO® MSET parameterization software operating instructions in order to enter and transmit a service code.

Service code	Description
0	No action.
1	<p><b>Sample extraction:</b> This service code informs the device that an oil sample has been taken for calibrating the absolute humidity H2O. Please be sure to note the time stamp on the sample information sheet!</p> <p><b>Important:</b> Adjustment is not possible unless a time stamp is set!</p> <p>Note: The following conditions must exist for the device to permit an adjustment:                      Oil temperature at sample extraction: +10 to +90 °C                      Ambient temperature at sample extraction: -20 to +60 °C                      For adjustment of the gases H2 and CO: Lab result (reference value) &gt;50 ppm                      For adjustment of the absolute humidity H2O (ppm): Lab result (reference value) &gt;5 ppm</p>
4	<p><b>Absolute humidity [ppm]:</b> The humidity (H2O) determined in the oil is output as the absolute humidity with the unit [ppm]. Warnings and alarms are evaluated only for the absolute humidity.</p>
5	<p><b>Relative humidity [%RH] (default):</b> The humidity (H2O) determined in the oil is displayed as the relative humidity with the unit [%RH]. Warnings and alarms are evaluated only for the relative humidity.</p>
6	<p><b>Trigger the fail-safe relay test alarm:</b> The fail-safe alarm is triggered manually. The fail-safe relay switches within 60 seconds. The alarm and the fail-safe relay will be automatically switched off again after 5 minutes.</p>
7	<p><b>Deactivation of the fail-safe relay test alarm:</b> A manually triggered fail-safe alarm will be canceled. The fail-safe relay switches off.</p>
33	<p><b>New calibration of the H2O value:</b> First enter the analysis results for the H2O reference and the time stamp of the sample extraction in the "Settings" menu.                      Then enter service code 33 here.                      Determine the new reference value at the device through the final synchronization.</p>

**Maintenance information**

A maintenance message that is configurable can be issued by the device via the available relay contacts (refer to the MESSKO® MSET parameterization software). It is possible to have a maintenance message issued 6 months in advance and when maintenance is due.

**7.4.3 Modbus settings**

You can configure the following settings for the Modbus communication using the MESSKO® MSET parameterization software.

**Modbus baud rate setting**

The transmission speed (baud rate) of the Modbus interface can be set as follows: 4800, 9600, 19200, 38400, 57600, 115200 Bd.

Modbus baud rate	
Standard value	19200 Bd
Maximum value	115200 BD
Minimum value	4800 BD



Take into consideration a minimum pause of 500 ms between two Modbus requests.

**Modbus address setting**

The following values are available for the Modbus address:

Modbus address	
Standard value	1
Maximum value	247
Minimum value	1



Issuing the same network address twice will lead to malfunctions.

**Parity**

For data transmission, the parity is determined as follows:

Parity	
Fixed specification	Even

Ensure that the same Modbus settings are made in your SCADA system.





## 8 Operation



Note the differences between the MSENSE® DGA 2 and MSENSE® DGA 3 device versions. Unless stated otherwise, the description refers to the MSENSE® DGA 3 device version.

Device version	Measured variables			
	Hydrogen (H <sub>2</sub> )	Carbon monoxide (CO)	Moisture (H <sub>2</sub> O)	Oil temperature
MSENSE® DGA 2	Yes	No	Yes	Yes
MSENSE® DGA 3	Yes	Yes	Yes	Yes

### 8.1 Operating the device with display

The display and 3 operating keys can be used to call up and display the settings of the device. Use the MESSKO® MSET software included in the device's scope of delivery for the parameterization.

There are 3 menu levels:

Menu level 1	Menu level 2	Menu level 3
Operating display	Setup selection: Setup CO parameters or Setup H <sub>2</sub> parameters or Setup H <sub>2</sub> O parameters	Parameter selection: High warning or High alarm or Rate high warning or Rate high alarm or 4 mA value or 20 mA value

Navigation is carried out via three-key operation.

▲ UP key

▼ DOWN key

ENTER key (short press or long press)

The display has 2 lines, each with 20 characters.

The display is in English only.

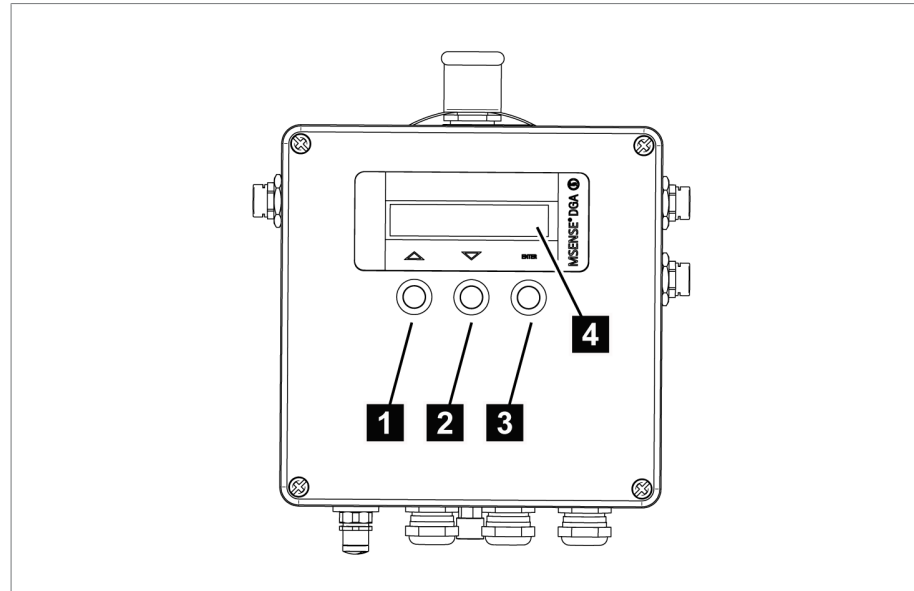


Figure 40: Operating keys and display

1 UP key ▲

2 DOWN key ▼

3 ENTER key

4 2-line display, each with 20 characters



**8.1.1 General operation**

**8.1.1.1 Menu level 1 = Display of the CO, H2 and moisture content and the oil temperature**

Action	Reaction
↵ Press the ENTER key briefly	Move forward one menu level

**8.1.1.2 Menu level 2 = Setup selection**

Action	Reaction
▲ Press UP key	Previous setup
▼ Press DOWN key	Next setup
⏏ Press and hold the ENTER key	Move back one menu level
↵ Press the ENTER key briefly	Move forward one menu level

**8.1.1.3 Menu level 3 = Parameter selection**

Action	Reaction
▲ UP key	Previous parameter
▼ DOWN key	Next parameter
⏏ Press and hold the ENTER key	Move back one menu level
↵ Press the ENTER key briefly	Move forward one menu level

### 8.1.2 Main screen / operating display

The following displays appear in rotation once the device has been commissioned:

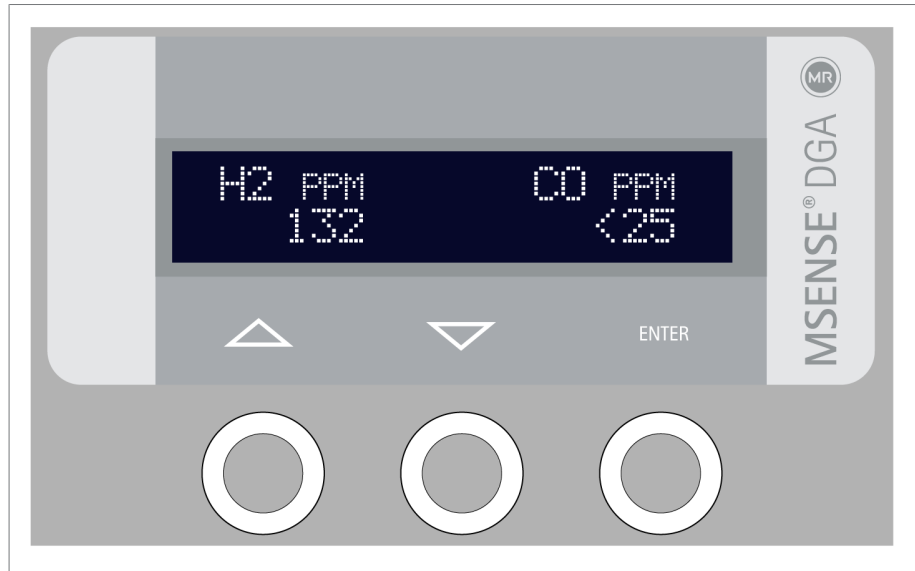


Figure 41: Display with current H2 and CO content

Left-hand side	Right-hand side
H <sub>2</sub> Hydrogen content in ppm	CO (MSENSE® DGA 3 only) Carbon monoxide content in ppm

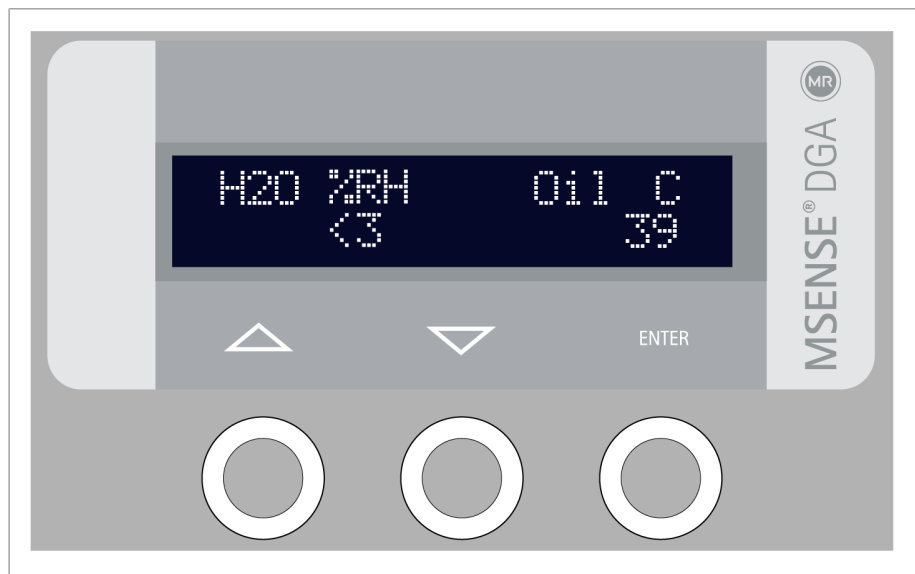


Figure 42: Display with current H2O content and oil temperature



Left-hand side	Right-hand side
H <sub>2</sub> O Water content (humidity) in %RH <sup>1)</sup>	Oil Oil temperature in °C

<sup>1)</sup> The water content (humidity) display can be converted from %RH to ppm via the MESSKO® MSET parameterization software if required (service code 4 and 5). When the measured data is transmitted (e.g. to a SCADA control center or a laptop), the water content is always transmitted in both display formats.

If an asterisk (\*) is displayed, the system is outside the specified measuring range in accordance with the chapter "Technical data" [► Section 13, Page 90]. The following applies to the displayed measured value:

- During the first measurement after the running-in phase, the value of the lower detection limit is displayed.
- If measured values within the specified measuring range have already been recorded, then the last valid measured value is displayed.

The asterisk (\*) disappears automatically as soon as the system is back in the valid measuring range.

The default settings for the warning and alarm limits are in accordance with the directives of IEEE C57.104 (for H<sub>2</sub> and CO) and DIN EN 60422 (for water content in oil).

You can adjust the limit values to your requirements via the MESSKO® MSET parameterization software.

The gas formation rates can be set as both positive and negative values.

The configurable parameters per sensor value are:

- Concentration too high warning
- Concentration too high alarm
- Formation rate too high warning
- Formation rate too high alarm



Any alarms, warnings or other messages present are only shown in the display for as long as the set threshold value is exceeded.

	H <sub>2</sub>	CO	H <sub>2</sub> O	
	[ppm]	[ppm]	[%RH]	[ppm] <sup>2)</sup>
Warning	500 ppm	350 ppm	30% RH	20 ppm
Alarm	700 ppm	570 ppm	45% RH	30 ppm
Gas formation rate warning	30 ppm/d	30 ppm/d	10% RH	10 ppm/d
Gas formation rate alarm	50 ppm/d	50 ppm/d	15% RH	15 ppm/d

<sup>2)</sup> For mineral-based insulating oils

These limits and rates are suitable for initial commissioning. However, the systems (transformer and device) must be aligned with each other over time. Thus, with sufficient data, the limits / formation rates for the "warning" and "alarm" values should be able to be calculated and loaded via the MESSKO® MSET parameterization software.

### 8.1.3 Events

If a set warning or alarm limit is exceeded, this will be shown on the display in rotation with the measured values (CO[ppm], H2[ppm], H2O[ppm/%RH], Oil[°C]) as follows:

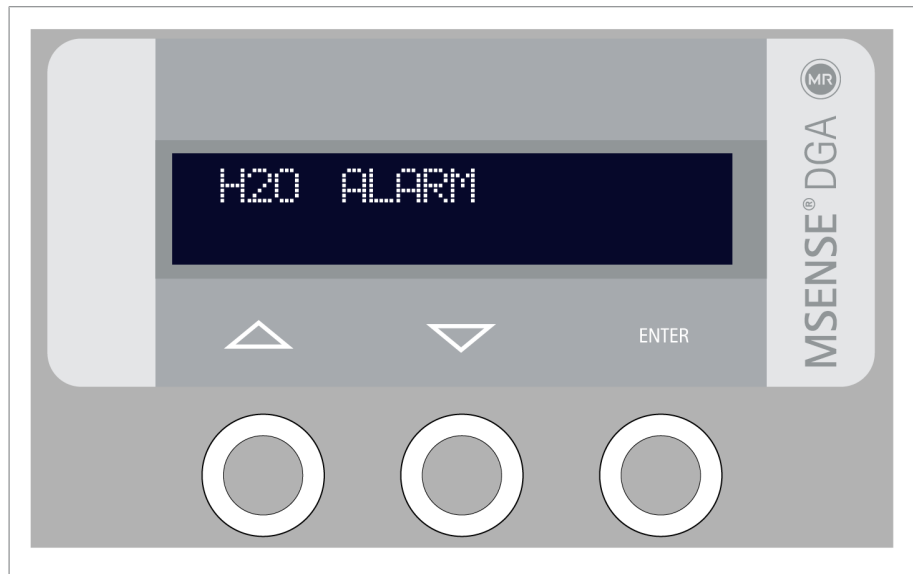


Figure 43: Warning

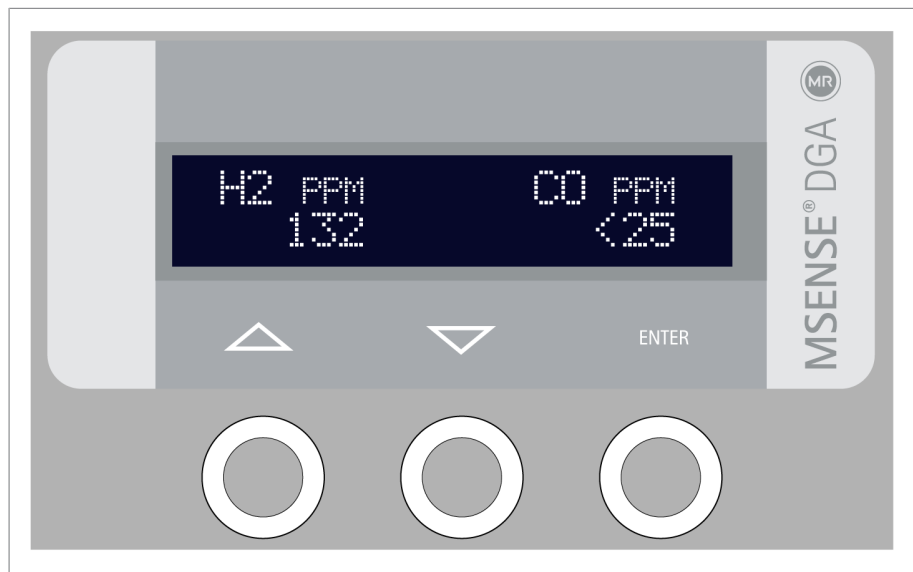


Figure 44: Measured values



The following table lists the possible events and the respective recommended actions:

Event	Text display	Recommended action
CO concentration warning (DGA 3 only)	CO Warn.	1
CO concentration alarm (DGA 3 only)	CO Alarm	2
CO gas formation rate warning (DGA 3 only)	CO Formation Warn.	1
CO gas formation rate alarm (DGA 3 only)	CO Formation Alarm	2
H2 concentration warning	H2 Warn.	1
H2 concentration alarm	H2 Alarm	2
H2 gas formation rate warning	H2 Formation Warn.	1
H2 gas formation rate alarm	H2 Formation Alarm	2
H2O concentration warning	H2O Warn.	1
H2O concentration alarm	H2O Alarm	2
H2O gas formation rate warn- ing	H2O Formation Warn.	1
H2O gas formation rate alarm	H2O Formation Alarm	1

These events are saved in the database on the device and can be loaded onto the PC with the MESSKO® MSET parameterization software. If the device has a display you can read the text display directly.

In addition, the events can be issued via the relay contacts S1...S4 and via the communication interface.

No.	Recommended action
1	Please monitor your system and have an oil sample [► Section 10.3, Page 69] analyzed in a laboratory (at least DGA and humidity determination) in good time.  Further procedures in accordance with the action instructions derived from the laboratory results.
2	Please monitor your system and have an oil sample [► Section 10.3, Page 69] analyzed in a laboratory (at least DGA and humidity determination) in good time.  Reduce the system load until the action instructions derived from the laboratory results are available.



## 8.2 Operating the device without display

Always use the MESSKO® MSET parameterization software for viewing the measured data and events, and for setting the parameters.





## 9 Fault elimination

This chapter describes how to eliminate operating faults.

### 9.1 Messages regarding the safety switching contact

Depending on the fault cause, the safety switching contact (fail-safe relay FSR) reacts with a delay time of approx. 7...60 seconds.

State	Contact 25-26	Contact 26-27
Idle state	Closed	Open
Fault	Open	Closed

The following faults are recorded via the safety switching contact FSR:

Characteristics/details	Cause	Remedy
Message via FSR	Cable break in the supply line	Check wiring; in the event of doubt, contact MR Service & Complaint
	Drop in the supply voltage	Check supply voltage; in the event of doubt, contact MR Service & Complaint
	Hardware overheating (µC)	Check ambient temperature; in the event of doubt, contact MR Service & Complaint
	Hardware failure at the component level (HW)	Contact MR Service & Complaint

### 9.2 Display faults

Characteristics/details	Cause	Remedy
Display no longer shows events	Display fault	Check wiring. If OK: Interrupt supply voltage for 5 seconds. This activates a restart.
Display without function	Safety fuse defective	Follow the instructions in the "Replacing a fuse" [► Section 9.3, Page 65] section

### 9.3 Replacing a fuse

The device is fused with a safety fuse.

This can be replaced by a replacement fuse (500 mA, 500 V, 5x20 mm, delayed-action) if needed.



**▲ WARNING**



**Electric shock**

Risk of fatal injury due to electrical voltage

- ▶ Only appropriately trained personnel may replace the fuse.
- ▶ Before opening the connection area in order to replace the fuse, the device is to be disconnected from all voltage sources via the prescribed disconnecting switch and secured against reconnection. The device must be grounded.

**To replace the fuse, proceed as follows:**

1. Disconnect the device from all voltage sources.
2. Open the device connection area. To do so, unscrew the 4 captive screws on the housing cover. The cover is connected to the device via hinges and can be flipped open.
3. Remove the safety cover.
4. Using a screwdriver, carefully move under one end of the fuse and lift it out of the holder.
5. Remove the fuse.
6. Position the replacement fuse with both ends on the holder and carefully press down until it locks into place.
7. Refit the safety cover.
8. Close the connection area.



## 10 Maintenance

Inspection and maintenance are required for the operational safety and to maintain measurement accuracy.

### 10.1 Inspection

Monitoring of the device is limited to occasional visual inspections and a regular oil extraction. For efficiency reasons, these inspection tasks can be combined with the usual checks on the transformer.

Check the following:

Interval	Recommended measure
Annually	Visual inspection: Check the perfect condition of the sealing points.
Annually	For devices with display: Check display function.
Every 2 years	Send oil sample to Messko GmbH. Observe the information in the following "Oil extraction" [► Section 10.3, Page 69] chapter for this.

Table 10: Inspection plan

To compare the current measured values of the device with the laboratory analysis, proceed as follows:

- ✓ According to the laboratory analysis, the gas concentration of hydrogen H<sub>2</sub> and carbon monoxide CO is at least 50 ppm.
  - ✓ According to the laboratory analysis, the moisture content H<sub>2</sub>O is at least 5 ppm.
  - ✓ The ambient temperature is between -20 °C and 60 °C.
  - ✓ The oil temperature is between 10 °C and 90 °C.
1. Evaluation of the measured values only makes sense under these conditions. In case of doubt, contact Technical Service [► Section 10.2, Page 68].
  2. Compare the values of the laboratory analysis with the current measured values of the device.
    - ⇒ If the measuring accuracy complies with the information in the "Technical data" chapter, a field calibration is not required.
    - ⇒ In the case of a deviation from the accuracy specified, proceed as described in the **Field calibration** chapter.



## 10.2 Maintenance

The device determines the point in time when maintenance is to be performed based on the operating parameters. Maintenance ensures the long-term accuracy of the measured results. The maintenance information is issued via the event database of the MESSKO® MSET parameterization software and can be transmitted to a SCADA system via Modbus. Furthermore, signaling via relay outputs can also be configured. The device version with display shows the maintenance information directly on the display.

In case of a maintenance signal, proceed as follows:

Event	Display	Recommended action
Maintenance in 6 months	Maintenance 6 months	Contact MR Technical Service
Maintenance required	Maintenance required	Contact MR Technical Service

In case of a maintenance signal, please contact the Technical Service of Maschinenfabrik Reinhausen GmbH (MR) immediately:

### Maschinenfabrik Reinhausen GmbH

Technical Service  
Postfach 12 03 60  
93025 Regensburg  
Germany  
Phone: +49 941 4090-0  
E-mail: [service@reinhausen.com](mailto:service@reinhausen.com)

### 10.3 Oil extraction

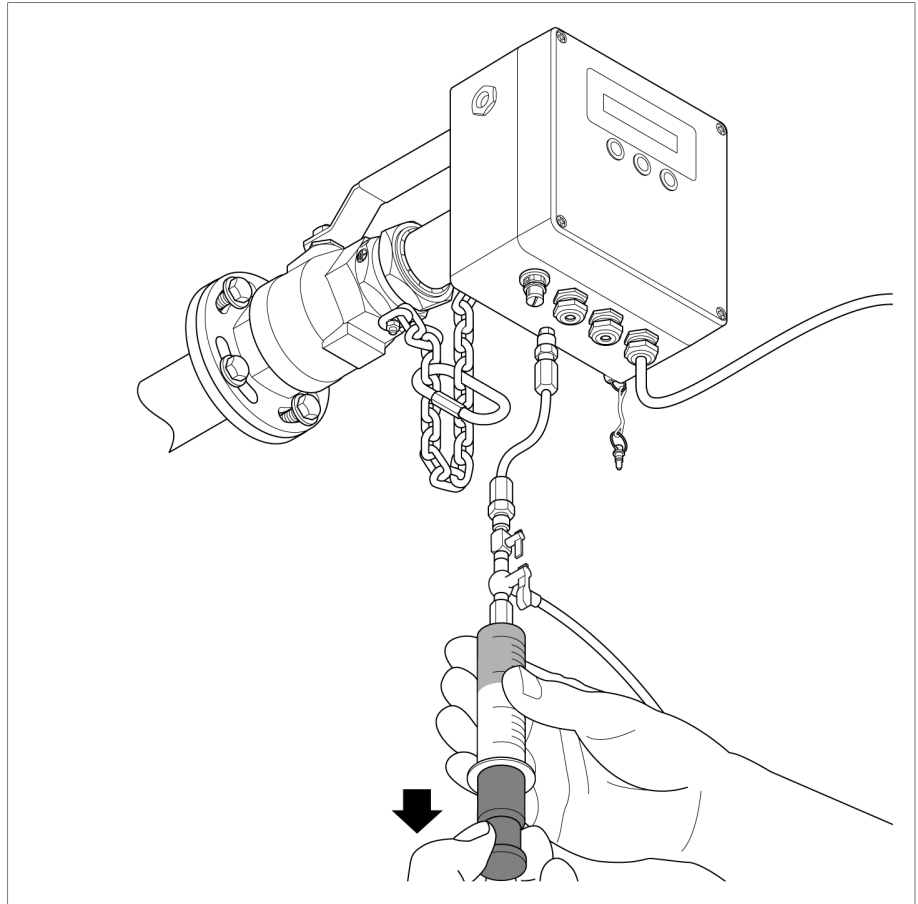


Figure 45: Oil extraction

The scope of delivery includes two MESSKO® sample extraction kits for taking oil samples via the oil sample extraction connection. For information on taking oil samples, refer to the included instructions BA2938054 and chapter Device field calibration [▶ Section 10.4, Page 70] in these instructions.

Send the oil sample, together with the completed "SAMPLE DATA SHEET – OIL ANALYSIS", to MESSKO GmbH for oil analysis. If the results of the analysis indicate that the device requires a field calibration, you will receive an action recommendation for the settings from MESSKO through the MESSKO® MSET parameterization software.

### 10.4 Device field calibration

The field calibration of the device gas analysis values serves to ensure the correct measurement results:

- For aged insulating oils
- For modified oils (e.g., the addition of additives)
- For oils that do not satisfy the standards ASTM D3486-091, IEC 60296 or IEC 60422

A field calibration should be performed if the following conditions apply:

Condition	CO	H2	H2O
Deviation from laboratory values	>15% or 20 ppm *)	>10% or 20 ppm *)	>5 ppm
Laboratory value	>50 ppm	>50 ppm	>5 ppm

\*) Evaluated in accordance with IEC 60567 – Appendix E

A field calibration of a gas component with lower laboratory values is not recommended.



The correct values for a field calibration can only be guaranteed if the oil is analyzed in the MESSKO GmbH laboratory or in a laboratory that specializes in gas analyses.

#### 10.4.1 Taking a sample for field calibration

The following material is required for taking a sample:

- Oil extraction kit
- Oil waste container
- Cleaning cloths
- Sample extraction adapter



Taking a sample for a field calibration is only recommended if the following conditions apply to the device:

Property	Condition
Oil temperature $T_{oil}$	$10\text{ °C} < T_{oil} < 90\text{ °C}$
Ambient temperature $T_{ambient}$	$-20\text{ °C} < T_{ambient} < 60\text{ °C}$



To take an oil sample, proceed as follows:

1. Complete the sample information sheet included in the oil extraction kit. When doing so, enter the current measured values under "MSENSE® DGA adjustment" for:
  - H<sub>2</sub>
  - CO (MSENSE® DGA 3 only)
  - H<sub>2</sub>O (%RH or ppm)
  - UNIX time stamp

**SAMPLE DATA SHEET – OIL ANALYSIS.**

WWW.REINHAUSEN.COM

Company: \_\_\_\_\_ Customer No.: \_\_\_\_\_ Reason:  Bulk  Routine  
 Address: \_\_\_\_\_ Equipment ID: \_\_\_\_\_ MSENSE®  None tested  
 Contact: \_\_\_\_\_ E-mail: \_\_\_\_\_ M&M Order No.: \_\_\_\_\_ Plant: \_\_\_\_\_  
 Name: \_\_\_\_\_ Fax: \_\_\_\_\_ Report No.: \_\_\_\_\_

**Equipment**

Oil sampling:  Transformer  D/GC  Generator  Busking  Cableline  Other: \_\_\_\_\_  
 Transformer:  Network  Furnace  Converter  Wind power  Reactor  Other: \_\_\_\_\_  
 D/GC: \_\_\_\_\_ Type: \_\_\_\_\_ Operation mode: \_\_\_\_\_ Other function: Yes ( ) No ( )  
 Equipment details: Manufacturer: \_\_\_\_\_ Location: \_\_\_\_\_ Substation: \_\_\_\_\_  
 Serial No.: \_\_\_\_\_ Year of commission: \_\_\_\_\_ Primary voltage: \_\_\_\_\_ Max MVA Rating: \_\_\_\_\_  
 Cooling Type:  Air  ONAN  ONAF  OFAF  Other: \_\_\_\_\_  
 Bushings:  Free breathing  Sealed  Rubber bag  A<sub>2</sub> Basket  Other: \_\_\_\_\_  
 Status:  In service  New oil  Extension  F / F  Other: \_\_\_\_\_

**Oil Sampling Information**

Sample ID: \_\_\_\_\_ Sample No.: \_\_\_\_\_ Top Oil temperature: \_\_\_\_\_ Date sampled: \_\_\_\_\_  
 Amount of oil in the equipment (kg): \_\_\_\_\_ Stored under oil: \_\_\_\_\_ Paper type / Temp. (°C): \_\_\_\_\_  
 Oil type:  Mineral oil  Natural ester  Synthetic ester  Silicone  Other: \_\_\_\_\_  
 Sampling point location:  Bottom  Middle  Top  Converter  Other: \_\_\_\_\_  
 Sampling point ID:  Converter  Reactor  Cable A, B, C  Converter  Other: \_\_\_\_\_  
 Sampling container:  Glass syringe  Aluminium bottle  Plastic bottle  Other: \_\_\_\_\_

**MSENSE® DGA adjustment**

Serial No.: \_\_\_\_\_ Installation Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ Installation Place: \_\_\_\_\_  
 Displayed values during sampling: H<sub>2</sub> \_\_\_\_\_ CO \_\_\_\_\_ H<sub>2</sub>O \_\_\_\_\_ Timestamp: \_\_\_\_\_

**Standard Oil Tests**

DGA analysis:  EC 8062 / ASTM D3813  Other index:  SO 249 / ASTM D1524  
 Moisture:  EC 8061 / ASTM D1521  Flash point:  SO 219 / ASTM D265  
 Dielectric Breakdown voltage:  EC 8063 / ASTM D877/814  Pour point:  SO 318 / ASTM D950  
 Dielectric Absorption Factor (tan δ):  EC 8067 / ASTM D924  PCB content:  EC 8039 / ASTM D4208  
 Determination of elements (Spectroscopy):  SO 13263  Converter sulphur (ppm wt%):  EC 8051 / ASTM D1708  
 IEC number:  EC 8067 / ASTM D1188  Converter sulphur (Other wt%):  SO 13135  
 Soluble content, overall:  EC 8062, Annex C  Converter sulphur:  EC 8068 / ASTM D4708  
 Determination of sludge:  EC 8062, Annex C  IEC number:  EC 8068 / ASTM D4708  
 Density 15°C:  SO 1708 or SO 15 / ASTM D153  Metal content:  EC 8069  
 Visual inspection:  EC 8062, Annex C  Particle count:  EC 8069 / ASTM D5198  
 Interfacial tension (IFT):  SO 1708 or SO 15 / ASTM D153  IFT analysis (with calculated IFT):  EC 8069 / ASTM D5198  
 Interfacial tension:  ASTM D 971-12  Methanol, Ethanol (with calculated IFT):  ASTM D 793  
 Acidity (pH<sub>4</sub>, 100°C):  SO 2100 / ASTM D1414  Oxidation paper IP with moisture content:  EC 8045 / ASTM D4050  
 Oxidation stability:  EC 8121 / ASTM D3440  Other oil quality tests: \_\_\_\_\_

THE POWER BEHIND POWER. MR

**MSENSE® DGA adjustment:**

Serial No.: \_\_\_\_\_ Installation Date: \_\_\_\_/\_\_\_\_/\_\_\_\_ Installation Place: \_\_\_\_\_  
 Displayed values during sampling: H<sub>2</sub> \_\_\_\_\_ CO \_\_\_\_\_ H<sub>2</sub>O \_\_\_\_\_ Timestamp: \_\_\_\_\_

Figure 46: Complete the sample information sheet (SAMPLE DATA SHEET – OIL ANALYSIS)

2. Take an oil sample in accordance with IEC 60567 and send it to the MESSKO® oil laboratory in suitable packaging. The sample analysis values will be used later for the field calibration.

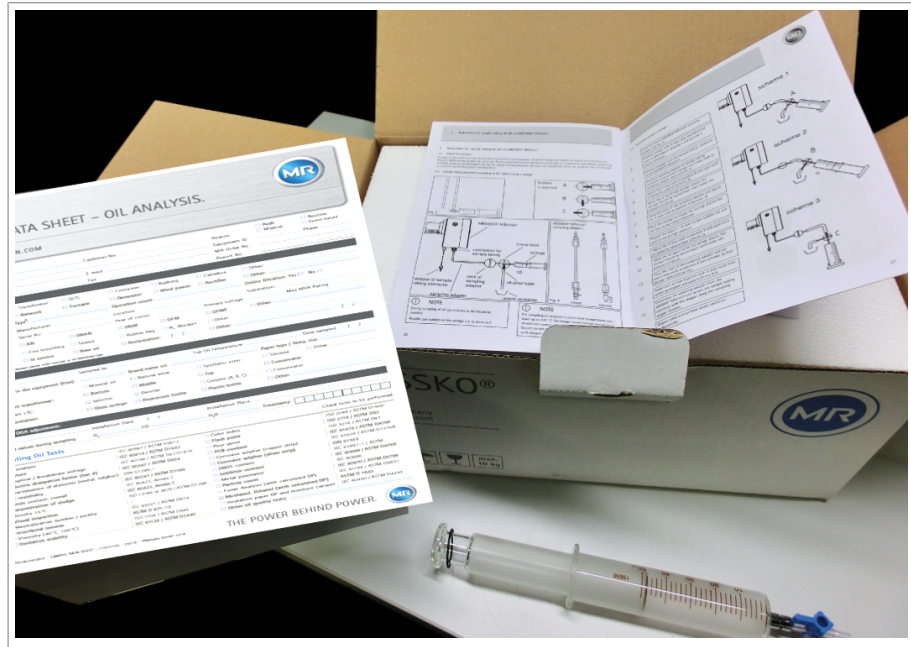


Figure 47: MESSKO® sample extraction kit for extracting and shipping oil samples

#### 10.4.2 Field calibration

Once the sample has been analyzed in the oil laboratory, you will be sent the oil sample report for the oil analysis. The following values are important:

- Hydrogen H<sub>2</sub>
- Carbon monoxide CO (MSENSE® DGA 3 only)
- Moisture content H<sub>2</sub>O
- Date of the oil sample





A specific recommendation for a field calibration can be found in the "Recommendations" chapter.

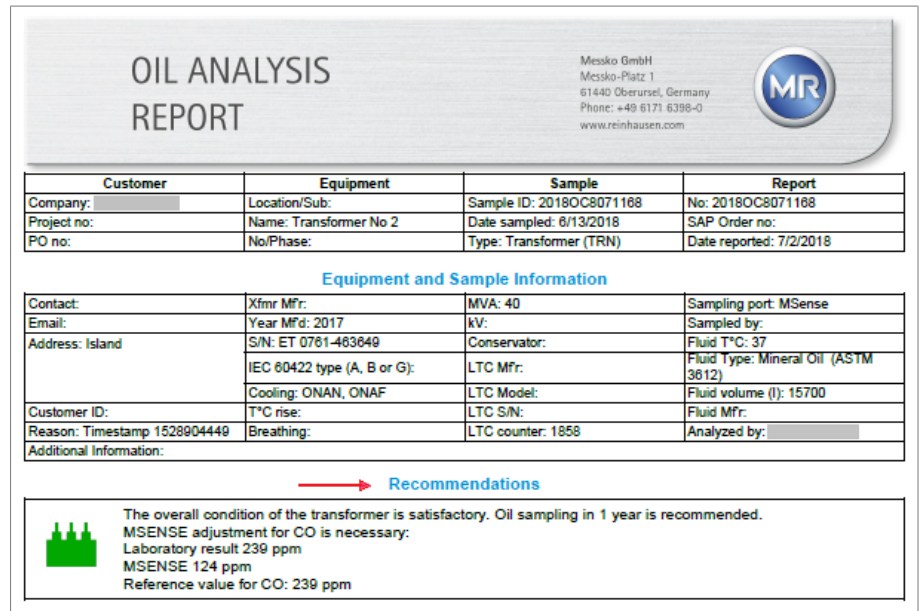


Figure 48: Sample report of the oil analysis (example)

The individual analysis values can be found on the following pages of the analysis report:

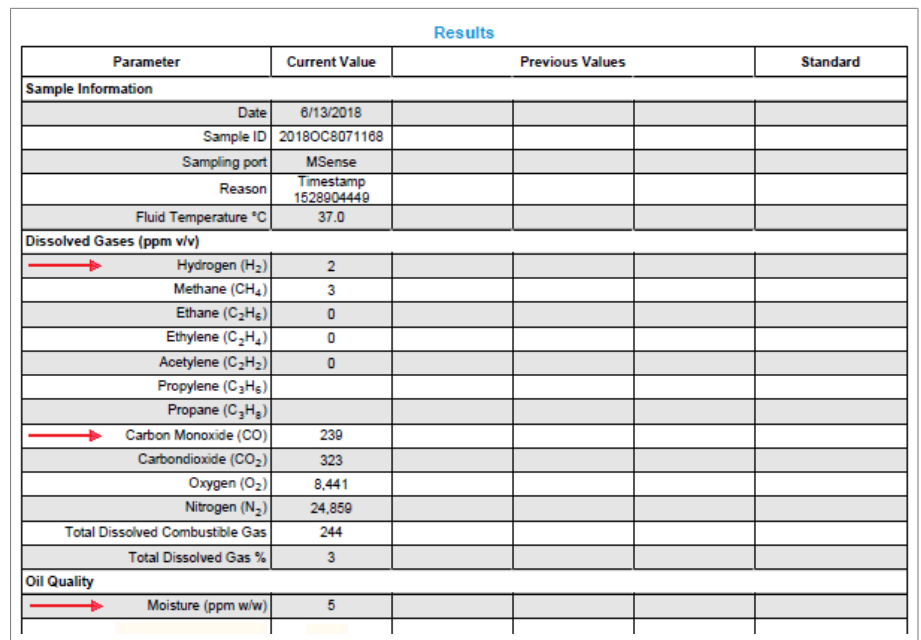


Figure 49: Analysis values (example)

To perform the field calibration, proceed as follows:

1. Connect the MSENSE® DGA 2/3 to the PC via the USB service adapter and open the MESSKO® MSET parameterization software.
  - ⇒ The parameterization software connects to the device.

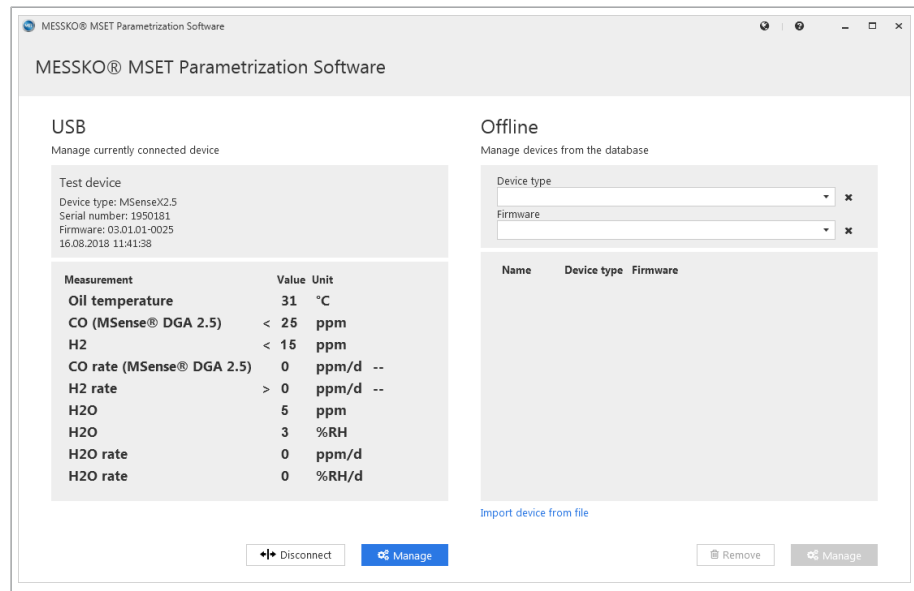


Figure 50: MSET main screen

2. Click on **Manage** on the left-hand side of the Home view (USB).
3. Click on **Service** and then on **MSENSE field calibration**.

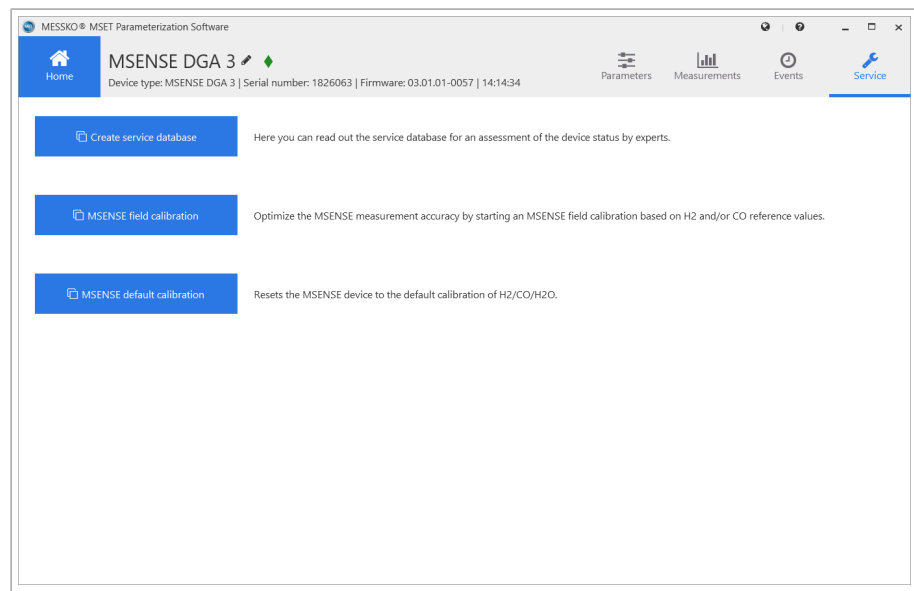


Figure 51: Service



4. Select the gases for which you want a field calibration. Enter the laboratory results as the reference corresponding to the respective gas.

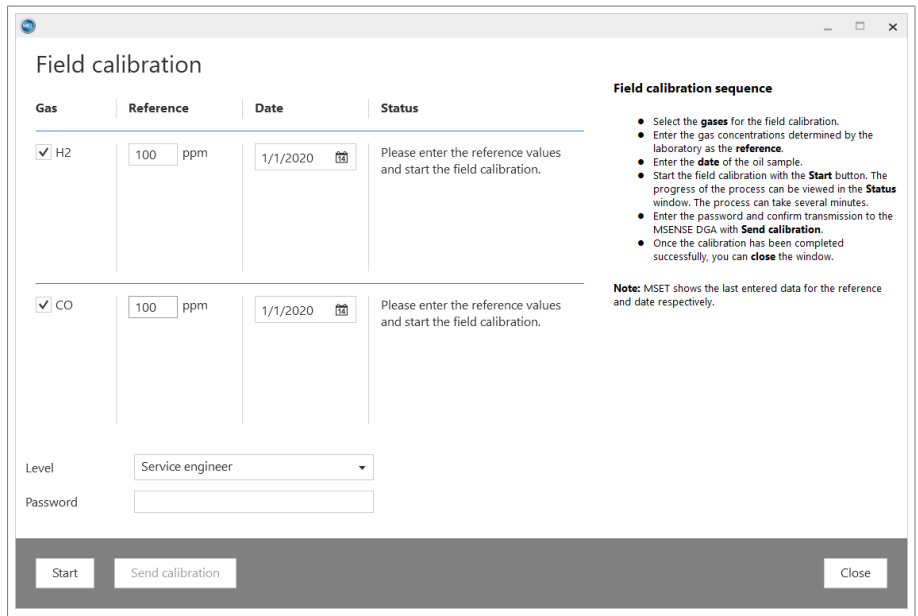


Figure 52: Field calibration step 1

5. Enter the date of the oil sample from the laboratory results.

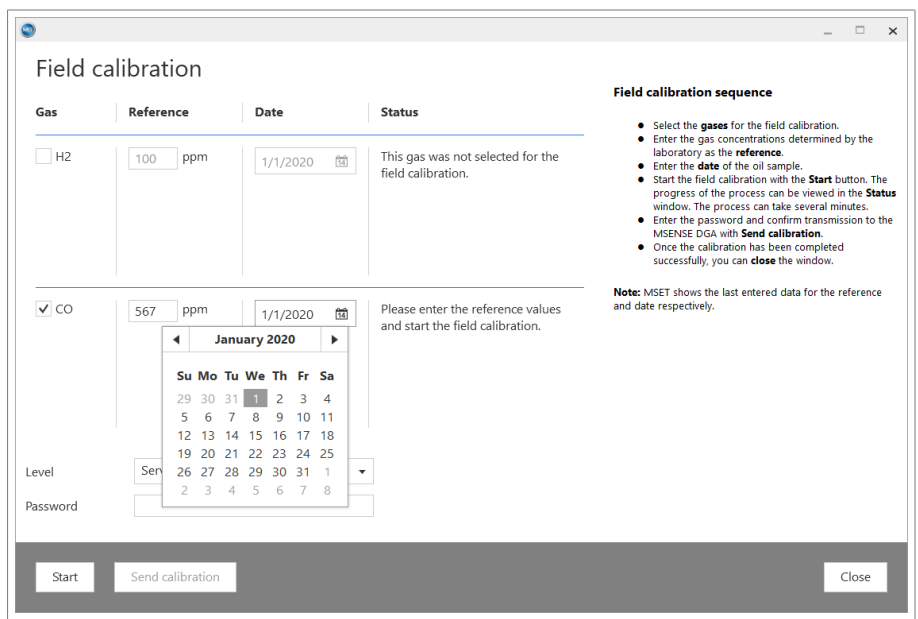
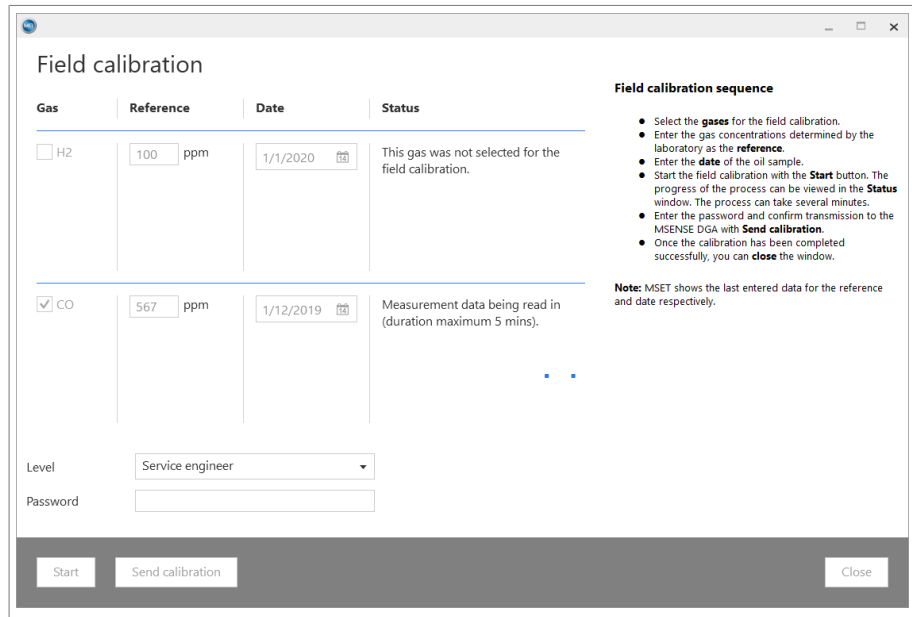


Figure 53: Entering the date

6. Click on **Start** to initiate the field calibration.



Gas	Reference	Date	Status
<input type="checkbox"/> H2	100 ppm	1/1/2020	This gas was not selected for the field calibration.
<input checked="" type="checkbox"/> CO	567 ppm	1/12/2019	Measurement data being read in (duration maximum 5 mins).

Level: Service engineer  
Password: [ ]

Buttons: Start, Send calibration, Close

**Field calibration sequence**

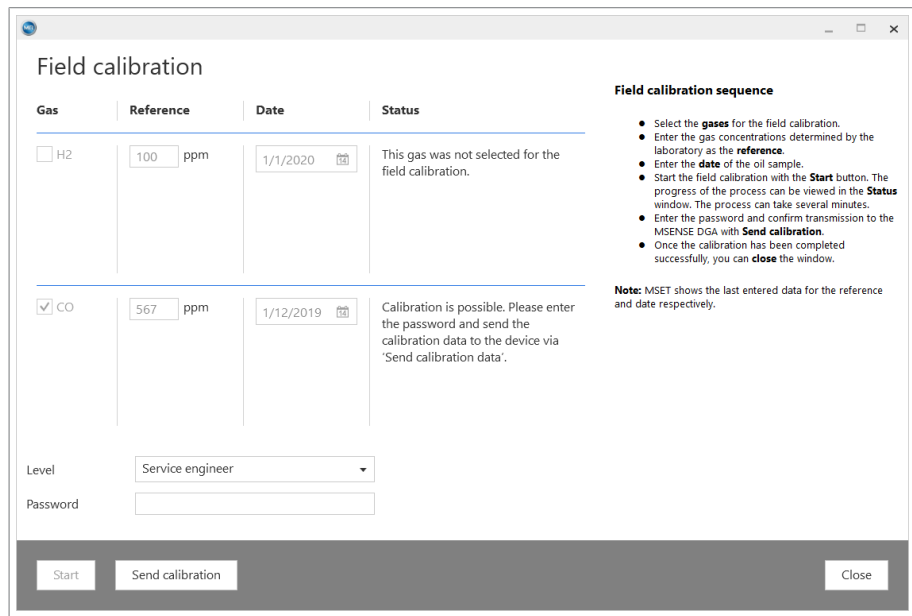
- Select the **gases** for the field calibration.
- Enter the gas concentrations determined by the laboratory as the **reference**.
- Enter the **date** of the oil sample.
- Start the field calibration with the **Start** button. The progress of the process can be viewed in the **Status** window. The process can take several minutes.
- Enter the password and confirm transmission to the MSENSE DGA with **Send calibration**.
- Once the calibration has been completed successfully, you can **close** the window.

**Note:** MSET shows the last entered data for the reference and date respectively.

Figure 54: Starting the field calibration

⇒ The process progress can be viewed in the status window. The process may take several minutes.

7. Wait until the status column shows whether or not the calibration is possible.



Gas	Reference	Date	Status
<input type="checkbox"/> H2	100 ppm	1/1/2020	This gas was not selected for the field calibration.
<input checked="" type="checkbox"/> CO	567 ppm	1/12/2019	Calibration is possible. Please enter the password and send the calibration data to the device via 'Send calibration data'.

Level: Service engineer  
Password: [ ]

Buttons: Start, Send calibration, Close

**Field calibration sequence**

- Select the **gases** for the field calibration.
- Enter the gas concentrations determined by the laboratory as the **reference**.
- Enter the **date** of the oil sample.
- Start the field calibration with the **Start** button. The progress of the process can be viewed in the **Status** window. The process can take several minutes.
- Enter the password and confirm transmission to the MSENSE DGA with **Send calibration**.
- Once the calibration has been completed successfully, you can **close** the window.

**Note:** MSET shows the last entered data for the reference and date respectively.

Figure 55: Calibration is possible



8. If the calibration is possible, enter the password and initiate the transmission of the calibration data to the device via **Send calibration**.

The screenshot shows the 'Field calibration' window with a table for gas calibration data. The 'CO' row is selected, and the 'Send calibration' button is highlighted.

Gas	Reference	Date	Status
<input type="checkbox"/> H2	100 ppm	1/1/2020	This gas was not selected for the field calibration.
<input checked="" type="checkbox"/> CO	567 ppm	1/12/2019	Calibration is possible. Please enter the password and send the calibration data to the device via 'Send calibration data'.

Level: Service engineer  
 Password: ●●●●●●●●

Buttons: Start, Send calibration, Close

**Field calibration sequence**

- Select the **gases** for the field calibration.
- Enter the gas concentrations determined by the laboratory as the **reference**.
- Enter the **date** of the oil sample.
- Start the field calibration with the **Start** button. The progress of the process can be viewed in the **Status** window. The process can take several minutes.
- Enter the password and confirm transmission to the MSENSE DGA with **Send calibration**.
- Once the calibration has been completed successfully, you can **close** the window.

**Note:** MSET shows the last entered data for the reference and date respectively.

Figure 56: Password entry and sending the calibration

9. Wait until the result of the calibration is displayed in the status column.

The screenshot shows the 'Field calibration' window with the 'CO' row status updated to indicate successful calibration.

Gas	Reference	Date	Status
<input type="checkbox"/> H2	100 ppm	1/1/2020	This gas was not selected for the field calibration.
<input checked="" type="checkbox"/> CO	567 ppm	1/12/2019	The calibration was successfully transmitted to the device. Close the window with 'Close'.

Level: Service engineer  
 Password: ●●●●●●●●

Buttons: Start, Send calibration, Close

**Field calibration sequence**

- Select the **gases** for the field calibration.
- Enter the gas concentrations determined by the laboratory as the **reference**.
- Enter the **date** of the oil sample.
- Start the field calibration with the **Start** button. The progress of the process can be viewed in the **Status** window. The process can take several minutes.
- Enter the password and confirm transmission to the MSENSE DGA with **Send calibration**.
- Once the calibration has been completed successfully, you can **close** the window.

**Note:** MSET shows the last entered data for the reference and date respectively.

Figure 57: Calibration successful

10. Upon successful calibration, you can close the window and disconnect the connection between the MSENSE DGA 2/3 and the laptop.

11. Unscrew the USB service adapter.

12. Then screw the protective cap onto the M12 socket to protect the device against water ingress.
- ⇒ The system will set itself to the adjusted level within the next 24 hours.



If you have made an incorrect entry, you can reset the parameters of the gas analysis (H<sub>2</sub> and CO) and the humidity (H<sub>2</sub>O in ppm) to the default calibration. To do so, send a valid access authorization to the device via the MESSKO® MSET parameterization software under **Service** in the area **MSENSE default calibration** in accordance with the corresponding operating instructions.

### 10.4.3 Reading out the service database

The service database contains all information on the device status and serves as customer-friendly advice through MR Support. If the MSENSE® DGA 2/3 issues a maintenance message, we recommend making an immediate copy of the service database and contacting Maschinenfabrik Reinhausen GmbH Technical Service.

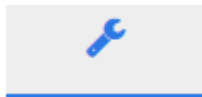
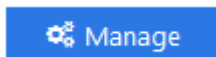
The following material is necessary for reading out the service database:

- PC with MESSKO® MSET parameterization software and up-to-date FTDI drivers
- Device USB service adapter

Proceed as follows:

1. Connect the device to the PC using the USB service adapter and open the MESSKO® MSET parameterization software.

⇒ The parameterization software connects to the device. Click on **Manage** on the left-hand side of the Home view (USB).



2. Click on **Service** in the top right.
3. Click on the **Create service database** button and save the zip file to the laptop.



Figure 58: Service database

4. Contact MR Technical Service and send the zip file.



**Maschinenfabrik Reinhausen GmbH**

Technical Service  
Postfach 12 03 60  
93025 Regensburg  
Germany  
Phone: +49 94140 90-0  
E-mail: [service@reinhausen.com](mailto:service@reinhausen.com)



## 10.5 Cleaning

When necessary, the installed device can be cleaned from the outside with water and a mild lye.

Only use a dry cleaning cloth to wipe down the measuring head of the uninstalled device (see chapter Design/versions [► Section 4.3, Page 18]).



## 11 Removal

### ⚠ CAUTION



#### Hot oil escape

Risk of injury and slipping.

- ▶ Wear safety clothing.
- ▶ Carry out the operating steps in the specified sequence.
- ▶ Ensure that the shutter valve remains closed after the removal of the device.

### ⚠ DANGER



#### Electric shock!

Risk of fatal injury due to electrical voltage. Always observe the following safety regulations when working in or on electrical equipment.

- ▶ Disconnect the system.
- ▶ Lock the system to prevent an unintentional restart.
- ▶ Ensure all poles are de-energized.
- ▶ Cover or cordon off adjacent energized parts.
- ▶ Disconnect electrical cabling correctly.

### NOTICE

#### Damage to the device!

Electrostatic discharge can lead to damage to the device.

- ▶ Take precautionary measures to prevent the build-up of electrostatic charges on work surfaces and personnel.

### 11.1 Removing the MSENSE® DGA 2/3

1. Undo and remove the chain connector.

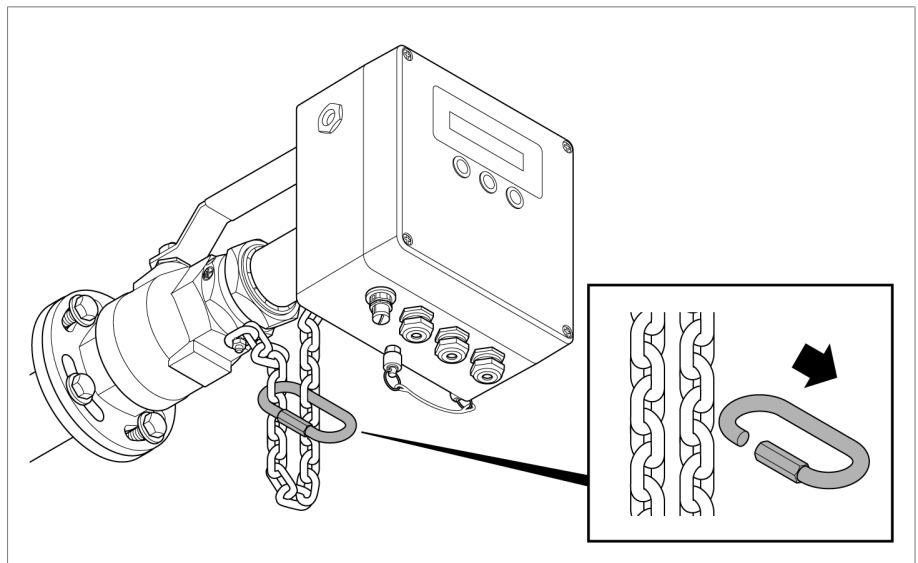


Figure 59: Releasing the chain

2. Release the ball valve clamp connection.

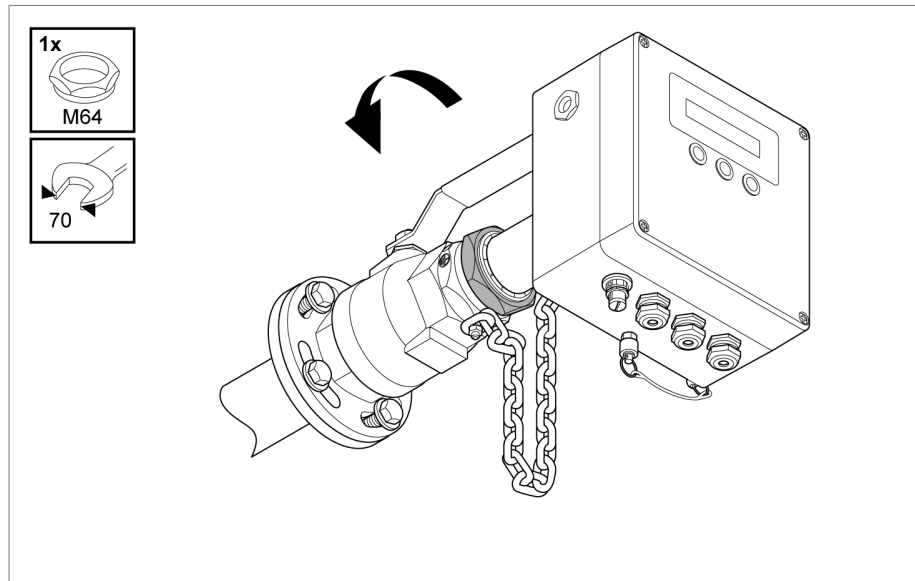


Figure 60: Releasing the ball valve clamp connection

3. Pull the device as far as possible out of the ball valve.



The chain should now be tightly tensioned.

**NOTICE**

**Danger of damaging the measuring pipe!**

If the device is operated in front of a slide valve, the tightly tensioned chain ensures that the measuring pipe of the device has been pulled out far enough and that the slide valve does not collide with it when closing.

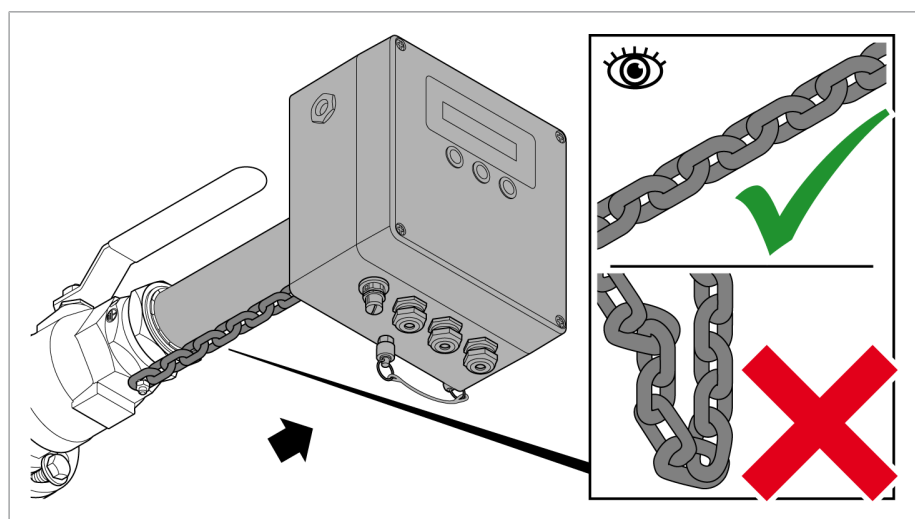


Figure 61: Pulling the device out

4. Close any upstream valves and slides.
5. Close the ball valve and position the oil collecting tray under the opening of the ball valve.

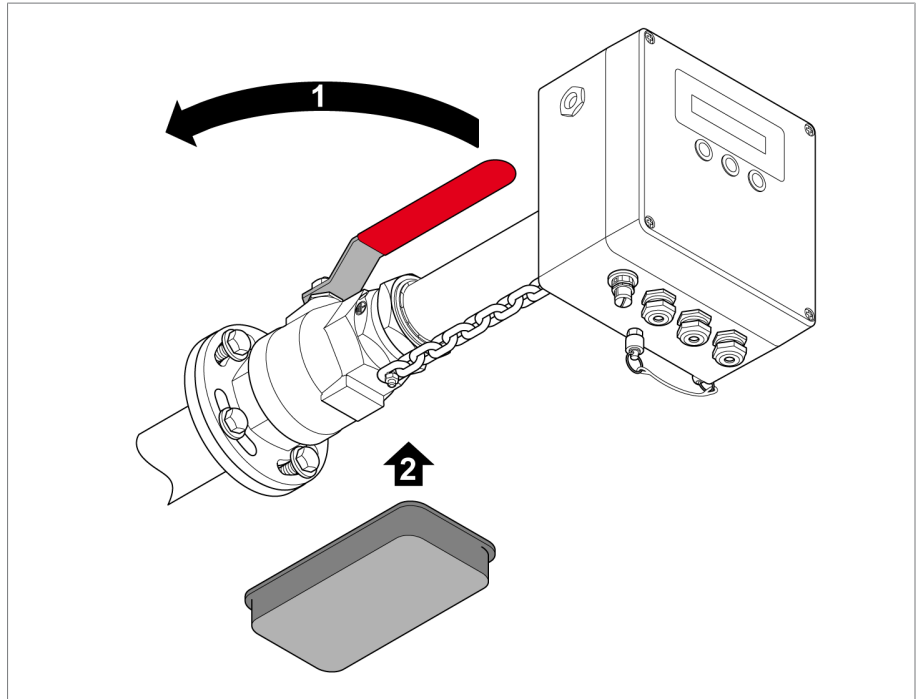


Figure 62: Closing the ball valve

**▲ CAUTION**



**Danger of crushing due to falling device**

The device is now free. Protect yourself against spraying oil with personal protective equipment and support the weight of the device.

6. Unscrew the fixing screw for the safety chain on the device far enough to free the chain. Pull the safety chain out and screw the fixing screw back into place.

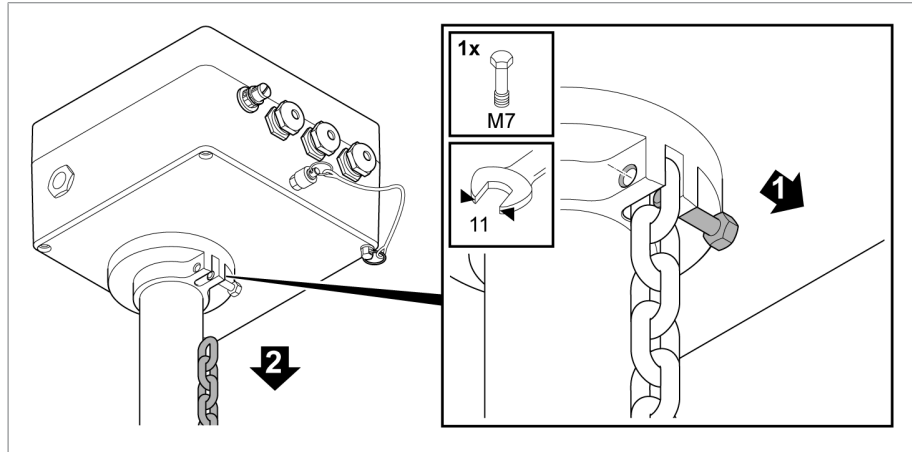


Figure 63: Releasing the link chain

7. Carefully pull the device out of the ball valve.

**NOTICE**

**Type and source of danger**

Ensure that the device does not become jammed during this procedure. Support the weight by hand. Collect the excess oil in the collecting tray.

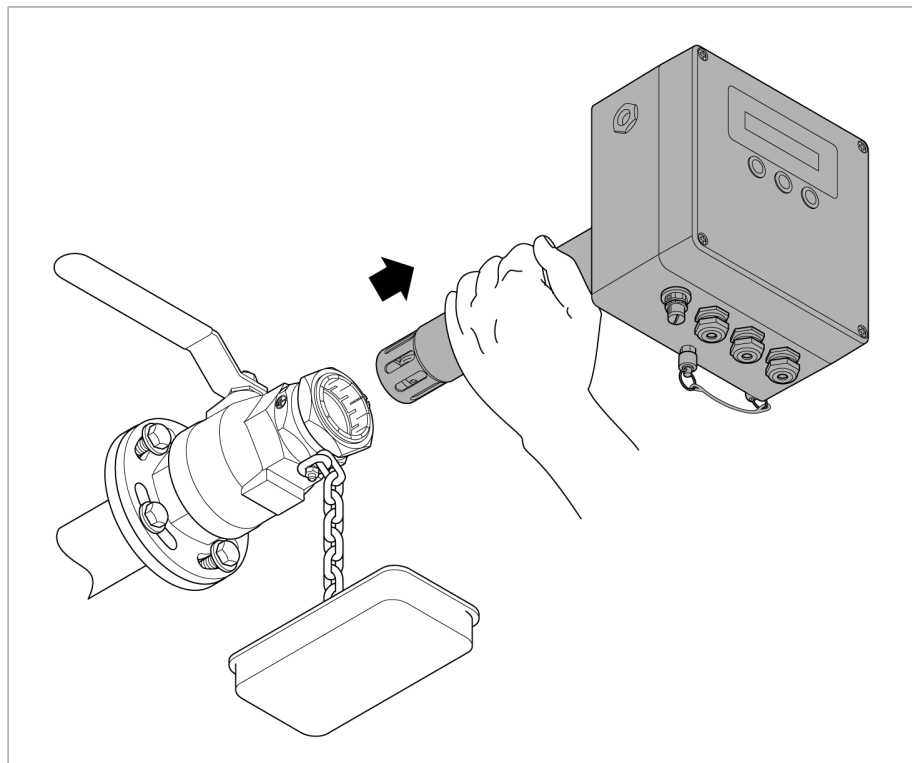


Figure 64: Pulling the device out of the ball valve

- Set the device down securely on a scratch-resistant and non-slip level surface.

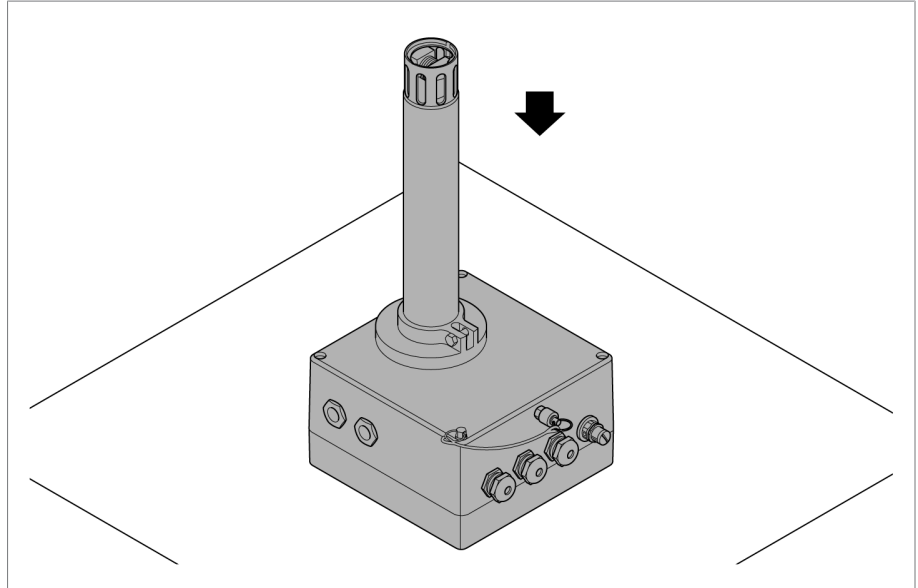


Figure 65: Setting the device down securely



When doing so, ensure that the display of the device version with display is not damaged.

- Place the supplied red protective cap onto the measuring pipe and close the protective cap opening with adhesive tape.

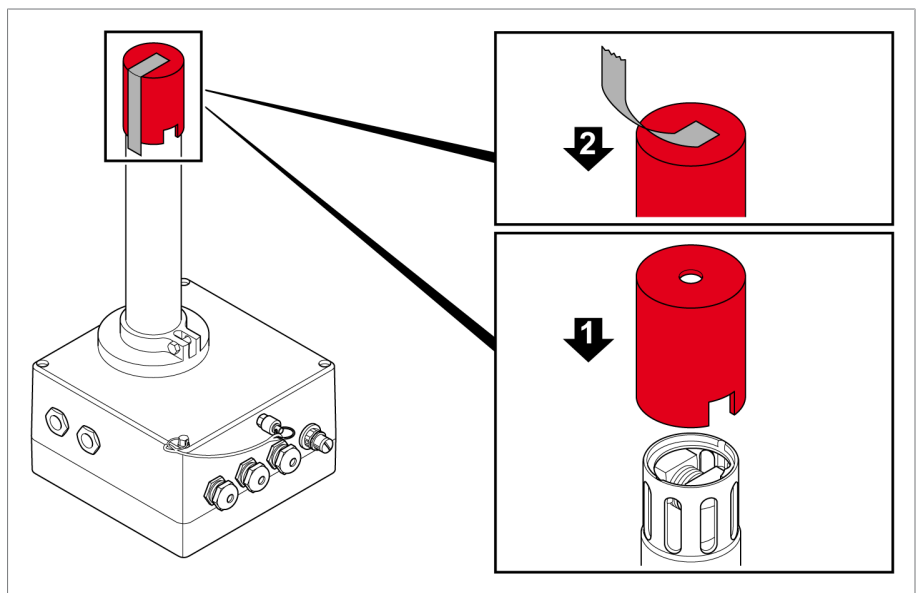


Figure 66: Placing the protective cap

10. Clean the device with a dry cloth.

The device has now been removed and can be transported or stored in suitable packaging.

**The ball valve is then to be secured:**

**▲ CAUTION**



**Hot oil escape**

Risk of injury and slipping.

- ▶ Ensure that the ball valve is closed.
- ▶ Wear safety clothing.

1. Open the air-vent valve of the ball valve dummy plug and insert the dummy plug into the ball valve up to the stop.

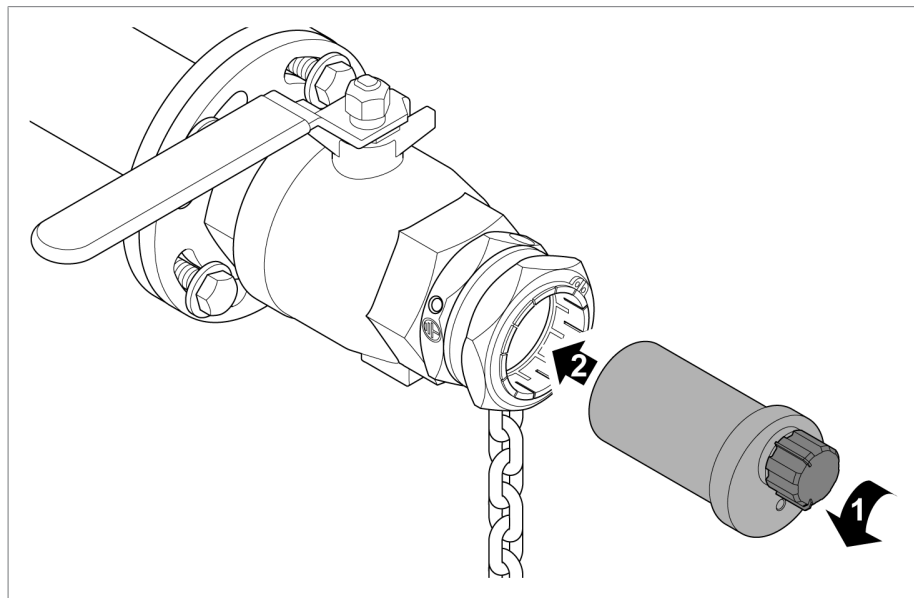


Figure 67: Inserting the dummy plug into the ball valve

2. Close the air-vent valve and tighten the ball valve clamp connection.

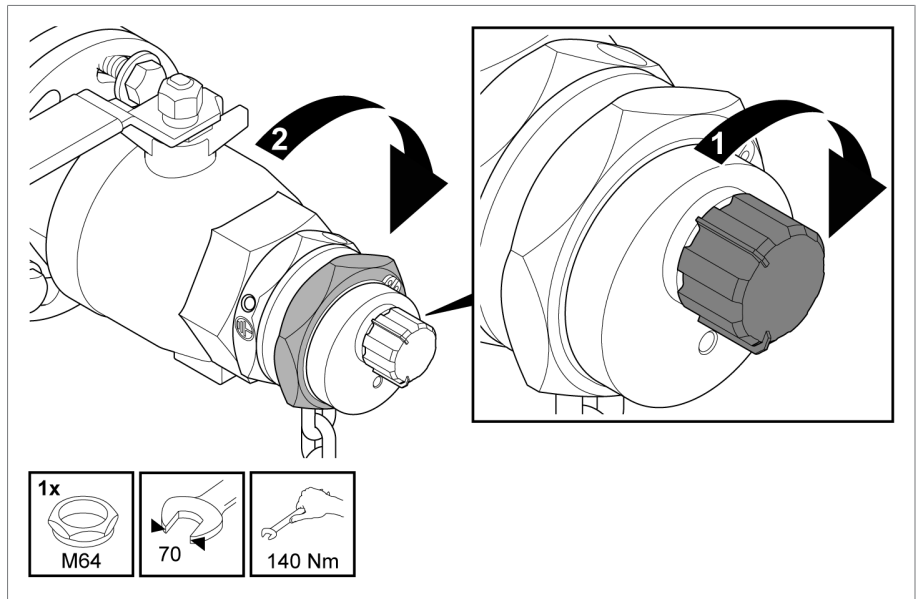


Figure 68: Tightening the ball valve clamp connection

3. Secure the free end of the safety chain with the dummy plug fixing screw.

Attach the chain under as much tension as possible.

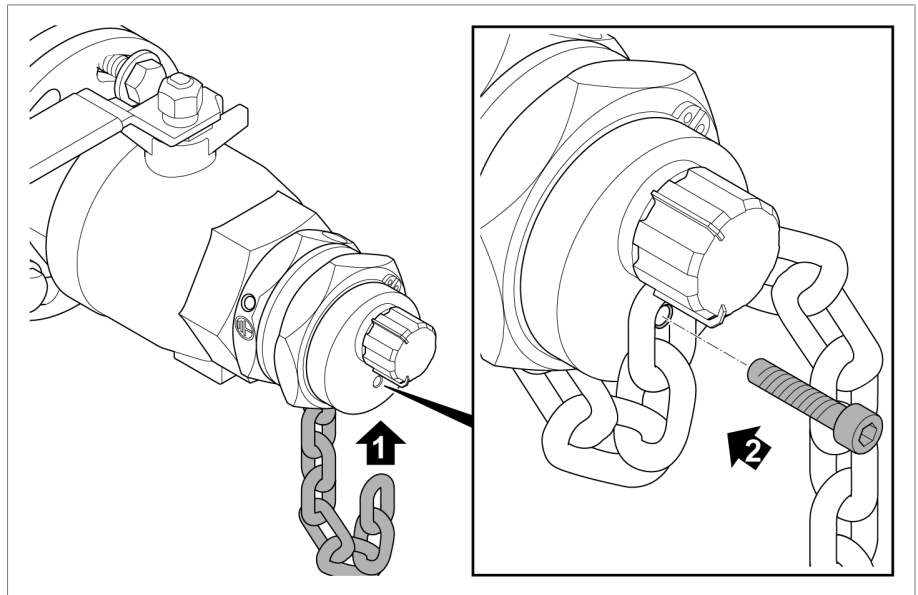


Figure 69: Securing the dummy plug with link chain

4. Remove the warning sign "Do not close!" on the slide valve.

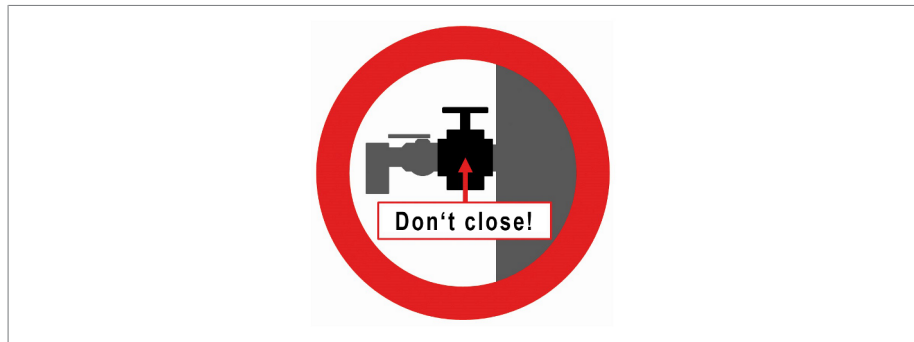


Figure 70: Slide valve warning sign





## 12 Disposal

Observe the national disposal regulations in the respective country of use.

### 12.1 SVHC information in accordance with the REACH regulation

This product complies with the provisions of European Regulation 1907/2006/EC dated December 18, 2006 on the Registration, Evaluation, Authorization and Restriction of Chemicals (REACH).

The following components of the product contain > 0.1% [w/w] of the SVHC substance lead (CAS no. 7439-92-1):

- Brass alloy
- Standard parts with a low property class



### 13 Technical data

Measurement					
Application	Determination of the gas concentration of fault gases as well as moisture in oil and oil temperature of mineral-based transformer insulating oil in accordance with IEC 60296:2012 / ASTM D3487-09				
Measured variables	H <sub>2</sub>	CO (only for MSENSE DGA 3)	Humidity Relative display can be switched	Absolute display can be switched	Oil temperature
Lower detection limit	15 ppm	25 ppm	3% RH	5 ppm	-20 °C
Upper detection limit	2,000 ppm	2,000 ppm	90% RH	2,000 ppm	+115 °C
Measuring accuracy	±10% <sup>1,2</sup> or <sup>3</sup> ±20 ppm	±15% <sup>1,2</sup> or <sup>3</sup> ±20 ppm	±1.8% RH <sup>5</sup>	±2% <sup>4</sup>	±1 °C
Repetition accuracy	±5% <sup>2</sup> or <sup>3</sup> ±10 ppm	±5% <sup>2</sup> or <sup>3</sup> ±10 ppm	±1% RH	±1% <sup>4</sup>	±1 °C
Sensor resolution	1 ppm	1 ppm	1% RH	n. a.	1 °C

<sup>1</sup> Determination based on IEC 60567, Appendix E

<sup>2</sup> Of the measured value

<sup>3</sup> Depending on which value is larger

<sup>4</sup> Of the saturation curve; IEC 60422

<sup>5</sup> At +23 °C

Conditions of use	
Locations of use	Indoors and outdoors, all climate zones
Installation altitude	Up to 4,000 m above sea level
Offshore	Optional
Mounting location	Directly on the transformer tank or in the oil closed circuit cooling pipe; installation horizontal
Operating temperature <sup>6</sup>	-40...+60 °C
Insulating fluid temperature <sup>6,7</sup>	-20...+115 °C
DGA measuring range with respect to the operating temperature <sup>6</sup>	-20...+60 °C
DGA measuring range with respect to the temperature of the insulating fluid <sup>6,7</sup>	+10...+90 °C
Ambient humidity	0...100% RH
Storage temperature	-40...+80 °C



<sup>6</sup> Please contact MR to check the use in case of extreme conditions

<sup>7</sup> At the point of measurement

<b>Device properties</b>	
Mechanical connection	Via ball valve and configurable flange DN50 or DN80 (several flanges available); with safety chain for safe installation and removal
Measuring pipe length	Two different lengths for optimum measuring conditions; Short measuring pipe: 285 mm; Long measuring pipe: 507 mm
Oil extraction connection	Luer lock socket on the device; adapter set for safe and clean oil extraction included in the scope of delivery
Operation	Optional VFD display (suitable for use in daylight) with 3 operating keys for displaying measured values and messages as well as for calling up parameters
Materials used	Stainless steel and aluminum; All external parts and parts in contact with oil are weather-resistant, resistant to transformer oil and UV-resistant
Gasket material	FPM (Viton®)
Available colors (terminal box)	RAL 7033 RAL 7038
Vacuum resistance	5 Pa for 48 hours
Pressure resistance	Max. 400 kPa
Degree of protection	IP 66
Dimensions	435 / 657 x 218 x 264 mm (version with short / long measuring pipe)
Device weight	Version with short measuring pipe: approx. 12 kg Version with long measuring pipe: approx. 14 kg (without ball valve / flange / safety chain)
Ball valve weight	Approx. 6 kg (including flange and safety chain)
<b>Electrical connection</b>	
Power supply	95...280 V AC, 50/60 Hz or 95...280 V DC (protected against polarity reversal)
Power consumption	<13 W
Overvoltage category	III
Connection terminals	Voltage supply, relays and analog outputs: 2.5 mm <sup>2</sup> , AWG 14
Cable gland	3 x M20 x 1.5 or 3 x ½" NPT; 8...15 mm lead diameter



<b>Interfaces</b>	
Relay outputs	4 freely configurable signaling relays (1 changeover contact each) for warning and alarm messages and for maintenance messages from the device-internal monitoring; 1 signaling relay for safety messages (e.g. loss of voltage) Contact current capacity: 250 V AC / 5 A; max. 400 V AC, $\cos \varphi = 1$ at 85°C; 30 V DC / 5 A to 300 V DC / 0.25 A
Analog outputs	Passive, signal tolerance $\pm 0.03$ mA, load resistance max. 700 $\Omega$ at 24 V DC MSENSE® DGA 2: 2 configurable outputs, 4...20 mA MSENSE® DGA 3: 3 configurable outputs, 4...20 mA
Service interface	5-pole socket (Molex) for communication via Modbus RTU and parameterization via MSET parameterization software

<b>MESSKO® MSET parameterization software</b>	
Delivery	On USB stick; included in the MSENSE® DGA 2/3 scope of delivery
Operating system	From Microsoft Windows 7 <sup>8</sup>
Measured value display and evaluation	Display of the current measured values and device information; Event database with time stamp (date and time); Graphic display and evaluation of the temporal progression of the measured values; Export of the measured values (CSV format) or protocol settings (PDF format)
Parameterization	Configuration of the parameters for commissioning, communication and ongoing operation
Field calibration	Setting the time stamp of the oil sample extraction; Entry of the reference values in accordance with the laboratory report
Service	Reading out the internal device service database for further analysis by MR Service experts

<sup>8</sup> Please note that Microsoft has stopped providing regular support for versions earlier than Windows 10.

<b>Mechanical tests</b>	
Vibration	10–150 Hz with 2g, 2 h (IEC 60068-2-6)
Seismic events	2–10 Hz, 22.5 mm, 1 h (IEC 60068-2-57)
Shock	10g, 10 ms (IEC 60068-2-27)

## 14 Appendix

### 14.1 Device dimensions with 285 mm measuring pipe length

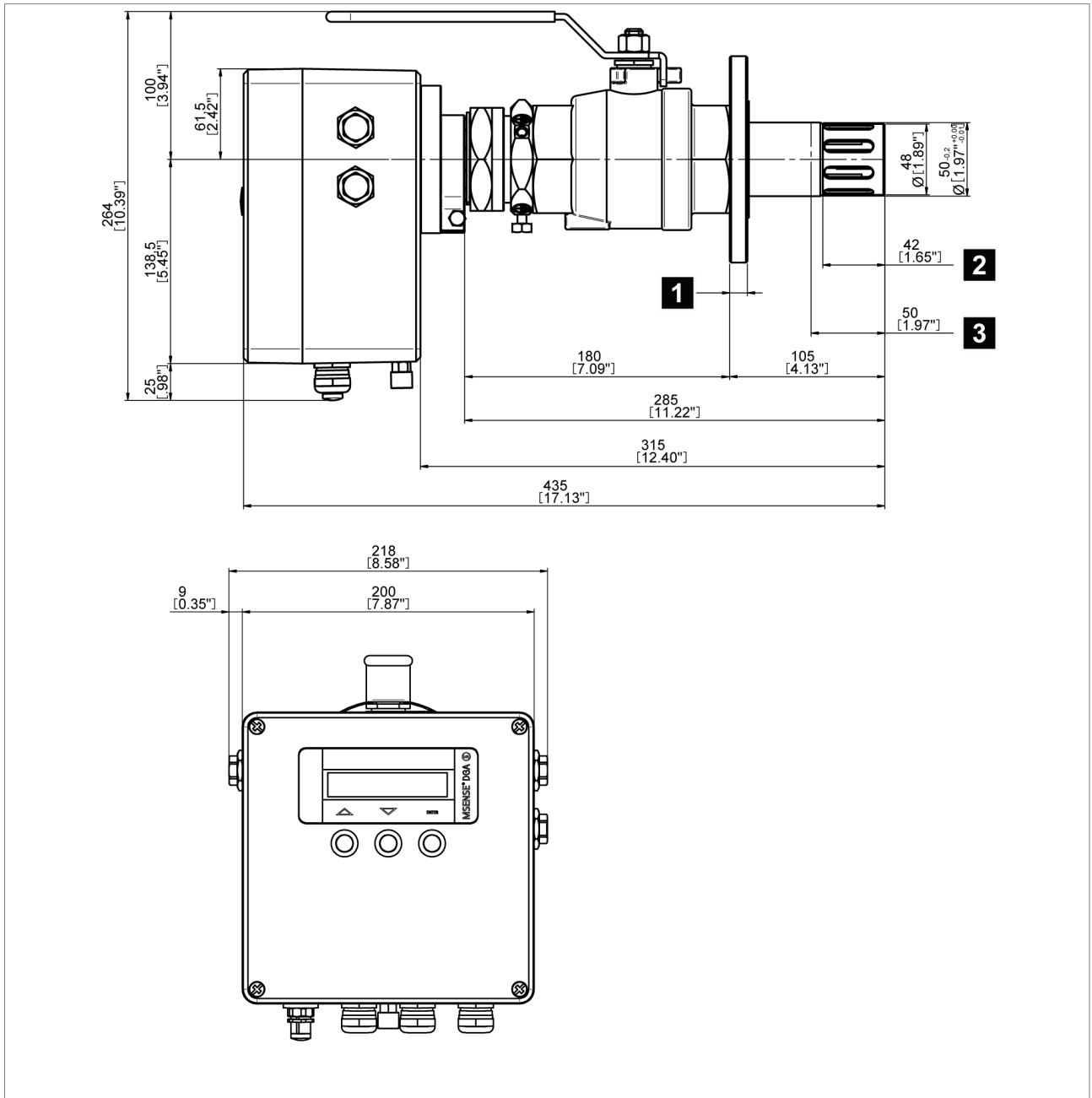


Figure 71: Device dimensions with 285 mm measuring pipe

- |   |   |
|---|---|
| 1 | Flange, see table [► Section 14.3, Page 95] |
| 2 | Minimum immersion depth                     |
| 3 | Recommended immersion depth                 |

### 14.2 Device dimensions with 507 mm measuring pipe length

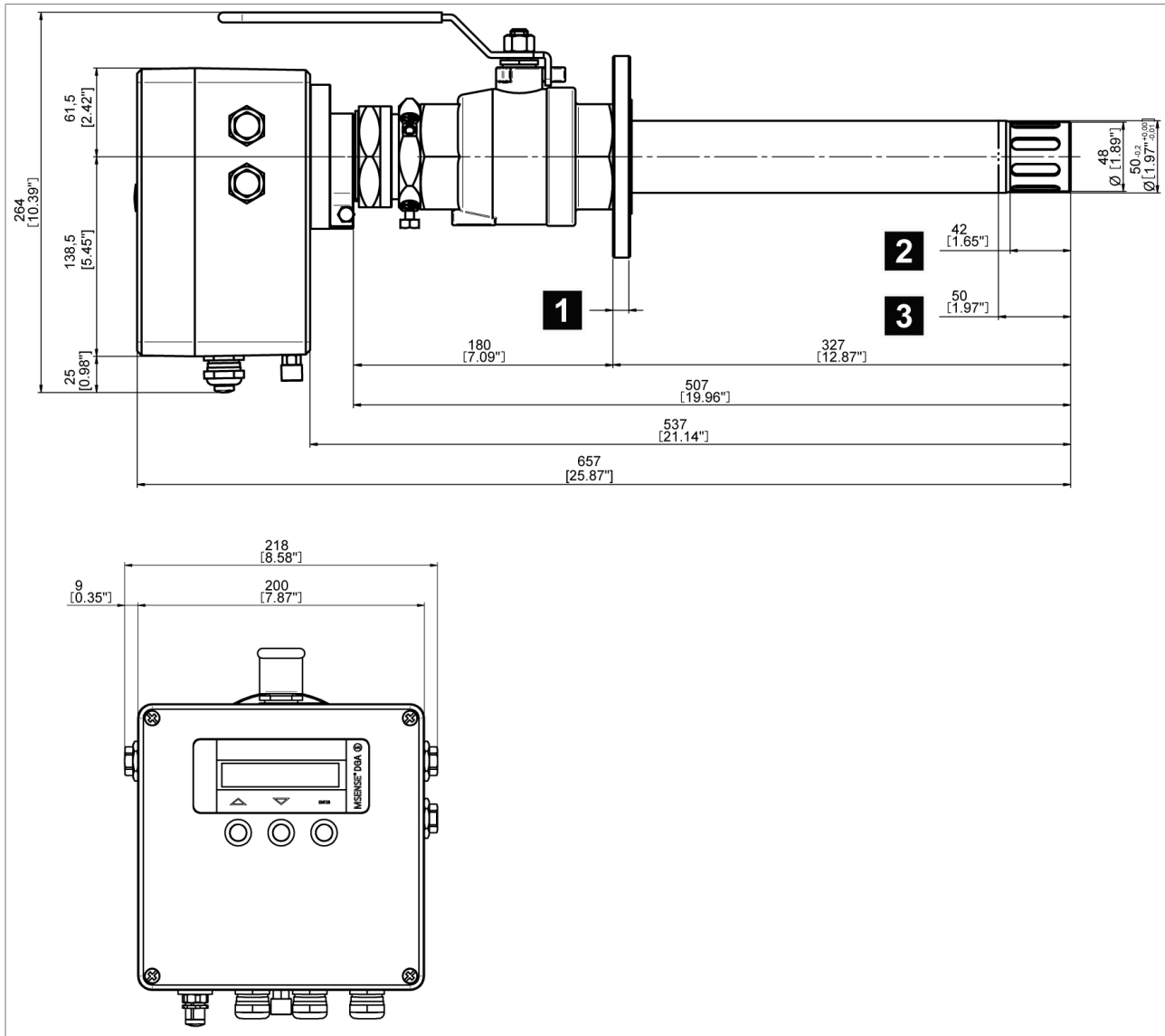


Figure 72: Device dimensions with 507 mm measuring pipe

1	Flange, see table [► Section 14.3, Page 95]
2	Minimum immersion depth
3	Recommended immersion depth

### 14.3 Connecting flange dimensions

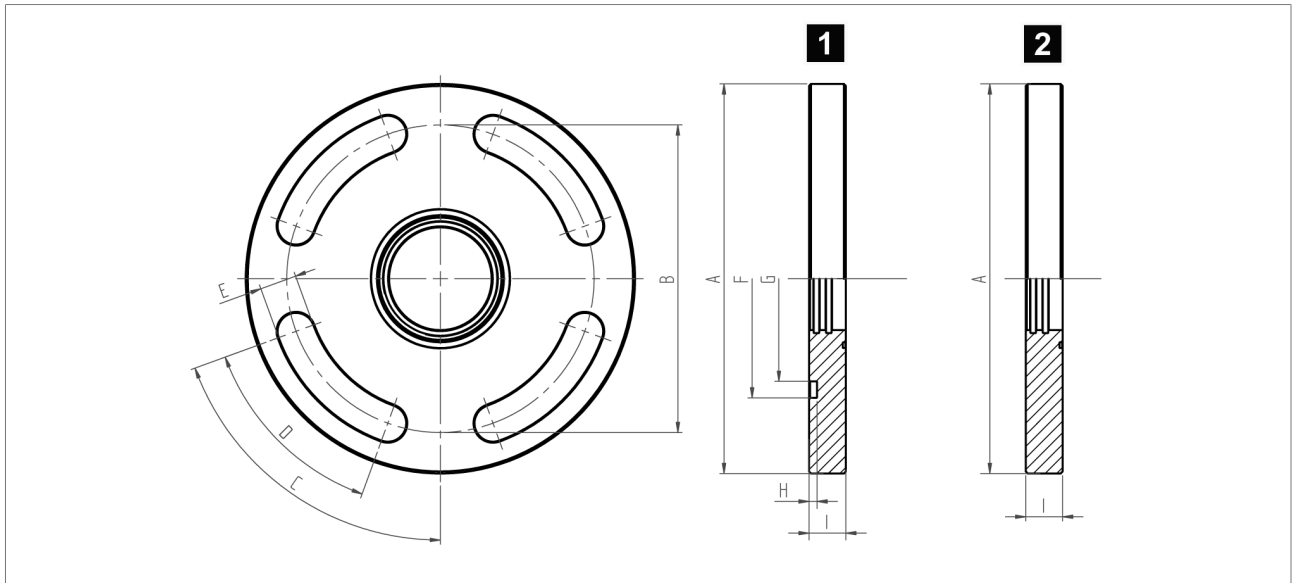


Figure 73: Flange DN50 PN6; DN50 PN16

- |   |  |
|---|--|
| 1 | For o-ring gasket (included in delivery)         |
| 2 | For any gasket (gasket not included in delivery) |

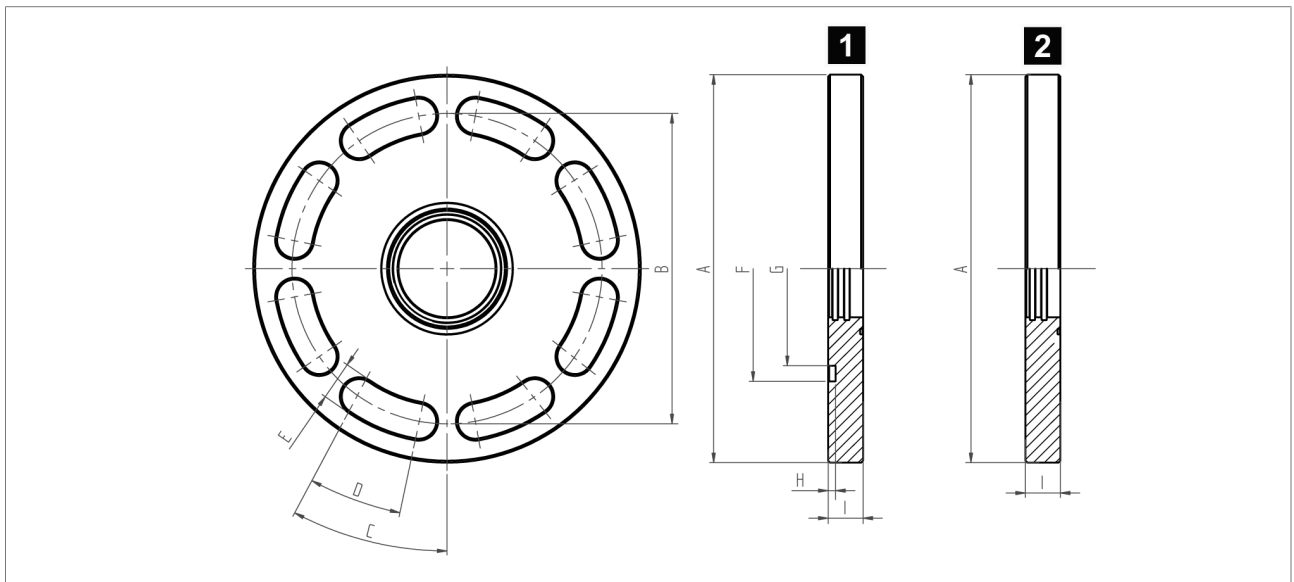


Figure 74: Flange DN80 PN16

- |   |  |
|---|--|
| 1 | For o-ring gasket (included in delivery)         |
| 2 | For any gasket (gasket not included in delivery) |

**Flange dimensions table**

Flange version	A mm [inch]	B mm [inch]	C	D	E mm [inch]	F mm [inch]	G mm [inch]
DN50 PN6	Ø140 [5.51"]	Ø110 [4.33"]	70°	4 x 50°	Ø13 [0.51"]	Ø81 [3.19"]	Ø65 [2.56"]
DN50 PN16	Ø165 [6.50"]	Ø125 [4.92"]	70°	4 x 50°	Ø18 [0.71"]	-	-
DN50 PN16	Ø165 [6.50"]	Ø125 [4.92"]	70°	4 x 50°	Ø18 [0.71"]	Ø81 [3.19"]	Ø65 [2.56"]
DN80 PN16	Ø200 [7.87"]	Ø160 [6.30"]	34.5°	8 x 24°	Ø18 [0.71"]	-	-
DN80 PN16	Ø200 [7.87"]	Ø160 [6.30"]	34.5°	8 x 24°	Ø18 [0.71"]	Ø116.2 [4.57"]	Ø100 [3.94"]

**Gasket dimensions table**

Flange version	H mm [inch]	I mm [inch]	O-ring gasket (di) x (da) x (t) mm [inch]
DN50 PN6	3 [0.12"]	12 [0.47"]	O-ring 67 [2.64"] x 79 [3.11"] x 4 [0.16"]
DN50 PN16	-	18 [0.71"]	For any gasket (gasket not included in delivery)
DN50 PN16	3 [0.12"]	18 [0.71"]	O-ring 67 [2.64"] x 79 [3.11"] x 4 [0.16"]
DN80 PN16	-	18 [0.71"]	For any gasket (gasket not included in delivery)
DN80 PN16	3.9 [0.15"]	18 [0.71"]	O-ring ID100 [3.94"] x Ø6 [0.24"]

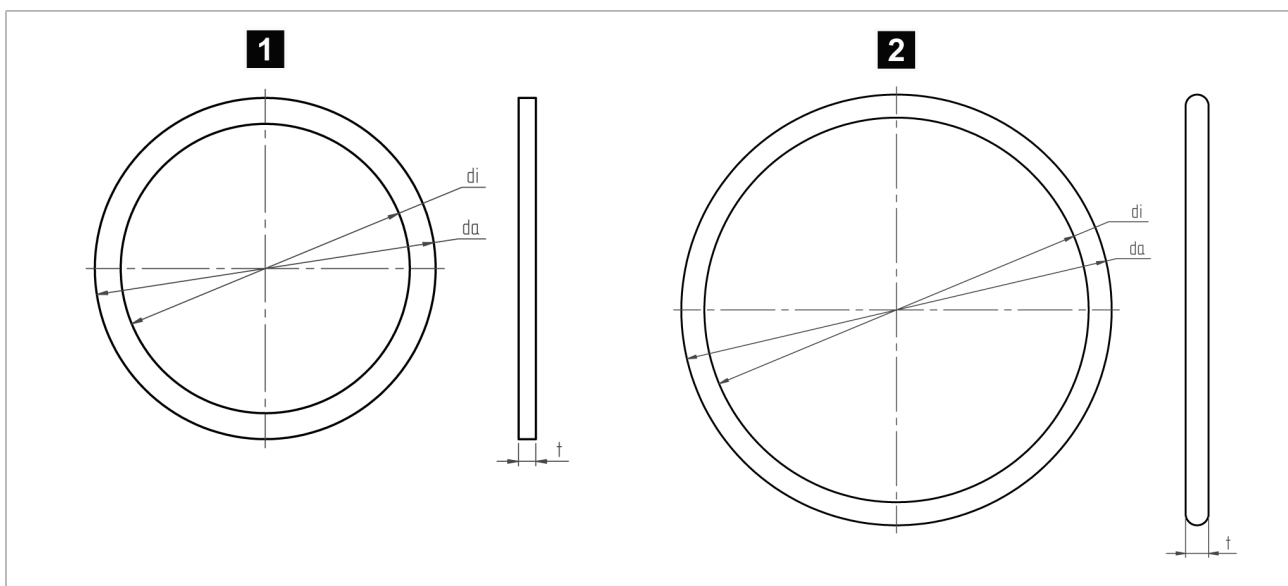


Figure 75: Flange gaskets

- |   |                               |
|---|-------------------------------|
| 1 | O-ring gasket for DN50/PN6/16 |
| 2 | O-ring for DN80/PN16          |



## 14.4 Electrical connection

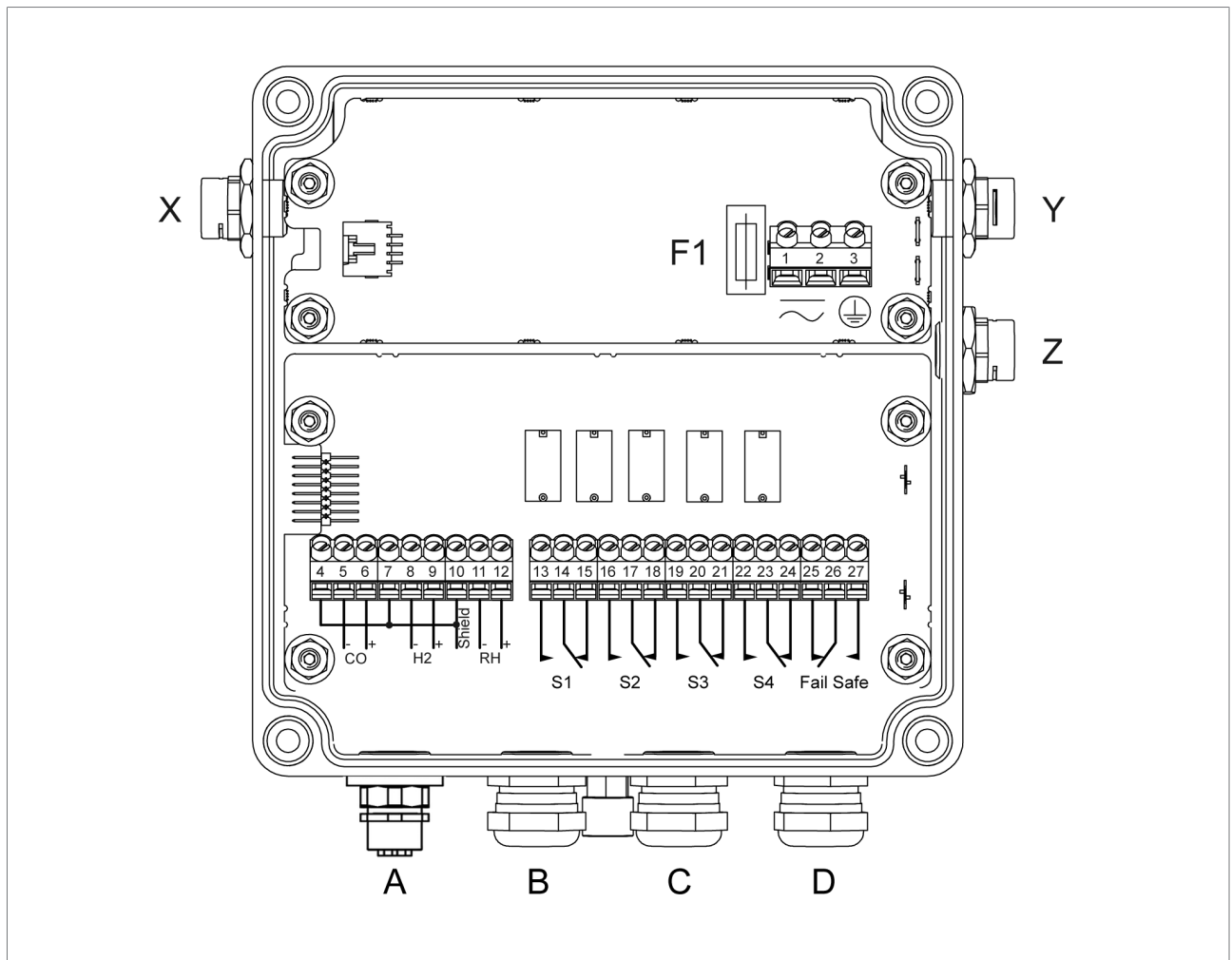


Figure 76: Electrical connection

1-2	Supply voltage (overvoltage category III) 95...280 V AC 50/60 Hz or 95...280 V DC (any polarity)
3	Protective conductor
4-12	Analog outputs 4...20 mA passive (must be supplied with 24 V DC)
13-27	Main switching contacts (change-over contacts for state signaling): capacity: 30 V DC / 5 A to 300 V DC / 0.25 A or 250 V AC / 5 A; max. 400 V AC, $\cos \varphi = 1$ at 85 °C, observe warning information [► Section 6.3.7, Page 43].
F1	Safety fuse 500 V, 500 mA, delayed-action
A	M12 socket, type A for Modbus RTU (RS485) and for USB service adapter (included in delivery)
B	M20x1.5 cable screw connection for analog outputs
C	M20x1.5 cable screw connection for signaling relay
D	M20x1.5 cable screw connection for supply voltage
X, Y, Z	Vents



## 14.5 Data point table for Modbus RTU

### Separate input register

No.	Address	Size	Description	Designation
1	0	1 byte	On / Off	CO limit 1
2	1	1 byte	On / Off	CO limit 2
3	2	1 byte	On / Off	H <sub>2</sub> limit 1
4	3	1 byte	On / Off	H <sub>2</sub> limit 2
5	4	1 byte	On / Off	H <sub>2</sub> O limit 1
6	5	1 byte	On / Off	H <sub>2</sub> O limit 2
7	6	1 byte	On / Off	CO rate limit 1
8	7	1 byte	On / Off	CO rate limit 2
9	8	1 byte	On / Off	H <sub>2</sub> rate limit 1
10	9	1 byte	On / Off	H <sub>2</sub> rate limit 2
11	10	1 byte	On / Off	H <sub>2</sub> O rate limit 1
12	11	1 byte	On / Off	H <sub>2</sub> O rate limit 2
13	12	1 byte	On / Off	Maintenance in 6 months
14	13	1 byte	On / Off	Maintenance required
15	14	1 byte	On / Off	CO Value Valid <sup>1)</sup>
16	15	1 byte	On / Off	H <sub>2</sub> Value Valid <sup>1)</sup>
17	16	1 byte	On / Off	H <sub>2</sub> O Value Valid <sup>1)</sup>
18	17	1 byte	On / Off	H <sub>2</sub> O Mode %RH

<sup>1)</sup> If the "Value Valid = Off" status is present, it means the same as an asterisk (\*) in the display or in the MSET status display, and the system is outside the specified measuring range in accordance with the "Technical data" [► Section 13, Page 90] chapter. The following applies to the transmitted measured value:

- During the first measurement after the running-in phase, the value of the lower detection limit is transmitted.
- If measured values within the specified measuring range have already been recorded, then the last valid measured value is transmitted.

If the status changes to "Value Valid = On", then the system is back in the valid measuring range.



### Input register

No.	Address (dec.)	Size	Description	Designation
1	0	4 bytes, SFLOAT	None	CO value ppm
2	2	4 bytes, SFLOAT	None	H <sub>2</sub> Value ppm
3	4	4 bytes, SFLOAT	None	H <sub>2</sub> O Value ppm
4	6	4 bytes, SFLOAT	None	Oil Temperature
5	8	4 bytes, SFLOAT	-	Empty 2
6	10	4 bytes, SFLOAT	None	H <sub>2</sub> O %RH
7	12	4 bytes, SFLOAT	-	Empty 4
8	14	4 bytes, SFLOAT	None	H <sub>2</sub> O Rate %RH/d
9	16	4 bytes, SFLOAT	None	CO Rate ppm/d
10	18	4 bytes, SFLOAT	None	H <sub>2</sub> Rate ppm/d
11	20	4 bytes, SFLOAT	None	H <sub>2</sub> O Rate ppm/d



## 14.6 Spare parts list

Seq. No.	Art. No.	Designation
1	1001099900	MSENSE® 2/3 oil extraction unit (standard) Sample extraction adapter (standard version) Material: stainless steel V2A and PTFE
2	1001100100	MSENSE® 2/3 oil extraction unit (offshore) Sample extraction adapter (offshore version) Material: stainless steel V4A and PTFE
3	1001100300	MSENSE® 2/3 USB stick Including MESSKO® MSET parameterization software and operating instructions
4	1001370400	MSENSE® 2/3 service adapter (standard) With USB connection, length 3 m, 9-pole (for devices built in 2016)
5	1001382201	MSENSE® 2/3 plug (standard) 9-pole (for devices built in 2016; for self-assembly)
6	1001100500	MSENSE® 2/3 ball valve DN50 PN6/285 For measuring pipe length 285 mm Flange diameter: DN50 Pressure rating: PN6 Material: stainless steel V4A Including flat gasket, material: FPM (Viton)
7	1001100600	MSENSE® 2/3 ball valve DN50 PN6/507 For measuring pipe length 507 mm Flange diameter: DN50 Pressure rating: PN6 Material: stainless steel V4A Including flat gasket, material: FPM (Viton)
8	1001100700	MSENSE® 2/3 ball valve DN50 PN16/285 For measuring pipe length 285 mm Flange diameter: DN50 Pressure rating: PN16 Material: stainless steel V4A Including flat gasket, material: FPM (Viton)
9	1001100900	MSENSE® 2/3 ball valve DN50 PN16/507 For measuring pipe length 507 mm Flange diameter: DN50 Pressure rating: PN16 Material: stainless steel V4A Including flat gasket, material: FPM (Viton)



Seq. No.	Art. No.	Designation
10	1001101000	MSENSE® 2/3 ball valve DN80 PN16/285 For measuring pipe length 285 mm Flange diameter: DN80 Pressure rating: PN16 Material: stainless steel V4A Including o-ring gasket, material: FPM (Viton)
11	1001101100	MSENSE® 2/3 ball valve DN80 PN16/507 For measuring pipe length 507 mm Flange diameter: DN80 Pressure rating: PN16 Material: stainless steel V4A Including o-ring gasket, material: FPM (Viton)
12	1000341800	MSENSE® 2/3 flange gasket (flat) for ball valve  For flange diameter: DN50 Material: FPM (Viton)
13	1000627700	MSENSE® 2/3 flange gasket (o-ring) ID100x6 for ball valve For flange diameter: DN80 Material: FPM (Viton)
14	1001101200	MSENSE® 2/3 dummy plug for ball valve Material: aluminum (offshore-resistant)
15	1001101300	MSENSE® 2/3 chain set 285 For measuring pipe length 285 mm (with chain connector) Material: stainless steel V4A
16	1001101400	MSENSE® 2/3 chain set 507 For measuring pipe length 507 mm (with chain connector) Material: stainless steel V4A
17	MS99105600	Tube of grease (Autol Top 2000) for offshore version
18	1000653603	MKaliba plug on USB plug (for devices built before 2016), incl. USB cable
19	1001008300	MSENSE® service adapter (plug M12, 5-pole on USB, length 3 m)
20	1000711400	MSENSE® Modbus connection plug M12, 5-pole (for self-assembly)
21	1001853000	Y adapter (5-pole, for Modbus ring cabling)
22	1001403600	Y adapter (9-pole, for Modbus ring cabling, for devices built in 2016)



Please direct inquiries about other flange designs and spare parts to the sales department of Maschinenfabrik Reinhausen GmbH.



## Glossary

### **Insulating fluid temperature**

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Permissible temperature of the insulating fluid in the product or directly on the product.

### **Operating temperature**

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Permissible temperature in the immediate surroundings of the device during operation taking ambient influences, for example due to the equipment and installation location, into consideration.

### **Storage temperature**

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Permissible temperature for storing the device in an unmounted state or in a mounted state so long as the device is not in operation.



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