Oil level indicator
MESSKO® MTO
Operating instructions

5972470/04 EN

The product may have been altered since this document was published.

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 product is delivered in accordance with MR's technical specifications, which are based on information provided by the customer. The customer has a duty of care to ensure the compatibility of the specified product with the customer's planned scope of application.

The original operating instructions were written in German.

Table of contents

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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

Maschinenfabrik Reinhausen GmbH
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93059 Regensburg
Germany

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E-mail: sales@reinhausen.com
Internet: www.reinhausen.com
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 Completeness

This technical file is incomplete without the supporting documents.

The following documents apply to this product:

- Operating instructions
- Works certification

1.3 Safekeeping

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

1.4 Notation conventions

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

1.4.1 Hazard communication system

Warnings in this technical file are displayed as follows.

1.4.1.1 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

1.4.1.2 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.

1.4.1.3 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

1.4.2 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.

1.4.3 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).

1.4.4 Typographic conventions

Typographic convention	Purpose	Example
UPPERCASE	Operating controls, switches	ON/OFF
[Brackets]	PC keyboard	[Ctrl] + [Alt]
Bold	Software operating controls	Press **Continue** button

Typographic convention	Purpose	Example
…>…>…	Menu paths	Parameter > Control parameter
Italics	System messages, error messages, signals	*Function monitoring* alarm triggered
[► Number of pages]	Cross reference	[► Page 41].
Dotted underscore	Glossary entry, abbreviations, definitions, etc.	Glossary entry

Table 2: Typographic conventions used in this technical file

- 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 oil level indicator displays the oil level of the oil conservator.

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

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:

- Only use the product with the transformer specified in the order.
- Operate the product in accordance with this technical documentation, the agreed-upon delivery conditions and the technical data.
- Ensure that all necessary work is performed by qualified personnel only.
- Use the equipment and special tools supplied solely for the intended purpose and in accordance with the specifications of this technical file.

2.2 Fundamental Safety Instructions

To prevent accidents, disruptions 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 15] 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.

Contamination level

Moisture, dust, sweat and other conductive dirt may cause malfunctions in the device. To ensure contamination level II, observe the following information:

- Wear assembly gloves.
- Ensure that no dirt or moisture enters the device when it is open.
- Close up the device after installation.

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 and inspection must have the following qualifications.

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.

Technical Service

We strongly recommend having repairs and retrofitting carried out by our Technical Service department. This ensures that all work is performed correctly. If repair work is not carried out by our Technical Service department, please ensure that the personnel who carry out the repairs 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.

Protective clothing	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.
Safety shoes	To protect against falling heavy objects and slipping on slippery surfaces.
Safety glasses	To protect the eyes from flying parts and splashing liquids.
Visor	To protect the face from flying parts and splashing liquids or other dangerous substances.
Hard hat	To protect against falling and flying parts and materials.
Hearing protection	To protect against hearing damage.
Protective gloves	To protect against mechanical, thermal and electrical hazards.

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.
- Ensure that the device is only operated by trained personnel who are familiar with IT security.
- If a network-based system (e.g. Ethernet) has access to the bus master, observe the IT security rules of the system used.

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

4.1 Scope of delivery

The product is packaged with protection against moisture and is delivered as follows:

- Oil level indicator
- Float gauge with float rod (packed separately if longer than 400 mm, otherwise included in the MTO packaging)
- Operating instructions

Optional:

- Passive 4...20 mA analog output
- Active 4…20 mA analog output and Modbus
- Flanged relay box with 4 relays
- Standard cable gland M25x1.5 (brass), WADI cable gland (brass or stainless steel), offshore cable gland (stainless steel) or EMC double cable gland
- 1/2" 14NPT adapters
- ANSI plug or MIL plug
- Connecting cable with ANSI socket

Please note the following:

- Check the shipment against the shipping documents for completeness
- Store the parts in a dry place until installation
- The product must remain in the packaging and may only be removed immediately before installation

4.2 Function description

The oil level indicator displays the oil level of the transformer's oil conservator using a float gauge. so that operating errors (e.g. when filling the transformer) can be prevented.

The oil level indicator is comprised of a gauge part and a transmitter part, which are connected but can be separated. A magnetic coupling transmits the lifting movement of the float gauge to the pointer axis in the gauge part.

4 Product description

Depending on the version, the measured value can be signaled via:

- Micro-switches
- Passive 4…20 mA analog output (TT)
- Active 4…20 mA analog output (TTM; 24 VDC device power supply required)
- Modbus RTU RS485 interface (TTM; 24 VDC device power supply required)
- Additional relay contact (TTMR).

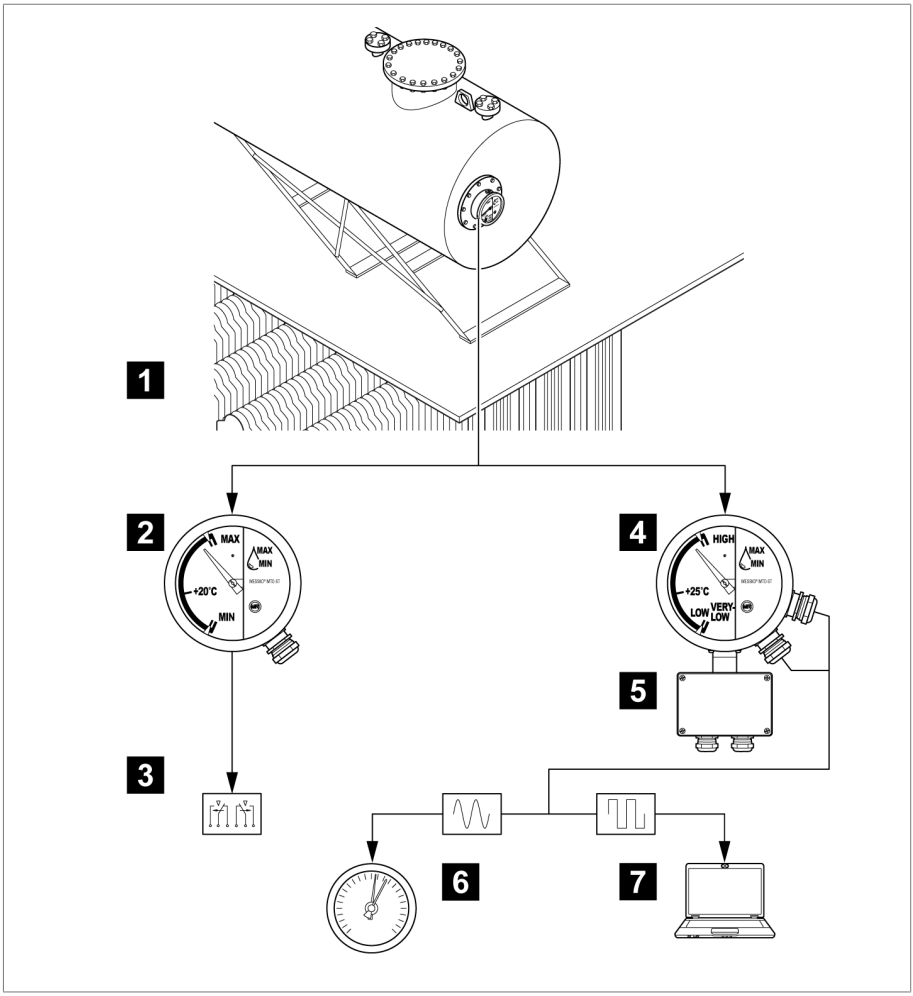

Figure 1: MTO functional overview

1	Oil level indicator on the oil conservator	2	Oil level indicator
3	Electric switching signals (microswitches; optional)	4	Version with two cable glands
5	Relay box (optional)	6	Electronic display
7	SCADA		

4 Product description

4.3 Design

Depending on the order, the oil level indicator has either one or two cable glands, one NPT cable gland, one ANSI socket or one MIL socket.

Standard version with cable gland

As an option, the M25x1.5 cable gland is also available in other versions, such as WADI (water-tight) or offshore.

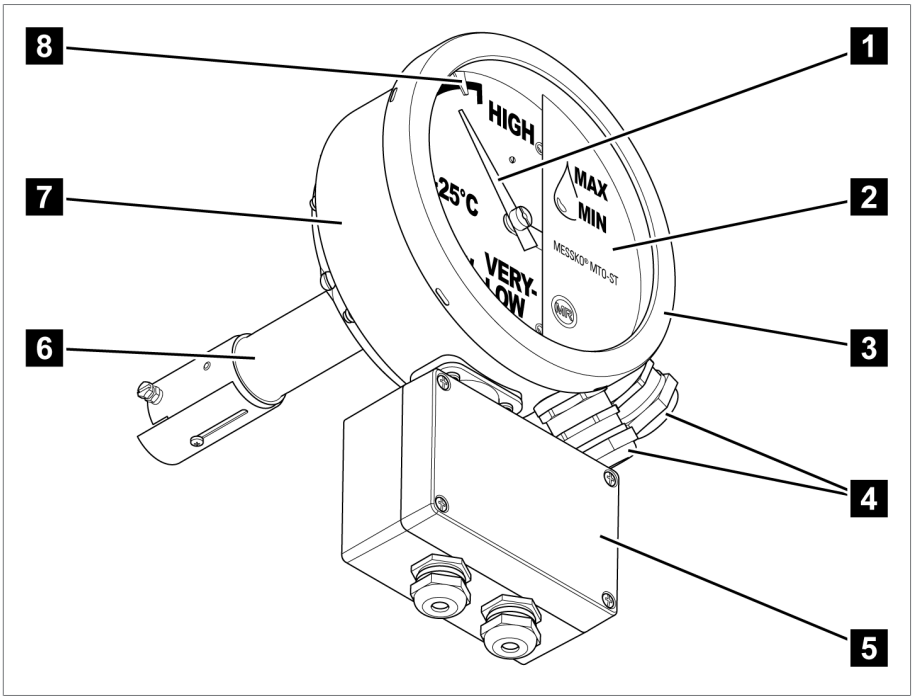

Figure 2: Version with two cable glands and a relay box

1	Pointer	2	Cover plate
3	Bayonet seal ring including viewing glass and rubber gasket	4	Cable glands (optionally with plug)
5	Relay box (optional)	6	Transmitter part
7	Display part	8	Micro-switch (optional)

Version with 1/2" NPT cable gland

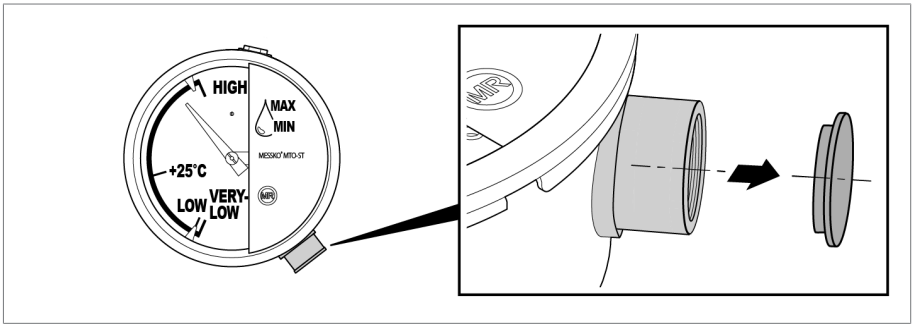

Figure 3: NPT cable gland, with locking cap as a transport lock

Version with sockets

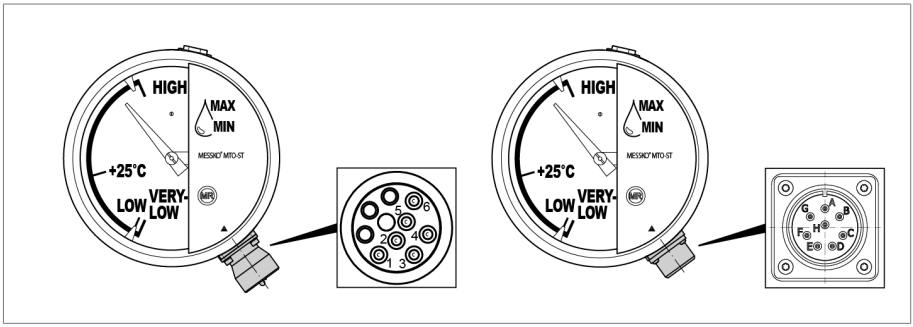

Figure 4: ANSI socket (left); MIL socket (right)

Ventilation

The oil level indicator has a pressure equalization element for preventing the build-up of condensation in the device interior.

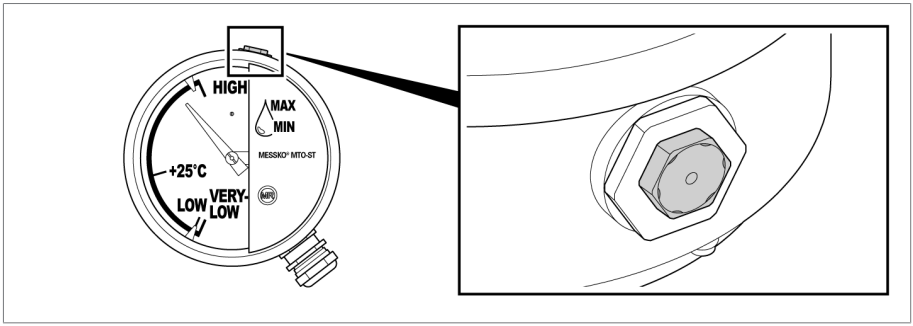

Figure 5: Pressure equalization element

4 Product description

4.4 Versions

The oil level indicator can be equipped as follows:

- Without micro-switch
- With permanently set micro-switches
  - A maximum of 3 micro-switches are permanently mounted
  - Permanently set micro-switches are secured at the factory and cannot be subsequently adjusted.
- With adjustable micro-switches
  - A maximum of 3 micro-switches which can be adjusted across the entire indicator scale.
  - The micro-switches are recognizable via the colored switching triangles (red or blue) on the edge of the dial.
- Depending on the design of the oil conservator, the oil level indicator is available with either radial or axial float movement.
- To improve readability, the oil level indicator is available for vertical or inclined mounting (with 15°, 30° or 45° angle of inclination).

Design	Mounting position	Micro-switches	Float movement
MTO-ST160 **MTO-ST160RM** **MTO-ST160TT**[1)] **MTO-ST160RMTT**[1)] **MTO-ST160TTM**[2)3)] **MTO-ST160TTMR**[2)3)4)] **MTO-ST160RMTTM**[2)3)] **MTO-ST160RMTTMR**[2)3)4)]	Vertical	Maximum 3, adjustable	Radial
MTO-STF160 **MTO-STF160TT**[1)] **MTO-STF160TTM**[2)3)] **MTO-STF160TTMR**[2)3)4)]	Vertical	Maximum 3, permanently set	Radial
MTO-ST160V **MTO-ST160VTT**[1)] **MTO-ST160VTTM**[2)3)] **MTO-ST160VTTMR**[2)3)4)]	Inclined	Maximum 3, adjustable	Radial

Design	Mounting position	Micro-switches	Float movement
MTO-STF160V **MTO-STF160VTT**[1)] **MTO-STF160VTTM**[2)3)] **MTO-STF160VTTMR**[2)3)4)]	Inclined	Maximum 3, permanently set	Radial
MTO-ST160G **MTO-ST160GTT**[1)] **MTO-ST160GTTM**[2)3)] **MTO-ST160GTTMR**[2)3)4)] **MTO-ST160GRM** **MTO-ST160GRMTT**[1)] **MTO-ST160GRMTTM**[2)3)] **MTO-ST160-GRMTTMR**[2)3)4)]	Vertical or inclined	Maximum 3, adjustable	Axial
MTO-STF160G **MTO-STF160GTT**[1)] **MTO-STF160GTTM**[2)3)] **MTO-STF160GTTMR**[2)3)4)]	Vertical or inclined	Maximum 3, permanently set	Axial
[1)] **Passive analog output**	This oil level indicator is equipped with a passive analog output.		
[2)] **Active analog output**	This oil level indicator is equipped with an active analog output.		
[3)] **Modbus**	This oil level indicator is equipped with a digital Modbus RTU (RS485) interface.		
[4)] **Relay box**	This oil level indicator is equipped with four additional relays.		

4.4.1 Radial float movement

The oil level indicators with float movement in the radial direction can be mounted on straight and angled flanges. Inclining the oil level indicator makes it easier to read off the indicated values.

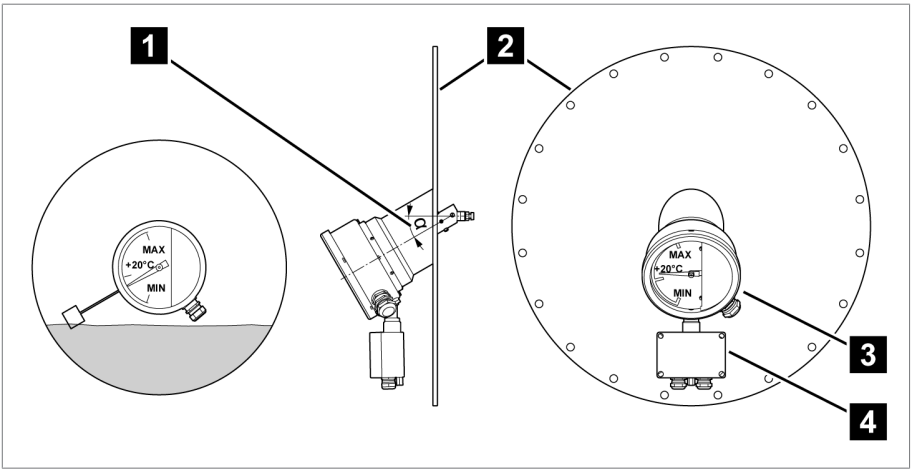

Figure 6: Installation with angle of inclination α = 0° (left) and an example for angle of inclination α = 45° (right)

1	Angle of inclination α (possible values: 0°, 15°, 30°, 45°)	2	Oil conservator cover
3	Inclined oil level indicator	4	Relay box (optional)

4.4.2 Axial float movement

The oil level indicators with float movement in the axial direction are intended for special conditions:

- In oil conservators with a breathing sack.
- In narrow or flat oil conservators in which only very little float movement is possible.

The float movement is transferred to the display part via gearing in the transmitter part in the ratio 1:1, 1:2, 1:3 or 1:4.

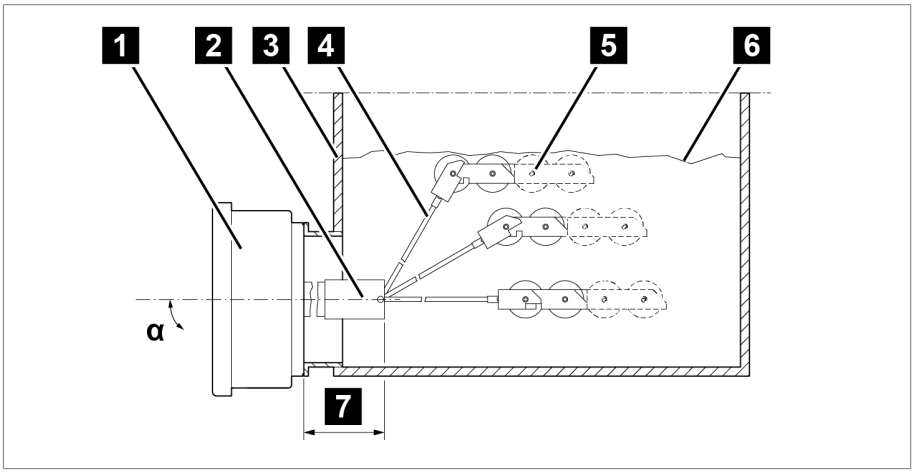

Figure 7: Axial float movement with breathing sack

1	Display part	2	Transmitter part
3	Oil conservator	4	Float rod
5	Float gauge (1, 2, or 4 rollers)	6	Breathing sack
7	Projection	α	Inclination 0°...45°

4.5 Safety markings

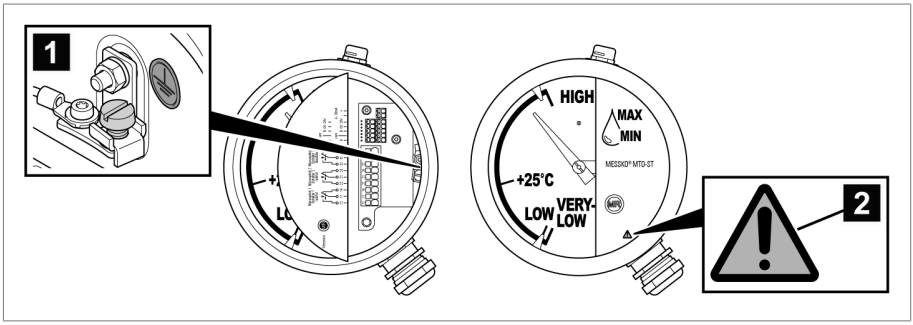

Figure 8: Safety marking/pictograms

1	Protective conductor connection	2	Observe the documentation

4 Product description

4.6 Nameplate

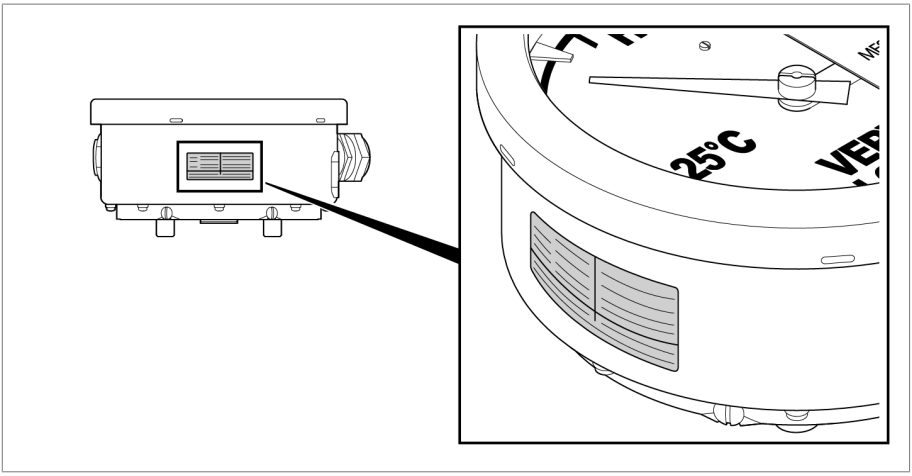

Figure 9: Nameplate

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 or solid wooden crate. These ensure 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 or crate stabilize the goods, preventing impermissible changes of 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.

	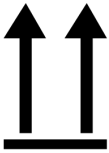			
Protect against moisture	Top	Fragile	Attach lifting gear here	Center of mass

Table 4: Shipping pictograms

5.4 Transportation, receipt and handling of shipments

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

Should the packaging tip over or fall, damage is to be expected regardless of the weight.

5 Packaging, transport and storage

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 manufacturer's sales department 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 the installation and electrical connection of the oil level indicator.

⚠ DANGER

Electric shock!

Danger of death due to electrical voltage when assembling/ disassembling the device.

- ► Switch off transformer on high-voltage side and low-voltage side.
- ► Lock transformer to prevent unintentional restart.
- ► Make sure that everything is de-energized.
- ► Visibly connect all transformer terminals to ground (grounding leads, grounding disconnectors) and short circuit them.
- ► 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.

Avoid installing components of different versions

There are different versions of the oil level indicator, depending on various factors (e.g. design of the float gauge connection, flange design, display range).

The gauge part and transmitter part are adjusted to one another at the factory and have identical serial numbers. Only attach transmitter parts and gauge parts together that have identical serial numbers.

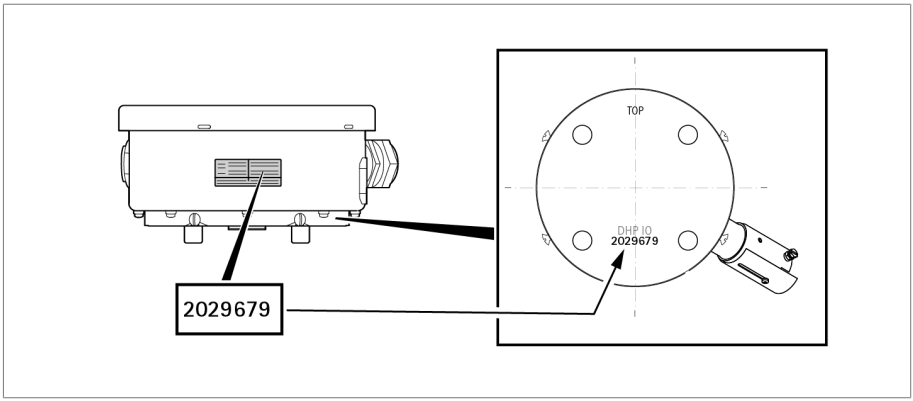

Figure 10: Identical serial numbers (example) on the nameplate of the gauge part and on the transmitter part

NOTICE

Indication deviation

Attaching transmitter parts and gauge parts together that have different serial numbers can have a detrimental effect on the stated tolerances of the fill level indication.

- ► Only attach transmitter parts and gauge parts together that are intended for the same version (e.g. for axial float movement with 1:1 gearing and display range MIN...+25 °C...MAX).
- ► Check for correct function using a sink test [►Section 7.2, Page 77].

6.1 Preparation

Observe the following information for the electrical connection.

6.1.1 Electromagnetic compatibility

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

6.1.1.1 Wiring requirement of installation site

Note the following when selecting the installation site:

- The system's overvoltage protection must be effective.
- The system's ground connection must comply with all technical regulations.
- Separate system parts must be joined by a potential equalization.

6.1.1.2 Wiring requirement of operating site

Note the following when wiring the operating site:

- Do not route lines which cause interference (e.g. supply lines) and lines susceptible to interference (e.g. signal lines) in the same cable duct.
- Maintain a distance of more than 100 mm (3.94″) between lines which cause interference and those which are susceptible to interference.

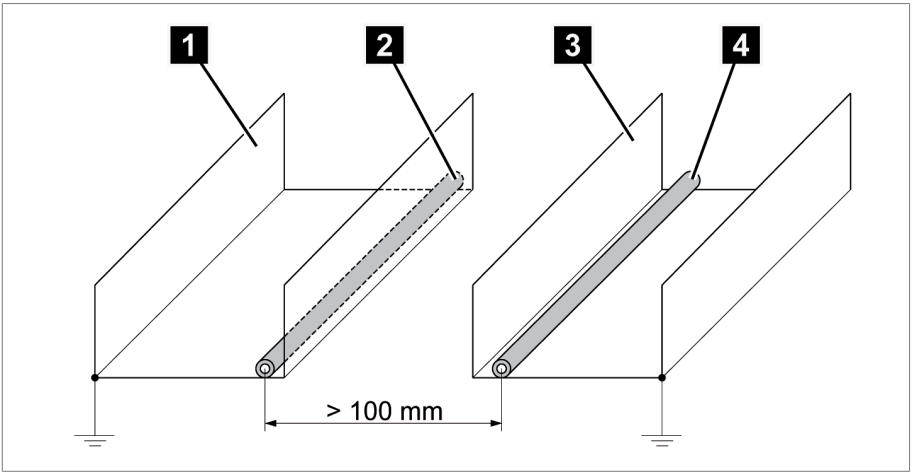

Figure 11: Recommended wiring

1	Cable duct for lines causing interference	3	Cable duct for lines susceptible to interference
2	Line causing interference (e.g. power line)	4	Line susceptible to interference (e.g. signal line)

- Never connect the device with a multi-wire collective pipe.
- Use a shielded cable for signal transmission of the analog output signal and Modbus.

6.1.2 Safeguarding the power circuits

You may only connect the device to circuits with an external overcurrent protective device and an all-pole isolating device so that the equipment can be fully de-energized if required.

Suitable equipment includes isolating devices in accordance with IEC 60947-1 and IEC 60947-3 (e.g. circuit breakers). Observe 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 the 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

You must protect the mains circuits for the main switching contacts as follows:

Miniature circuit breaker	Micro-switches		Relay (TTMR)
	Freely adjustable	Permanently set	
– Rated current	6 A	16 A	6 A
– Triggering characteristic	C	C	C

Conductor cross-section

For all mains circuits, use a conductor cross-section suitable for the miniature circuit breaker that you have selected, but at least 1.5 mm^2 (AWG 16).

6.1.3 Cable recommendation

Please note the following recommendation from the manufacturer when wiring the device:

- If both low voltage and extra-low voltage are connected in the device, it must be ensured that the circuits for extra-low voltage and for low voltage in the connection area and in the cable are separated from each other with double insulation.
- The cables used must be flame-resistant in accordance with IEC 60332-1-2 or UL 2556 VW-1.
- Due to the intrinsic heating of the devices, the connection cables used must have a temperature resistance that is 20 K higher than the operating temperature (example: at an ambient temperature of +70 °C, at least +90 °C).
- Use copper conductors only because the terminals are not designed for other conductor materials.

Cable	Terminals	Permissible cross-sections
Protective conductor connection	⏚ Grounding screw in the device / grounding screw outside on the housing	≧ all other conductors
Micro-switches	12, 11, 14, 22, 21, 24	0.2...4 mm² / 24...12 AWG
Analog output[1)]	(+), (-)	0.2...1.5 mm² /24...16 AWG
Power supply[1)]	24 V, 0 V	0.2...1.5 mm² /24...16 AWG
Modbus[1)] A = "+" connection COM = common ground B = "-" connection	A, B, C	0.2...1.5 mm² /24...16 AWG
Relays[1)]	K1 (1, 2, 3), K2 (1, 2, 3), K3 (1, 2, 3), K4 (1, 2, 3)	0.25...4 mm² / 24...12 AWG

[1)]Depending on the equipment version (optional)

It must be possible to apply a nominal voltage of at least 300 V to all connection cables; Cable type unshielded rigid or flexible.

Modbus

A shielded twisted-pair cable is recommended. For reasons of space, it may be advantageous to run the Modbus and the 24 V supply in the same cable.

Connect the shield to the Modbus master (e.g. in the control cabinet). Route the shield to the device without interruption and use an EMC cable gland on the device to connect the shield.

Analog output

A shielded cable is recommended.

Connect the shield in the control cabinet. Route the shield to the device without interruption and use an EMC cable gland on the device to connect the shield.

6.1.4 Checking the flanges

NOTICE

Damage to the flanges.

A gap between the flanges caused by a deviation in evenness or impurities can cause damage to the flanges.

- ► Observe the information on the flange requirements.
- ► Tighten screws with 10% of the target tightening torque and ensure that there is no gap between the flanges.
- ► If there is a gap, repair the affected oil conservator flange or, if necessary, detach and re-weld it so that there is no longer a gap.

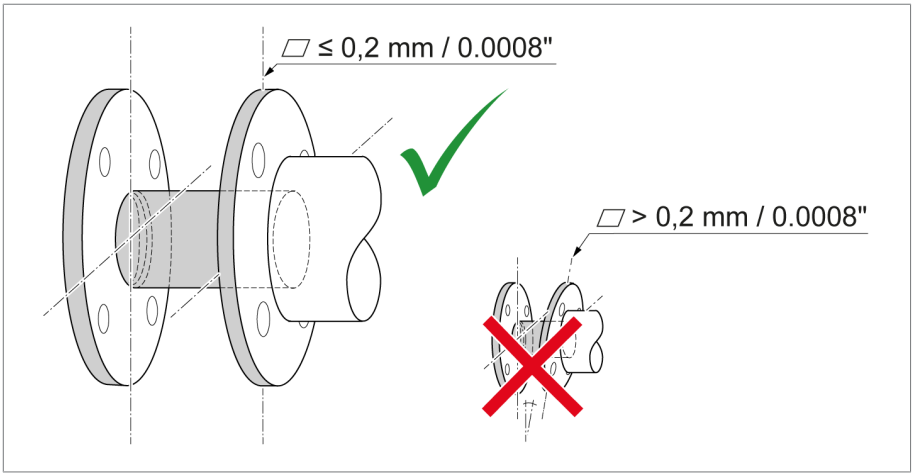

Figure 12: Checking the counter-flange for evenness and gaps

Flange requirements

- Flanges on the oil conservator
  - Flush and even
  - Evenness deviation ≤ 0.2 mm
- Sealing surface of the flanges on the oil conservator
  - Clean and undamaged
  - Without any damage along the radial surface, such as scratches or points of impact
- Installation material (screws, nuts, sealing rings/washers)
  - Clean and undamaged
- Gasket
  - Clean
  - Undamaged
  - Dry

► Further installation in accordance with the following instructions.

6.1.5 Gasket requirements

Observe the following information when selecting the gaskets:

- Ensure that the gasket and sealing groove meet the latest technical standards.
- Use new and clean gaskets.
- Use O-rings or flat gaskets.
- Never use paper gaskets.
- Gasket material:
  - The chemical resistance must be suitable for the insulating fluid in order to prevent later leaks due to chemical degradation.
  - The gasket material must be suitable for use at the specified ambient temperatures and operating temperatures.
  - The gasket material must be suitable for the prevailing relative humidity on site.
  - Elastomer gaskets must occupy a maximum of 80% of the sealing groove when installed. The remaining 20% of the groove is required as expansion space.

6.2 Preparing the connecting flange on the oil conservator

Mount the connecting flange for the oil level indicator on the oil conservator depending on the flange design and the device mounting position. Note the following information during mounting:

1. Ensure that the device is not subject to any vibrations at the installation location.
2. Comply with EMC standards [▶Section 6.1.1, Page 31].
3. Observe the dimensions listed in the chapter "Technical data".

4. Ensure that the device is mounted vertically.

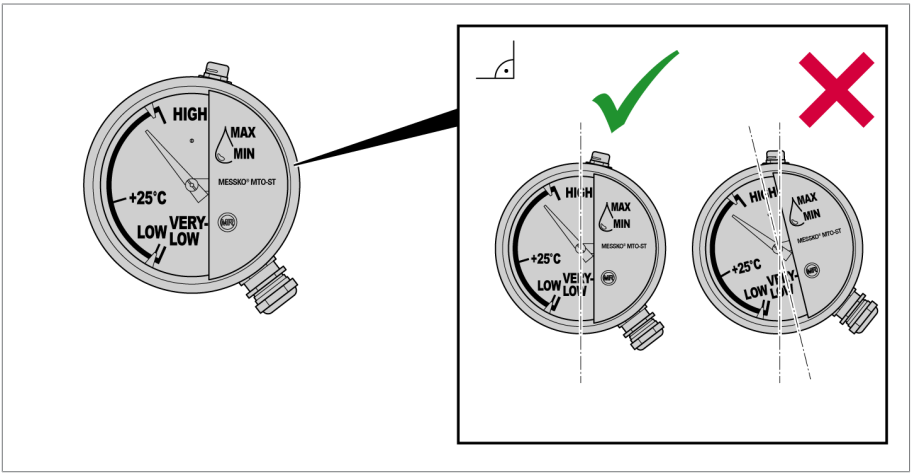

Figure 13: Mounting position

5. Mount the connection flange with connection holes or stud bolts for accommodating the device. When doing so, comply with the hole dimensions and hole distances in accordance with the type of flange connection, see:

- Standard flange [►Section 6.2.1, Page 38]
- RM flange (MTO-ST160RM) [►Section 6.2.2, Page 39]
- NAT/DS flange (MTO-ST160RM) [►Section 6.2.3, Page 41]

6.2.1 Standard flange

In order to be able to connect the device with the standard flange, establish the following connection conditions on the oil conservator depending on the space available:

1. Drill a through hole of Ø 68 mm [2.68“] into the oil conservator at the desired position.
2. Affix a connecting flange with the following parameters to the oil conservator via this through hole:

- Internal diameter of 68 mm [2.68“]
- 4 bolt connections with a bolt circle of 102 mm [4.02“] as one of the following versions:

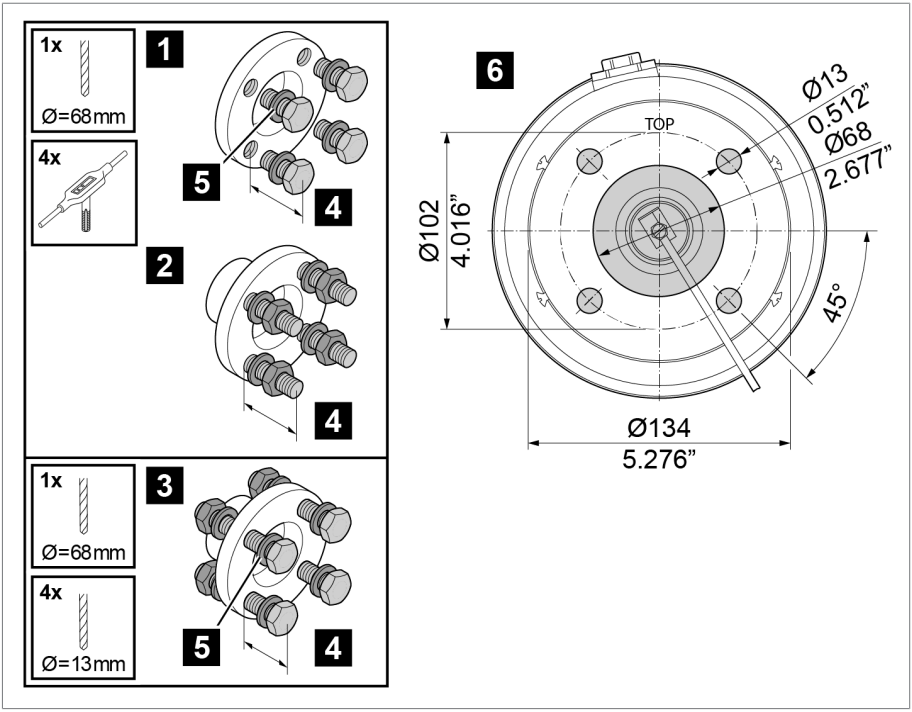

Figure 14: Connecting flange with holes for accommodating the MTO standard flange

1	**Version 1:** 4 blind holes with internal thread max. M12 [0.47"]	2	**Version 2:** 4 stud bolts with thread max. M12 [0.47"]
3	**Version 3:** 4 through-holes Ø 13 mm [0.51"] for bolt-nut connections	4	Length of the bolts beyond the device flange or total height of the connecting parts beyond the device flange ≤ 11.5 mm [0.45"]
5	4 aluminum sealing rings (not included in the scope of delivery, see appendices)	6	MTO with standard flange

6.2.2 RM flange (MTO-ST160RM)

In order to be able to connect the device with an RM flange, establish the following connection conditions on the oil conservator depending on the space available:

1. Drill a through hole of Ø 66 mm [2.60"] into the oil conservator at the desired position.

2. Affix a connecting flange with the following parameters to the oil conservator via this through hole:

- Through hole with an internal diameter of 66 mm [2.60"]
- 4 bolt connections with a bolt circle of 101.6 mm [4.0"] as one of the following versions:

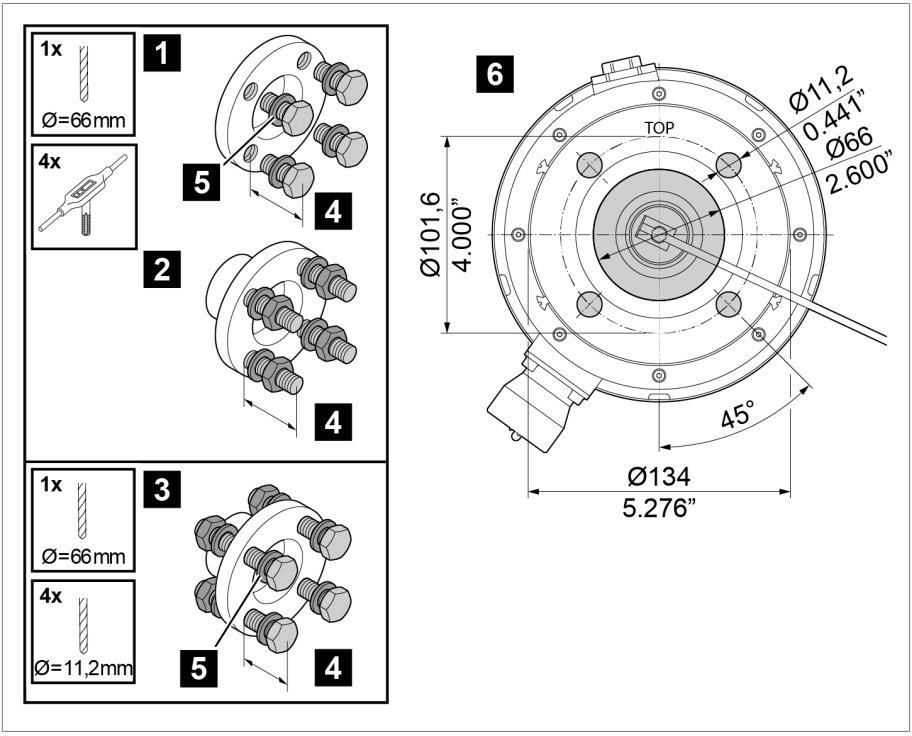

Figure 15: Connecting flange with holes for accommodating the RM flange

1	**Version 1:** 4 blind holes with internal thread max. M10 [3/8" or 3/8" - 16 UNC or 1/8" - 27 NPTF]	2	**Version 2:** 4 stud bolts with thread max. M10 [3/8" or 3/8" - 16 UNC or 1/8" - 27 NPTF]
3	**Version 3:** 4 through-holes Ø 11.2 mm [0.44"] for bolt-nut connections	4	Length of the bolts beyond the device flange or total height of the connecting parts beyond the device flange ≤ 11.5 mm [0.45"]
5	4 aluminum sealing rings (not included in the scope of delivery, see appendices)	6	MTO with RM flange

6.2.3 NAT/DS flange (MTO-ST160RM)

NOTICE! Only RM float gauges with brass float rods up to 350 mm [13.78"] long may be used with this flange version.

In order to be able to connect the device with an NAT/DS flange, establish the following connection conditions on the oil conservator depending on the space available:

1. Drill a through hole of Ø 54 mm [2.13"] into the oil conservator at the desired position.
2. Affix a connecting flange with the following parameters to the oil conservator via this through hole:

- Through hole with an internal diameter of Ø 54 mm [2.13"]
- 4 bolt connections with a bolt circle of 79.38 mm [3.12"] as one of the following versions:

6 Mounting

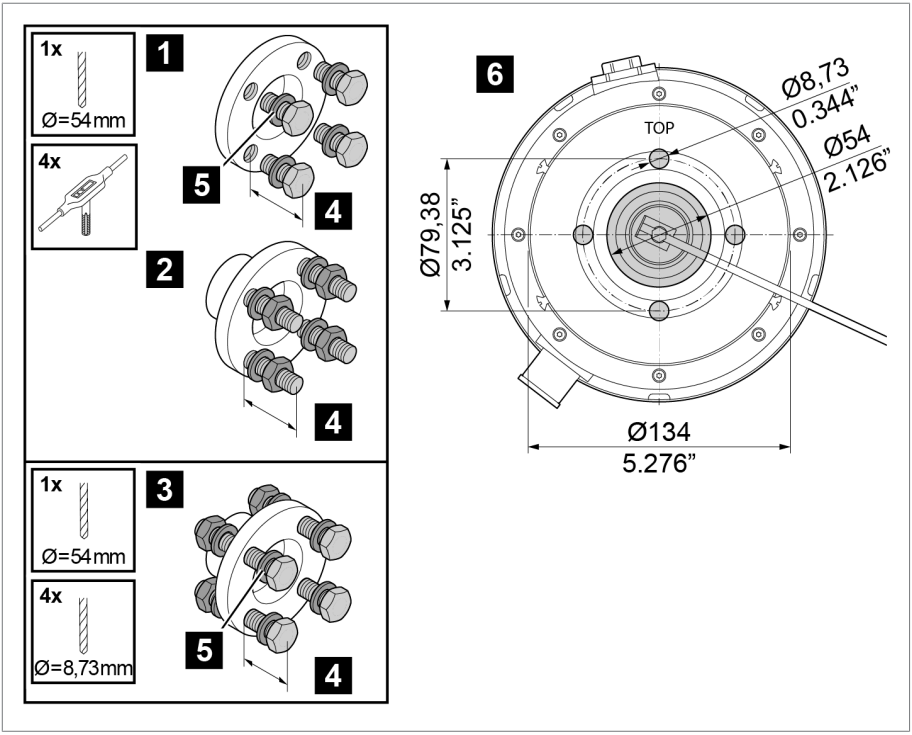

Figure 16: Connecting flange with holes for accommodating the NAT/DS flange

1	**Version 1:** 4 blind holes with internal thread max. M8 [5/16" or 5/16" - 18 UNC or 1/16" - 27 NPT]	2	**Version 2:** 4 stud bolts with thread max. M8 [5/16" or 5/16" - 18 UNC or 1/16" - 27 NPT]
3	**Version 3:** 4 through-holes Ø 8.73 mm [0.34"] for bolt-nut connections	4	Length of the bolts beyond the device flange or total height of the connecting parts beyond the device flange ≤ 11.5 mm [0.45"]
5	4 aluminum sealing rings (not included in the scope of delivery, see appendices)	6	MTO with NAT/DS flange

6.3 Mounting the MTO on the oil conservator

NOTICE

Damage to the transformer!

Improperly tightening the bolts will lead to a high dispersion of the preload forces and can lead to the required surface pressure of the gasket not being reached or to the permissible surface pressure on the MTO flange being exceeded (leakage, material breakage).

- ► Preinstall the bolts manually and insert them such that all the bolt heads are arranged on one side of the flange.
- ► Position the sealing rings / washers under the bolt heads. The bolt heads, nuts and sealing rings / washers must be flush.
- ► Observe the maximum height of the connecting elements (≤11.5 mm [0.45"]), see "Preparing the connecting flange on the oil conservator" [►Section 6.2, Page 37].
- ► Replace bolts that are difficult to move with ones that are easy to move.

Depending on the flange ordered, mount the oil level indicator on the oil conservator in accordance with the instructions in the following sections.

6.3.1 Mounting an MTO with radial float rod

When mounting an oil level indicator with radial float rod, proceed as follows:

1. If necessary, shorten the float rod to the required length using a metal saw, but no shorter than 200 mm [7.87"].

2. Loosen the 4 screws on the rear housing edge so that the display part and transmitter part can be separated from each other. Place both parts separately on a firm and clean surface.

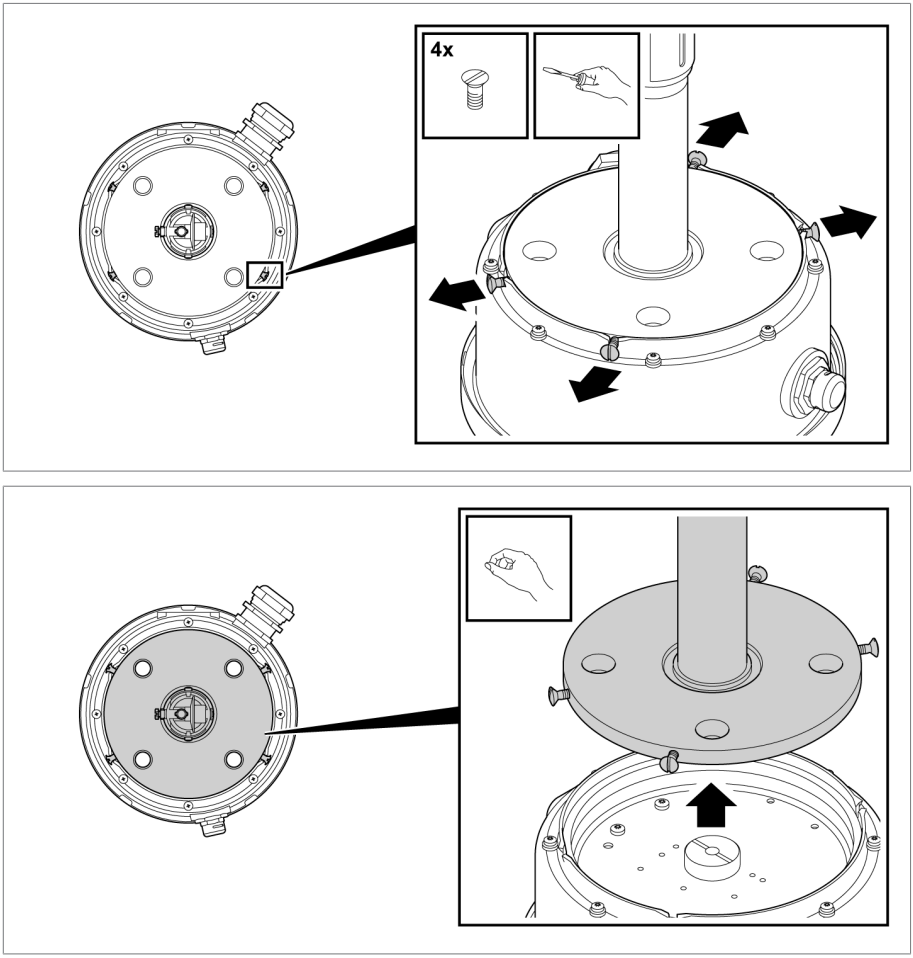

Figure 17: Separating the display part and transmitter part

3. Insert the float rod into the shaft hole for the magnetic coupling up to the stop.

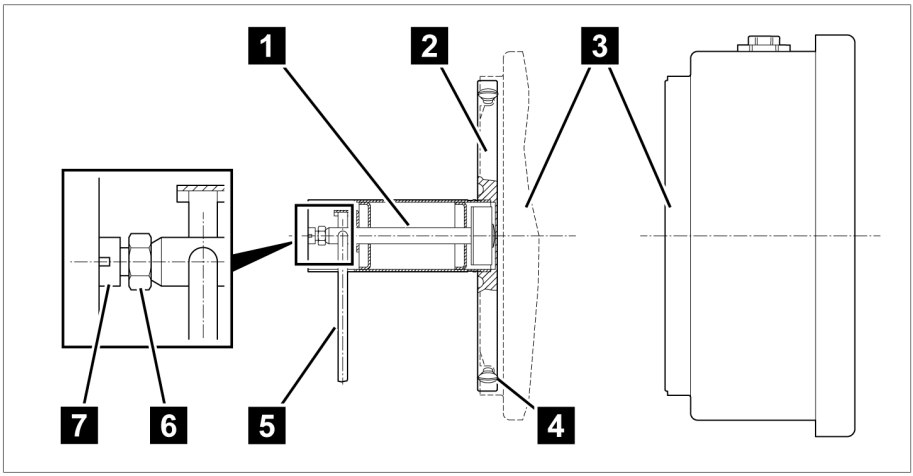

Figure 18: Inserting the float rod

1	Shaft for magnetic coupling	2	Transmitter part
3	Display part	4	Fixing screw
5	Float rod	6	Lock nut
7	Clamping screw for the float gauge		

4. Tighten the clamping screw firmly and secure with the lock nut.

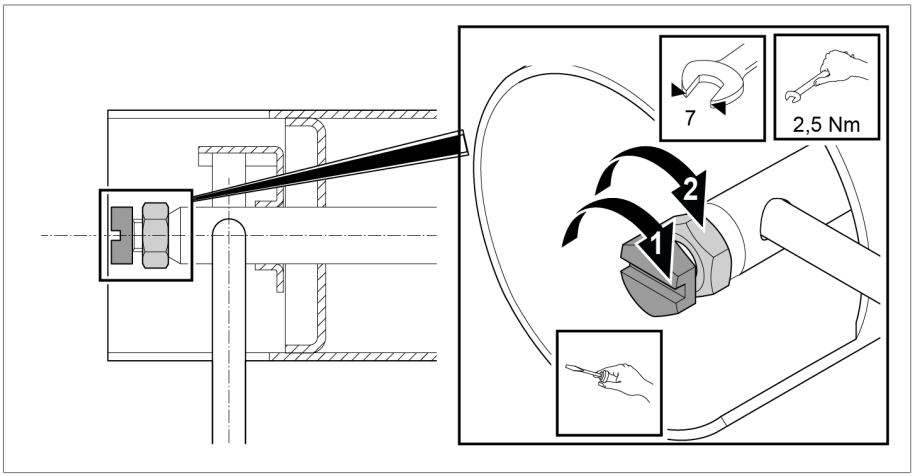

Figure 19: Securing the float rod

5. **NOTICE!** Damage to the oil level indicator! The oil level indicator may become damaged if the transmitter part is incorrectly mounted or if the incorrect gaskets are used. Observe the sections "Checking the flanges" [▶Section 6.1.4, Page 35] and "Gasket requirements" [▶Section 6.1.5, Page 37].
6. When using a standard flange, position the flat gasket on the transmitter part. When using an RM flange or NAT/DS flange, insert the molded gasket or o-ring into the sealing groove, see appendices [▶Section 12, Page 110].
7. Seal through-holes with o-rings, for example, to prevent the ingress of water into the device.
8. Insert the entire float gauge into the oil conservator. (Depending on the design of the oil conservator and the mounting position of the MTO, it may be necessary to mount the float rod after mounting the transmitter part, see Special instructions [▶Section 6.3.3, Page 54].)

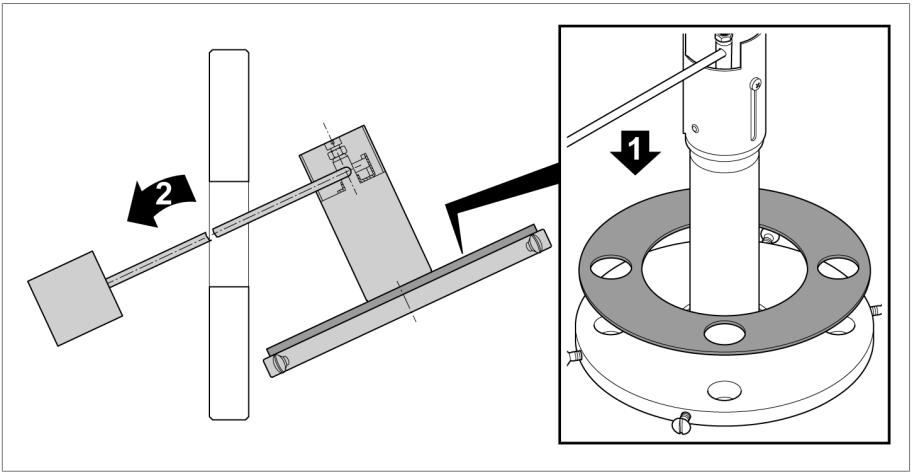

Figure 20: Inserting the float rod (example)

9. Position the transmitter part with gasket on the connecting flange so that the "TOP" marking is facing upwards.
10. **NOTICE!** Thread sizes and wrench sizes vary depending on the flange design (Standard [▶Section 6.2.1, Page 38], RM [▶Section 6.2.2, Page 39], NAT/DS [▶Section 6.2.3, Page 41]). Therefore, adapt the tightening torques to the materials of the connecting parts and flange and to the design of the gasket.

11. Depending on the method of attachment, tighten the 4 screws or nuts crosswise with 30% of the target tightening torque. Observe the total height of the connecting elements when using washers and locking elements or sealing rings (see appendices [▶Section 12, Page 110]) on the MTO flange.

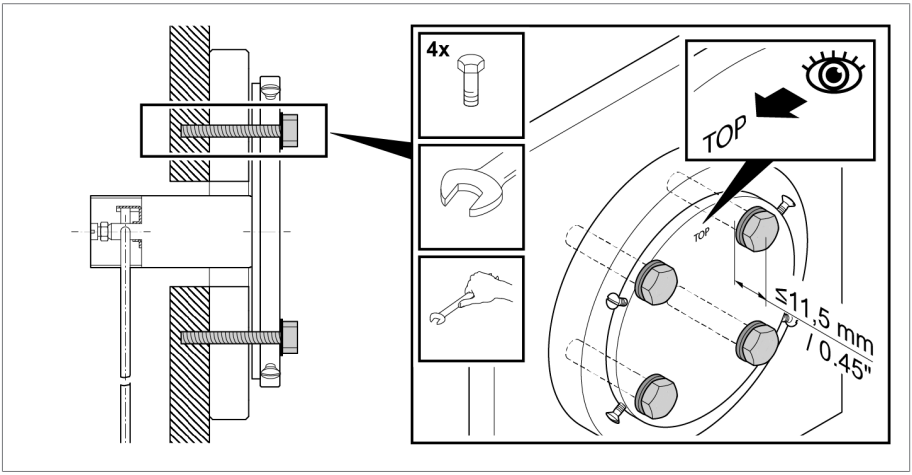

Figure 21: Mounting the transmitter part with gasket (example, parameters depending on mounting method)

12. Tighten the screws or nuts crosswise with 60% of the target tightening torque.
13. Tighten the screws or nuts crosswise with 100% of the target tightening torque.
14. Only if a flat gasket is being used, tighten all of the screws again crosswise with the maximum target tightening torque until the screws cannot be turned any further at the maximum tightening torque.
15. ***NOTICE!*** Clean up the contact areas of the magnetic coupling in the display part and transmitter part from metal cuttings and dirt particles.

16. Place the display part on the transmitter part so that the recesses in the housing lie over the 4 fixing screws.

    ⇨ The magnetic coupling engages.

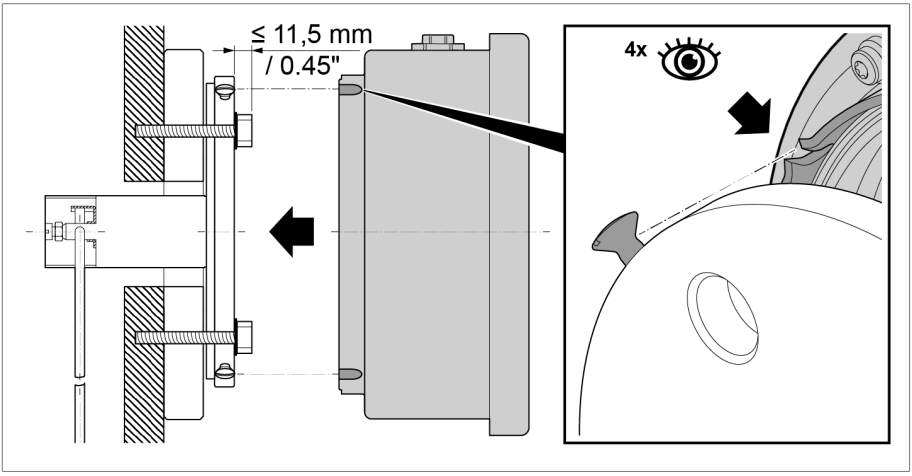

Figure 22: Placing the display part on the transmitter part

17. Push the display part firmly onto the transmitter part and tighten the 4 screws on the rear housing edge crosswise.

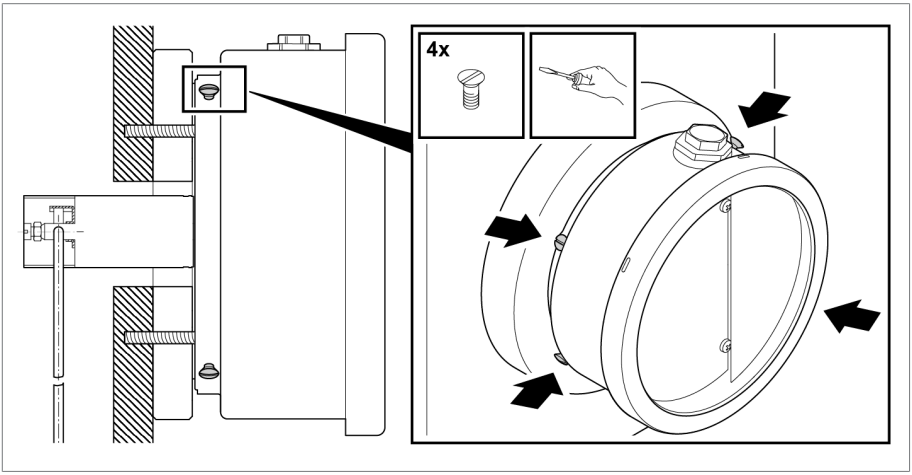

Figure 23: Fastening the display part to the transmitter part

6.3.2 Mounting an MTO with axial float rod

The stop plates on the lower side for MIN and on the upper side for MAX are preset in production depending on the dial. The stop plates can be moved and adjusted by slightly loosening the screw for this purpose and then tightening it again.

1. Loosen the 4 screws on the rear housing edge so that the gauge part and transmitter part can be separated from each other. Place both parts separately on a firm and clean surface.

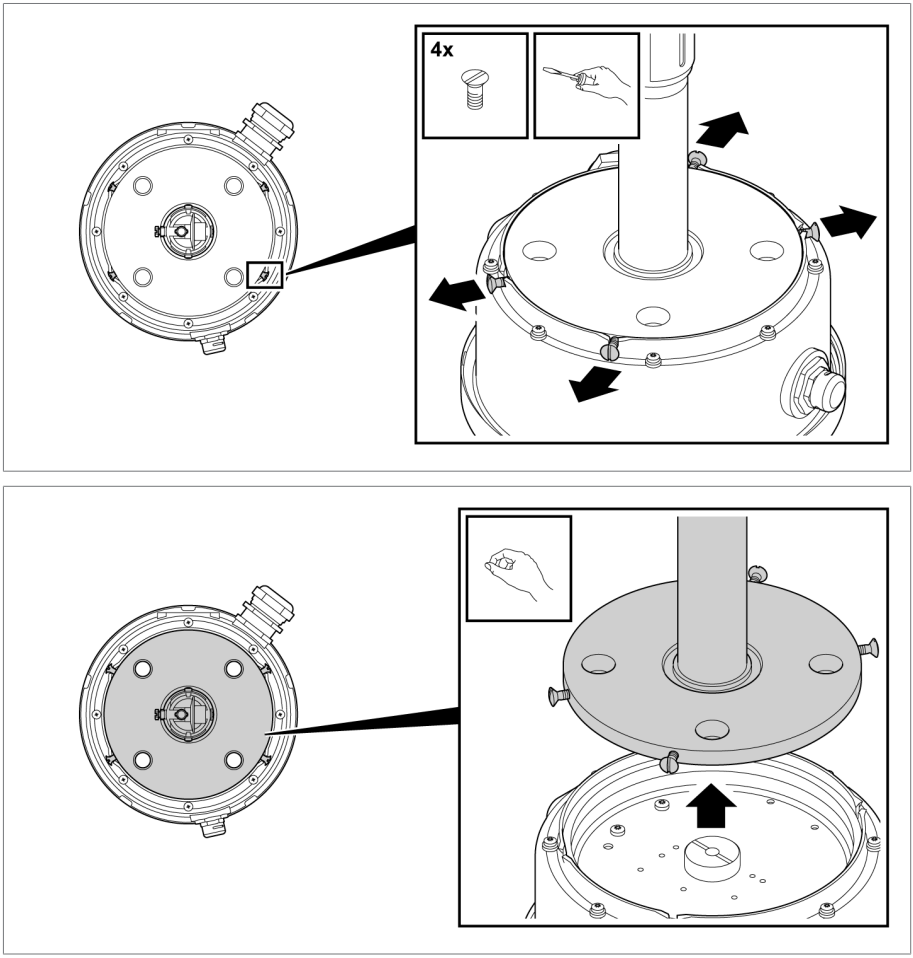

Figure 24: Separating the gauge part and transmitter part

2. Insert the float rod into the hole in the float shaft for the magnetic coupling. When doing so, observe the direction of the rotation lock at the end of the float rod and push the float rod to the stop in the elongated hole in the gearing axle.

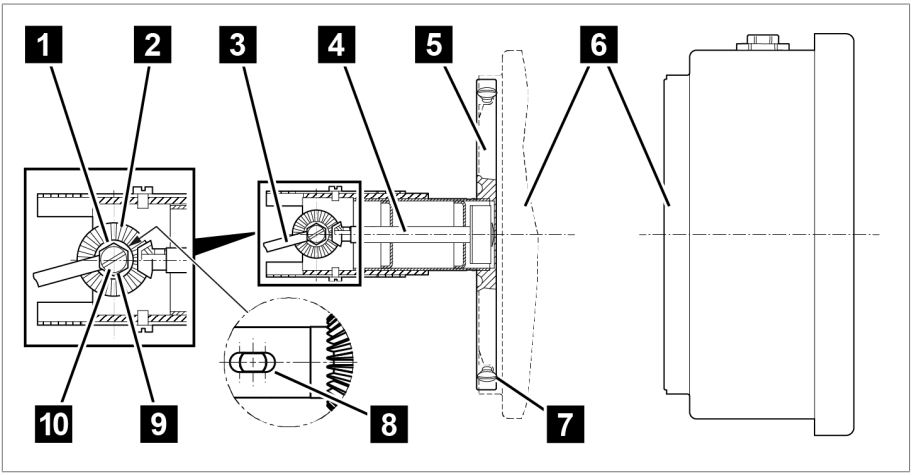

Figure 25: Inserting the float rod

1	Gearing axle	2	Gearing
3	Float rod	4	Shaft for magnetic coupling
5	Transmitter part	6	Gauge part
7	Fixing screw	8	Rotation lock
9	Lock nut	10	Clamping screw for the float gauge

3. Tighten the clamping screw firmly and secure with the lock nut.

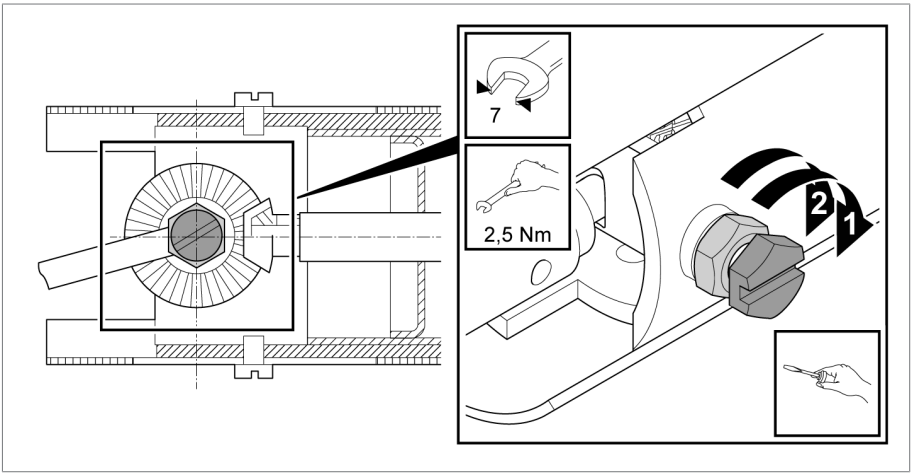

Figure 26: Securing the float rod

4. Screw the transmitter part with the "TOP" marking upwards.
5. **NOTICE!** Damage to the oil level indicator! The oil level indicator may become damaged if the transmitter part is incorrectly mounted or if the incorrect gaskets are used. Observe the sections "Checking the flanges" [▶Section 6.1.4, Page 35] and "Gasket requirements" [▶Section 6.1.5, Page 37].
6. When using a standard flange, position the flat gasket on the transmitter part. When using an RM flange or NAT/DS flange, insert the molded gasket or o-ring into the sealing groove; see appendices [▶Section 12, Page 110].
7. Seal through-holes with o-rings, for example, to prevent the ingress of water into the device.

8. Insert the entire float gauge into the oil conservator. (Depending on the design of the oil conservator and the mounting position of the MTO, it may be necessary to mount the float rod after mounting the transmitter part; see Special instructions [►Section 6.3.3, Page 54].)

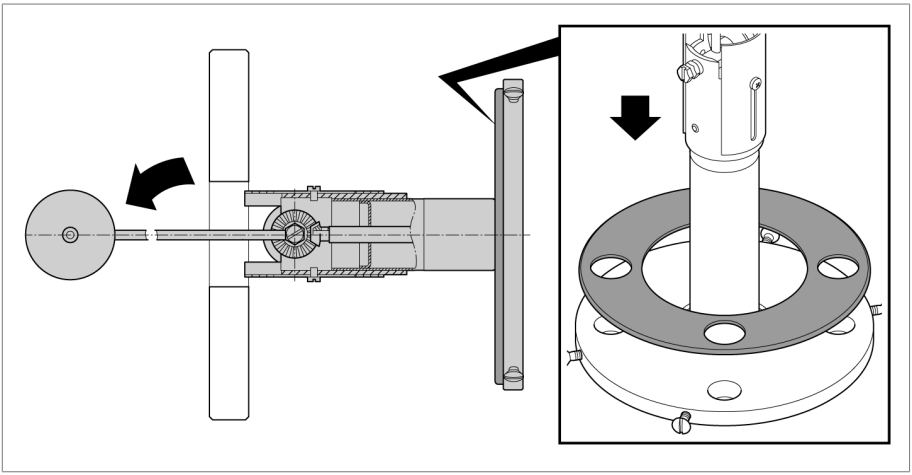

Figure 27: Inserting the float rod

9. Position the transmitter part with gasket on the connecting flange so that the "TOP" marking is facing upwards.
10. ***NOTICE!*** Thread sizes and wrench sizes vary depending on the flange design (Standard [►Section 6.2.1, Page 38], RM [►Section 6.2.2, Page 39], NAT/DS [►Section 6.2.3, Page 41]). Therefore, adapt the tightening torques to the basic materials of the connecting parts and flange and to the design of the gasket.
11. Depending on the method of attachment, tighten the 4 screws or nuts crosswise with 30% of the target tightening torque. Observe the total height of the connecting elements when using washers and locking elements or sealing rings (see appendices [►Section 12, Page 110]) on the MTO flange.
12. Tighten the screws or nuts crosswise with 60% of the target tightening torque.
13. Tighten the screws or nuts crosswise with 100% of the target tightening torque.

14. Only if a flat gasket is being used, tighten all of the screws again crosswise with the maximum target tightening torque until the screws cannot be turned any further at the maximum tightening torque.

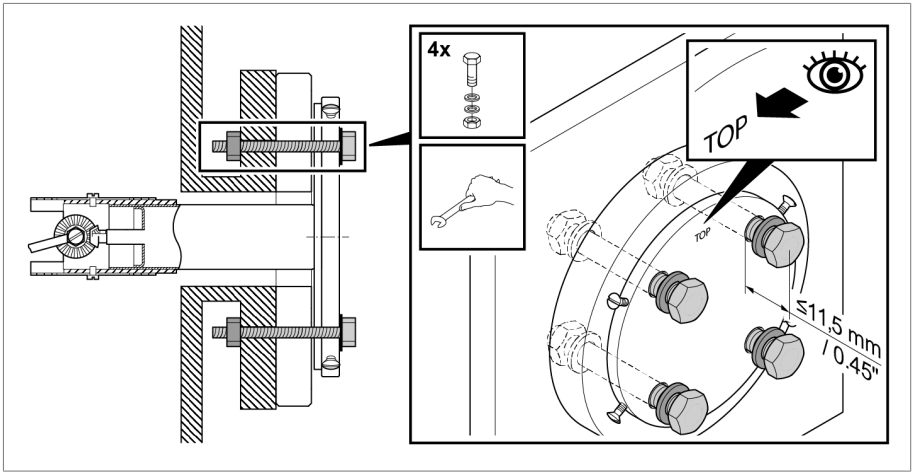

Figure 28: Mounting the transmitter part with gasket (example)

15. **NOTICE!** Clean up the contact areas of the magnetic coupling in the gauge part and transmitter part of metal cuttings and dirt particles.
16. Place the gauge part on the transmitter part so that the recesses in the housing lie over the 4 fixing screws.

    ⇨ The magnetic coupling engages.

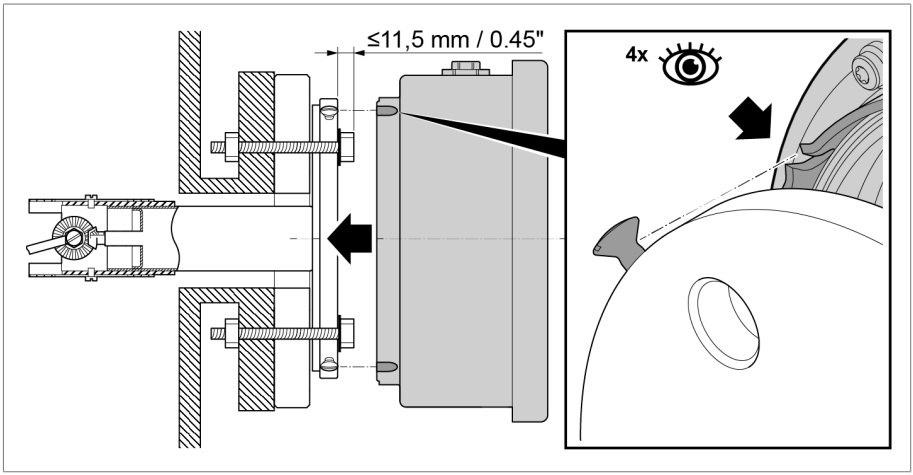

Figure 29: Locking the gauge part onto the transmitter part

17. Push the gauge part firmly onto the transmitter part and tighten the 4 screws on the rear housing edge crosswise.

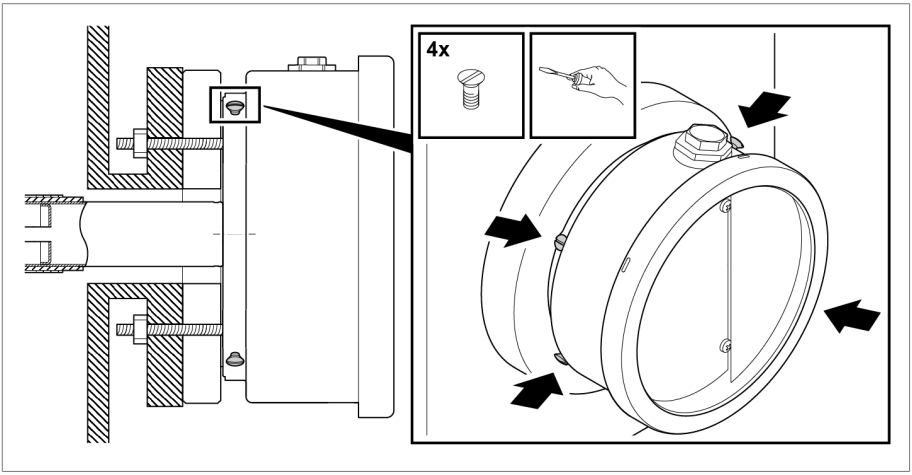

Figure 30: Fastening the gauge part on the transmitter part

6.3.3 Mounting the MTO on an inclined flange

If the mounting situation does not allow for the transmitter part to be inserted with the float gauge fully installed, note the following special instructions:

✓ If the oil conservator has a manhole:

1. Mount the transmitter part on the connecting flange from the outside.
2. Mount the float gauge from the inside, to do so refer to Mounting an MTO with radial float rod [►Section 6.3.1, Page 43] or Mounting an MTO with axial float rod [►Section 6.3.2, Page 49].

✓ If the oil conservator does not have a manhole:

1. Open the oil conservator cover.
2. Mount the transmitter part on the outside of the cover.
3. Mount the float gauge on the transmitter part on the inside of the cover, see Mounting an MTO with radial float rod [►Section 6.3.1, Page 43] or Mounting an MTO with axial float rod [►Section 6.3.2, Page 49].
4. Close the cover.

When mounting inside the oil conservator, observe the following conditions:

1. Align the float rod so that the float buoy(s) float horizontally in the insulating fluid.

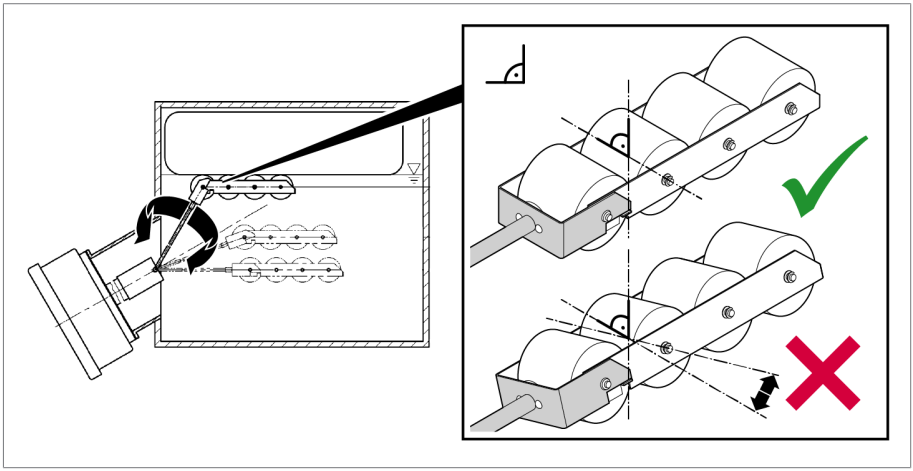

Figure 31: Aligning the float buoys horizontally

2. Mount the collection grille for the breathing sack so that the float gauge can move freely at all oil conservator fill levels.

6.4 Electrical connection

⚠ DANGER

Electric shock!

Danger of death due to electrical voltage when assembling/ disassembling the device.

- ► Switch off transformer on high-voltage side and low-voltage side.
- ► Lock transformer to prevent unintentional restart.
- ► Make sure that everything is de-energized.
- ► Visibly connect all transformer terminals to ground (grounding leads, grounding disconnectors) and short circuit them.
- ► Cover or cordon off adjacent energized parts.

⚠ WARNING

Electric shock!

Too small bending radii could damage the insulation of cables or cores.

- ► Observe bending radii for the cables and their cores according to the manufacturer's instructions.

⚠ WARNING

Fire hazard!

There is a fire hazard if the conductor material is not suitable for the terminals. This can lead to severe burns and property damage.

- ► Use copper conductors only.

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.

6.4.1 Connecting MTO with cable gland or NPT screw connection

To connect the oil level indicator with cable gland or NPT srew connection, open the device, insert the prepared cable and secure the screw connection.

6.4.1.1 Removing the bayonet seal ring

Before connecting, setting or testing the oil level indicator, the bayonet seal ring must be removed.

► Turn the bayonet seal ring approx. 30...40° counter-clockwise and then lift out together with the viewing glass. The viewing glass is held in place by a rubber gasket.

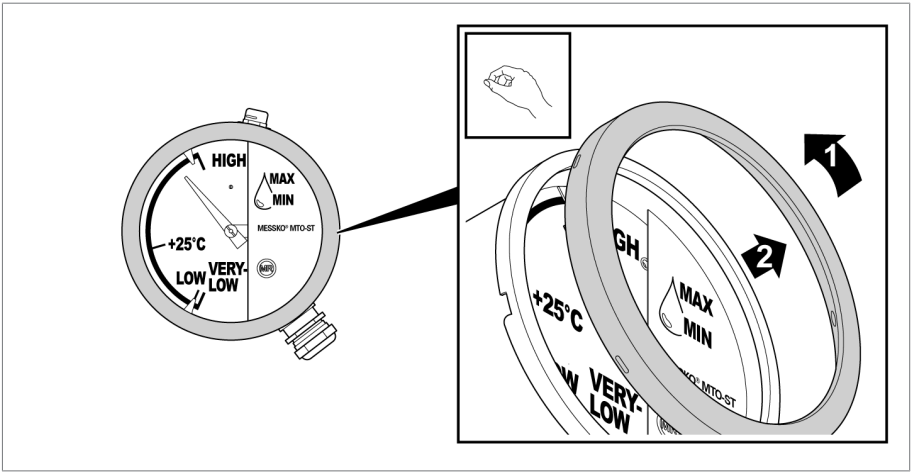

Figure 32: Removing the bayonet seal ring

6.4.1.2 Opening the cover plate

The micro-switches are connected as shown in the diagram printed on the inside of the cover plate.

1. Open the cover plate.

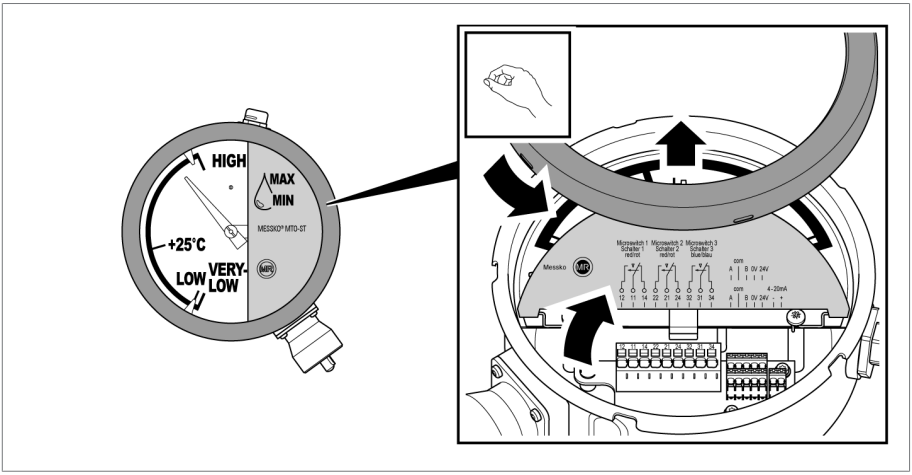

Figure 33: Opening the cover plate

2. To prevent tension on the cable glands and to comply with the bending radii of the cables used, secure cables after a maximum of one meter.

6.4.1.3 Standard, WADI or offshore cable gland option

► ***NOTICE!*** If a cable gland or is not used, it must be sealed with a suitable seal and metal locking screw to ensure the IP degree of protection and flame protection of the device.

- Metal locking screws are available upon request.
  - Standard (nickel-plated brass): Material no. MS960750xx
  - Offshore (stainless steel 1.4404, 316 L): Material no. 781711xx

Proceed as follows to prepare the cable glands:

1. Unscrew the pressure screw (standard) or union nut (WADI, offshore) to open the cable gland.

2. Remove the dust protection disk.

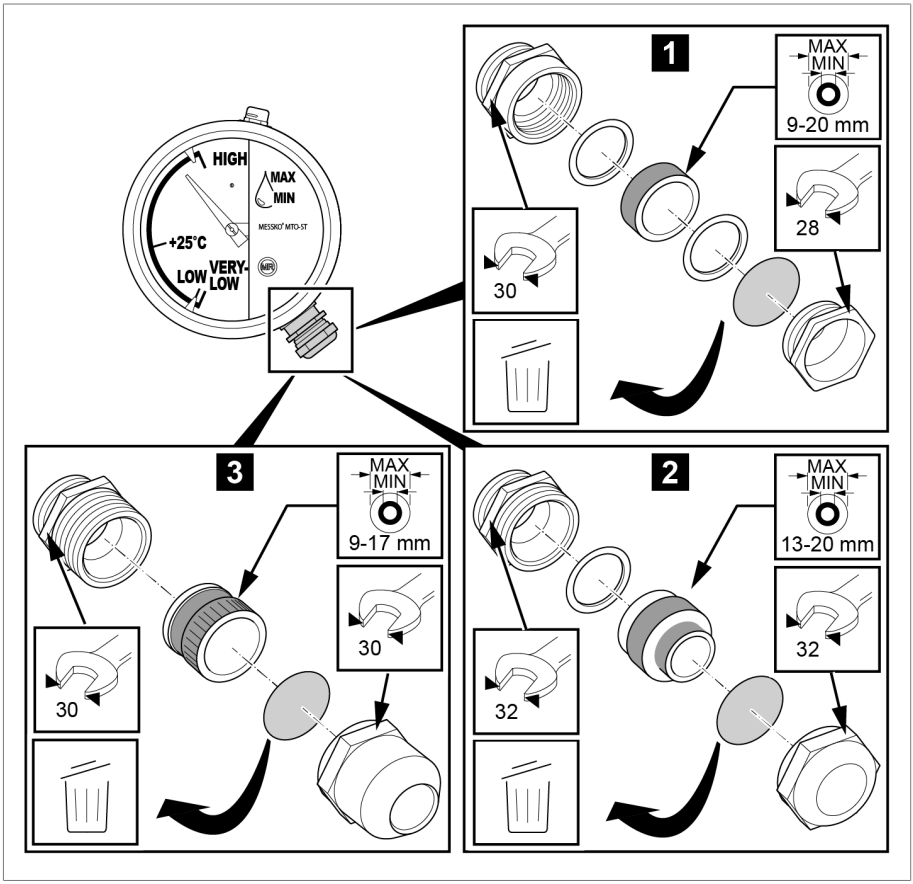

Figure 34: Removing the dust protection disk

1	Standard cable gland	2	WADI cable gland (water-tight)
3	Offshore cable gland (stainless steel)		

3. Lead the connection cable through the cable gland and tighten the cable gland. To do this, tighten the pressure screw (standard cable gland) or union nut (WADI, offshore).

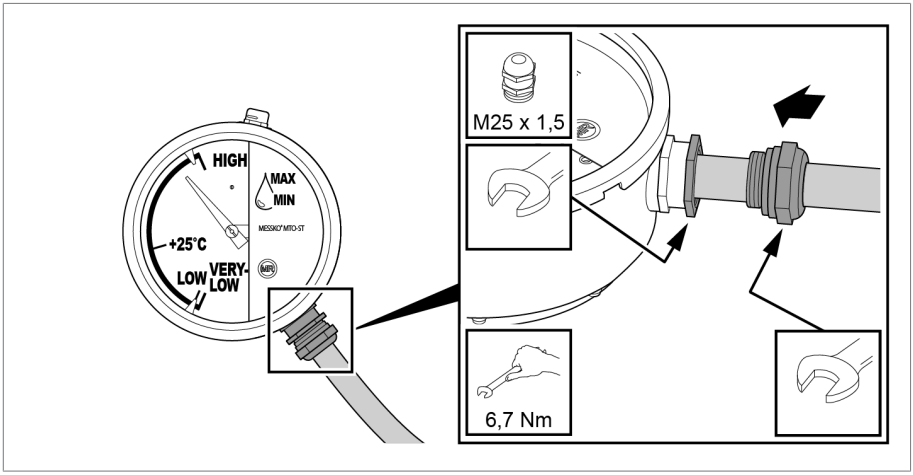

Figure 35: Mounting the cable gland (example)

6.4.1.4 EMC double cable gland option

Use shielded conductors for the Modbus wiring and connect the shield on both sides (same shielding potential for all devices).

We recommend EMC cable glands, which are commercially available as EMC **single** cable glands.

Depending on the device version and choice of connection cables, using an EMC **double** cable gland may be useful. You can order these as accessories from Maschinenfabrik Reinhausen GmbH:

- EMC double cable gland: material no. 10173481xx

You will find the technical drawing for this EMC double cable gland in the appendix.

The EMC double cable gland is suitable for cables with an external diameter of 8.7 mm $^{+}/_{-}$ 10%.

Prepare the section of cable that will be located in the EMC double cable gland:

1. Strip a length of at least 15 mm of insulation from the cables.

2. Insulate the braid at the lower end with insulating tape.

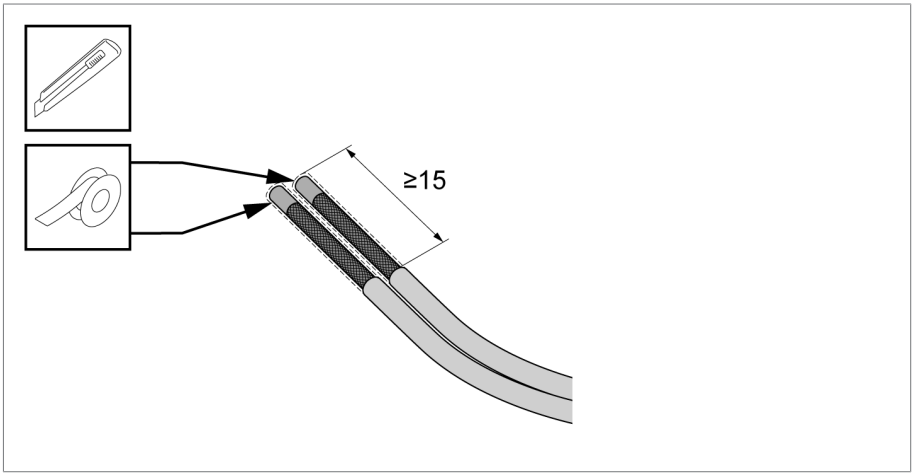

Figure 36: Stripping the cable

The cable gland can now be attached. To do so:

1. Gently twist the cables and feed through the openings in the cable gland.

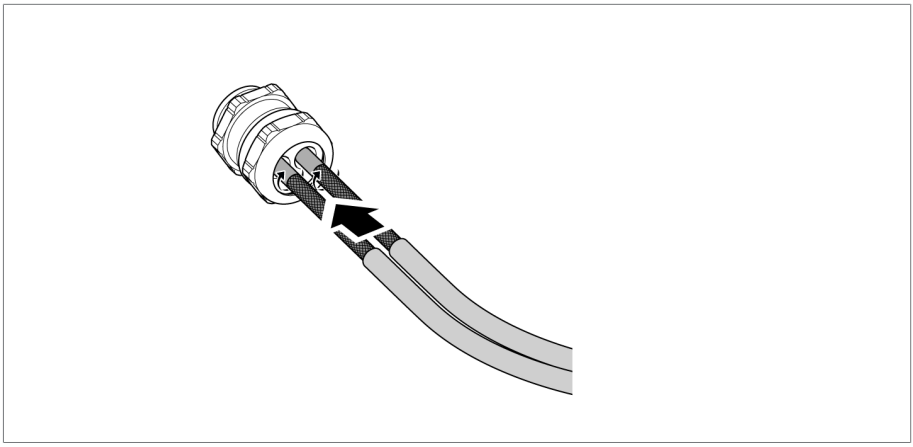

Figure 37: Inserting the cables

2. Feed the cables through until the cable sheath contacts the spring in the cable gland.

3. Mark this position above the gland on the cable sheath.

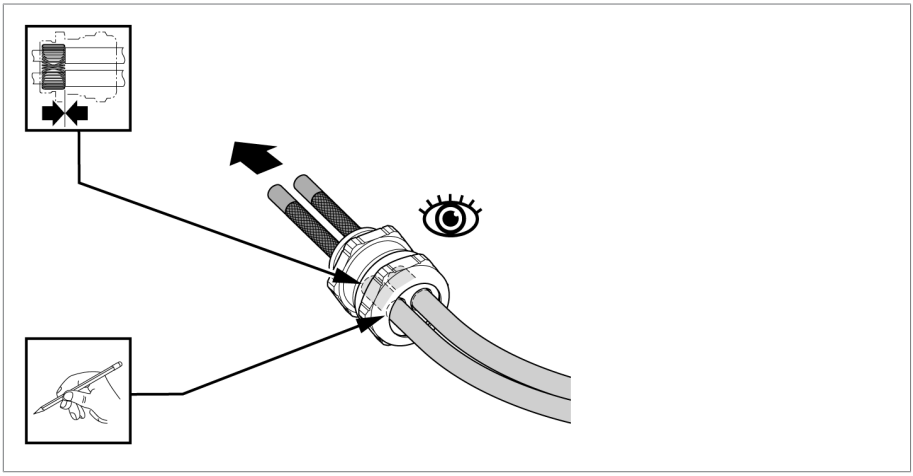

Figure 38: Marking the cables

4. Pull the cables back out to a length of 10 mm from the marking.

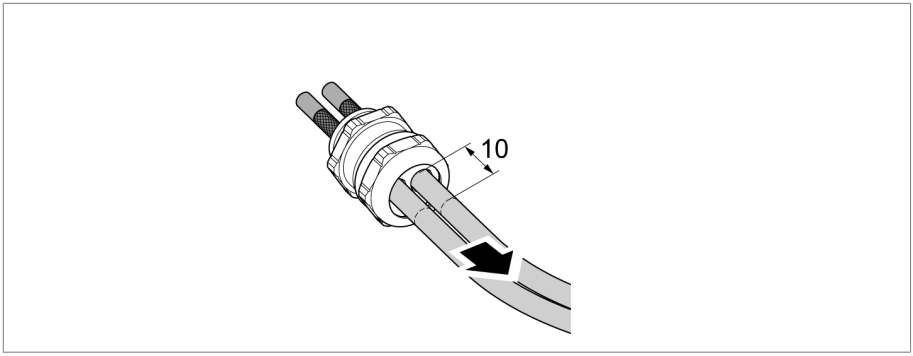

Figure 39: Pulling the cables out

5. Attach the cable gland to the device housing (wrench size 30).
6. Tighten the pressure screw on the cable gland (wrench size 30) with approx. 15 Nm.

Cable example (suitable for winding temperature indicators up to 50 °C ambient temperature and for oil temperature indicators up to 65 °C ambient temperature):

Unitronic Robust C (TP) 3 x 2 x 0.5 from Lapp

- Shielded; 3x twisted pair (TP); 0.5 mm^2
  - 1 TP used for 24 VDC
  - 1 TP used for Modbus A and B
  - 1 TP used for Modbus Common GND
- External diameter 8.7 mm

6.4.1.5 NPT screw connection option

1. **NOTICE!** If the NPT cable screw connection is not used, remove the locking cap and replace it with an NPT dummy plug in order to ensure the IP degree of protection.
2. Remove the locking cap.

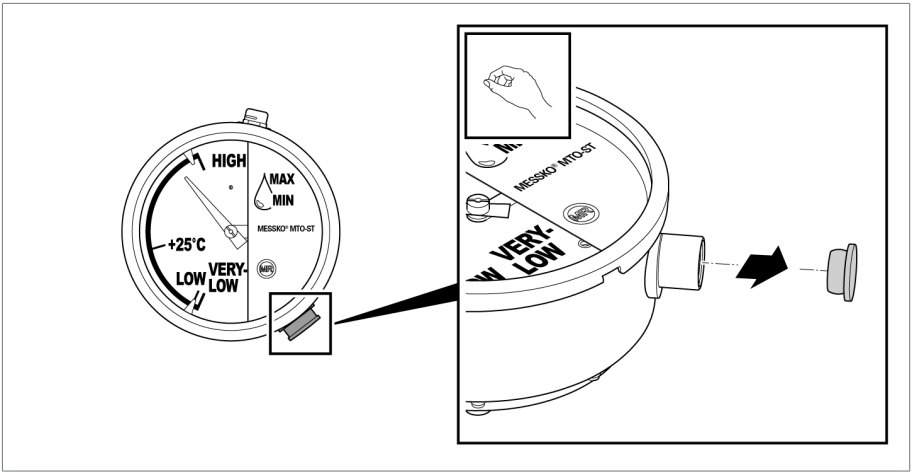

Figure 40: Removing the locking cap and feeding the connection cable through

3. The NPT screw connection is for accommodating cable protection systems. Observe the respective operator directives for the systems and the country-specific regulations.
4. Feed a sufficient length of the connection cable through the NPT screw connection and tighten, see Dimensions [▶Section , Page 101].

6.4.1.6 Connecting to ground

To ground the device, proceed as follows:

► Secure the protective conductor (PE) with cable shoe or ferrule to the grounding screw of the oil level indicator.

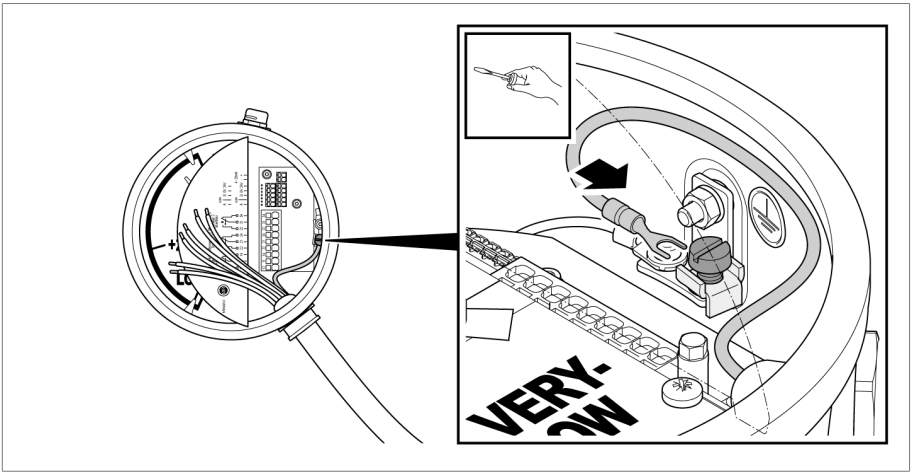

Figure 41: Grounding the device

6.4.1.7 Connecting the interfaces (optional)

NOTICE

Damage to the device!

Applying an incorrect test voltage to the terminals for the 4…20 mA analog outputs (types TT, TTM) or to the terminals for Modbus and the supply voltage (type TTM) can cause damage to the device.

► Perform the dielectric test (terminals to ground) with a maximum of 500 VDC.

If the number of cable glands is not sufficient, multiple glands can be used, for example to route the supply cable as well as an incoming and an outgoing cable for Modbus into the device through one cable gland at the same time. EMC double cable glands [►Section 6.4.1.4, Page 60] can be ordered as accessories (material no. 10173481).

Limited space in the device can make the connection more difficult. Connect the data lines before the micro-switches. Route the cables for the micro-switches through the left-hand cable gland.

Preparation

1. Strip the cable to a suitable length.
2. Strip a length of 8 mm of insulation from the wires.
3. Use ferrules for flexible lines (with a collar of max. 0.75 mm²).

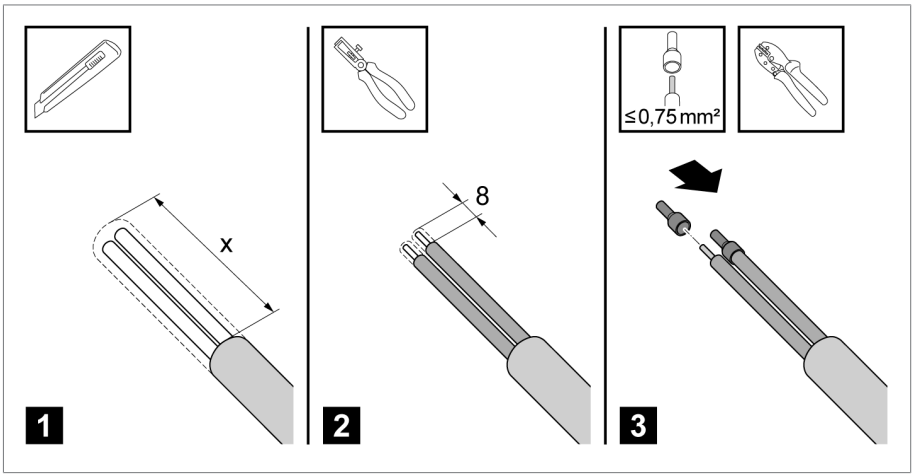

Figure 42: Cable preparation for interfaces

You will need an actuating tool if wires have to be released from the Push-in terminals used.

An actuating tool is not absolutely necessary for connecting the wires. When using wires with sufficient buckling resistance, direct plugging is possible without an actuating tool.

6.4.1.7.1 Connecting the passive 4…20 mA analog output (TT version)

The device is equipped with a passive sensor that converts the oil level into an electrical 4...20 mA signal. The sensor has a 2-conductor design.

Preparation

1. Strip the cable to a suitable length.
2. Strip a length of 8 mm of insulation from the wires.

3. Use ferrules for flexible lines (with a collar of max. 0.75 mm²).

Connecting the passive analog output in accordance with the connection diagram

1. Press in the white actuator using the actuating tool (width 2.5 mm).
2. Connect the wires to the terminals "4…20 mA (+/-)". Do so by pushing the wires through the opening up to the stop.
3. Release the actuator.

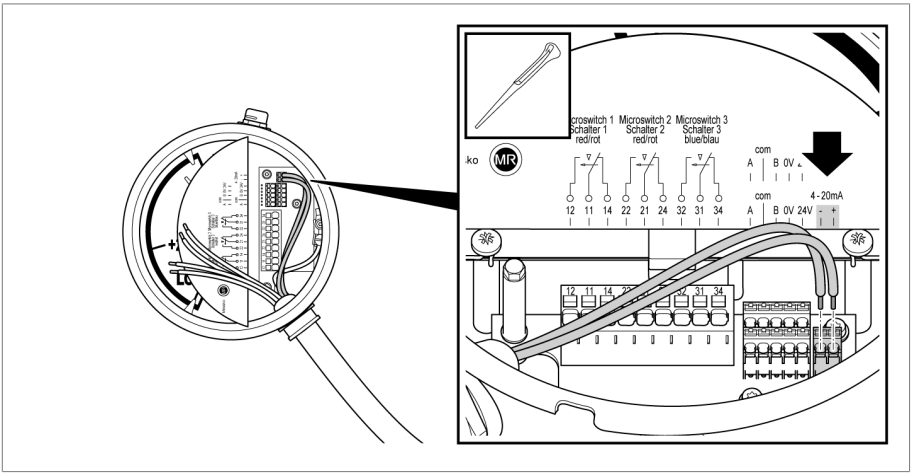

Figure 43: Connecting the analog output

4. Connect an evaluation unit with driving output (18...30 VDC) or, if necessary, an additional power supply (24 VDC).

6.4.1.7.2 Connecting the active 4…20 mA analog output (TTM version)

The device is equipped with an active current output that converts the oil level into an electrical 4...20 mA signal. The sensor has a 4-conductor design.

Preparation

1. Strip the cable to a suitable length.
2. Strip a length of 8 mm of insulation from the wires.
3. Use ferrules for flexible lines (with a collar of max. 0.75 mm²).

Connecting the 24 VDC power supply in accordance with the connection diagram

Connect the wires to the terminal strip in accordance with the connection diagram. To do so:

1. Press in the white actuator using the actuating tool (width 2.5 mm).
2. Connect the wires to the terminals "0V" and "24V". Do so by pushing the wires through the opening up to the stop.
3. Release the actuator.

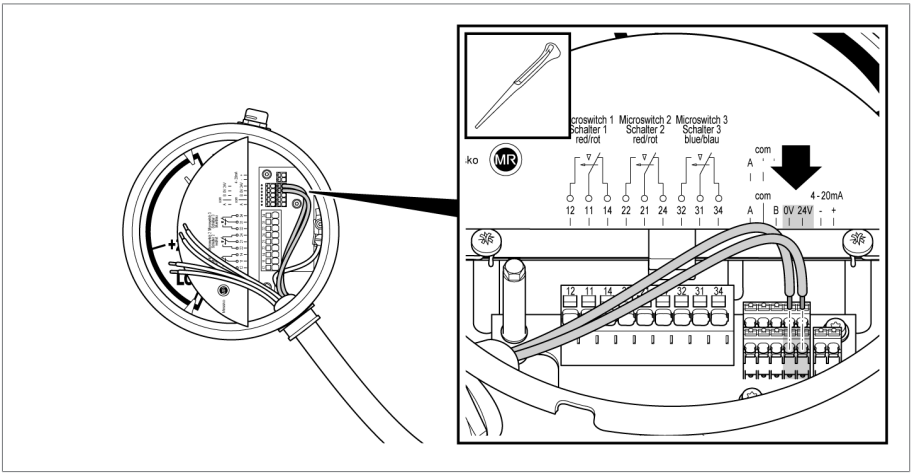

Figure 44: Connecting the supply voltage

Connecting the 4...20 mA analog output in accordance with the connection diagram

1. Press in the white actuator using the actuating tool (width 2.5 mm).
2. Connect the wires to the terminals "4…20 mA (+/-)". Do so by pushing the wires through the opening up to the stop.

3. Release the actuator.

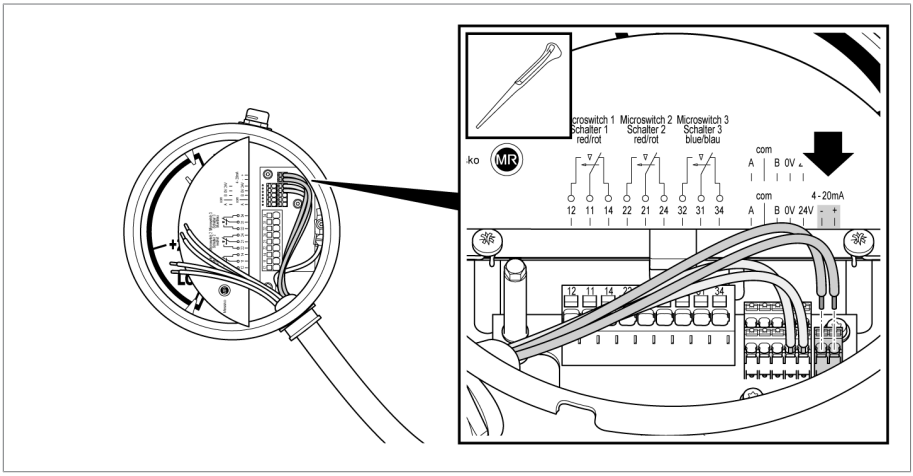

Figure 45: Connecting the analog output

4. Connect an evaluation unit without a driving input.

6.4.1.7.3 Connecting Modbus (TTM and TTMR versions)

The device is equipped with a Modbus RTU (RS-485) interface that digitally transmits the oil level. The interface has a half-duplex design.

Preparation

1. Strip the cable to a suitable length.
2. Strip a length of 8 mm of insulation from the wires.
3. Use ferrules for flexible lines (with a collar of max. 0.75 mm²).

Connecting the 24 VDC power supply in accordance with the connection diagram

1. Press in the white actuator using the actuating tool (width 2.5 mm).
2. Connect the wires to the terminals "0V" and "24V". Do so by pushing the wires through the opening up to the stop.

3. Release the actuator.

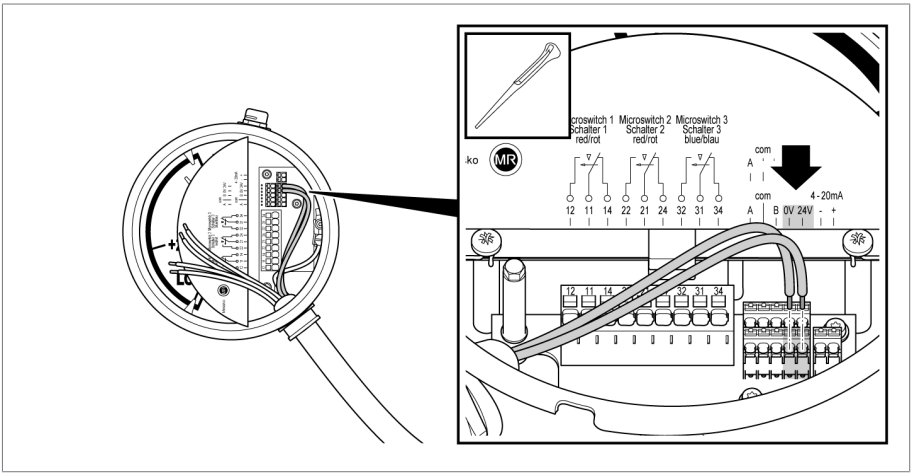

Figure 46: Connecting the supply voltage

Connecting the MODBUS in accordance with the connection diagram

1. Press in the white actuator using the actuating tool (width 2.5 mm).
2. Connect the wires to the terminals "A", "COM", and "B". Do so by pushing the wires through the opening up to the stop.
3. Release the actuator.

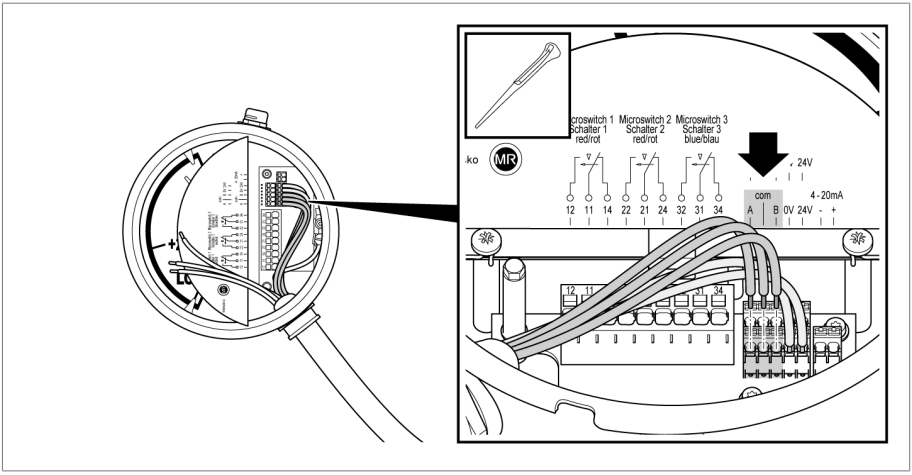

Figure 47: Connecting Modbus

The circuit board provides the possibility to loop through the RS485 connection to the next device (daisy-chain) via the second terminal strip.

If the device is the only bus device or the last bus device, insert a terminating resistor (120 Ω, 0.5 W) into the second terminal strip between "A" and "B".

6.4.1.8 Connecting the micro-switches

⚠ WARNING

Electric shock!

The micro-switches may be connected either to only extra-low-voltage circuits or to only low-voltage circuits. Mixed voltages are not permitted.

⚠ WARNING

Electric shock

If a wire should come loose from a terminal, the chance of a dangerous contact voltage and extra-low voltage coming together must be prevented.

- ► Secure wire bundles with a dangerous contact voltage with a cable tie.
- ► In the same way, secure wire bundles with extra-low voltage with a cable tie.

Limited space in the device can make the connection more difficult. Connect the data lines before the micro-switches. Route the micro-switches through the lower cable gland and 4… 20 mA / 24 V DC / Modbus through the upper cable gland.

Prepare the following before connecting the cable:

1. Strip the cable to a suitable length.
2. Strip a length of 10-12 mm of insulation from the wires.
3. Use ferrules if necessary (max. 2.5 mm²)

Connect the wires to the terminal strip in accordance with the connection diagram. To do so:

1. Insert the white actuator into the opening behind the respective connection with an actuating tool (width 2.5 mm).

2. Route the cable through the front opening until the stop.
3. Remove the actuator.

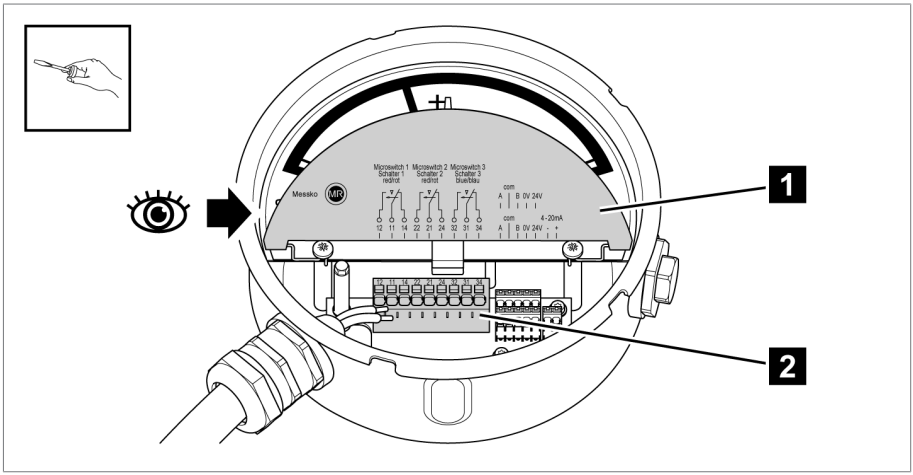

Figure 48: Connecting the micro-switches

1	Connection diagram	2	Terminal strip

6.4.1.9 Closing the cover plate

1. Check that the device is sealed tight and check that settings of the switching marks and limit switches are correct; see Commissioning [▶Section 7, Page 77].
2. Close the cover plate.

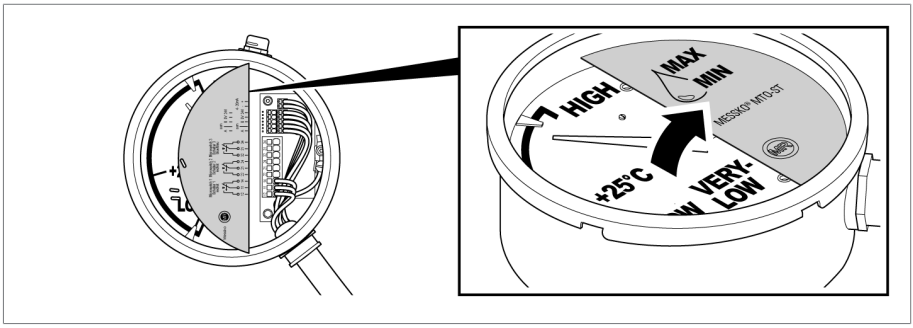

Figure 49: Closing the cover plate

6.4.1.10 Positioning and closing the bayonet seal ring

NOTICE! If the rubber gasket and glass do not seal all the way around, liquids or moisture can penetrate and damage the device.

► Position the bayonet seal ring with viewing glass onto the device, press down firmly and turn 30...40° clockwise so that the viewing glass is pressed firmly into the rubber gasket all the way around.

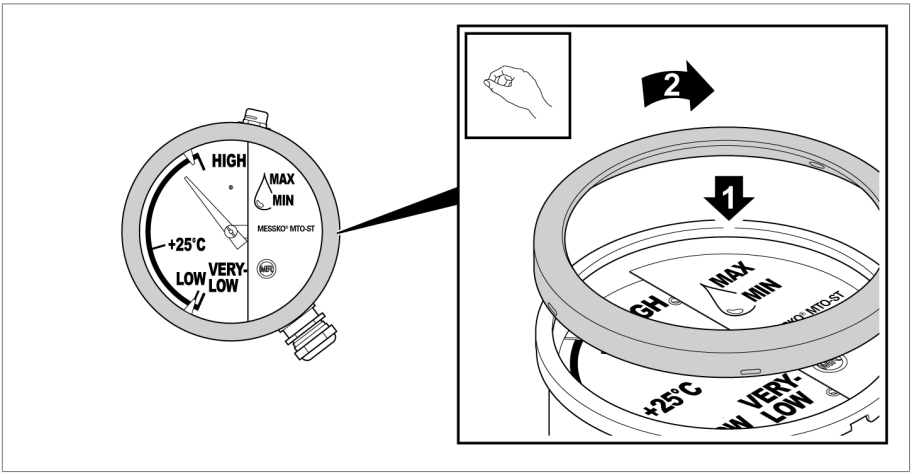

Figure 50: Closing the device

⇨ The oil level indicator is ready for operation.

6.4.2 Connecting the MTO with connector

The oil level indicator is pre-wired and set. The micro-switches are connected as shown in the diagram printed on the inside of the cover plate. All that is necessary is to connect the protective conductor and the connection cable.

1. Connect the protective conductor to the grounding screw on the side of the housing.

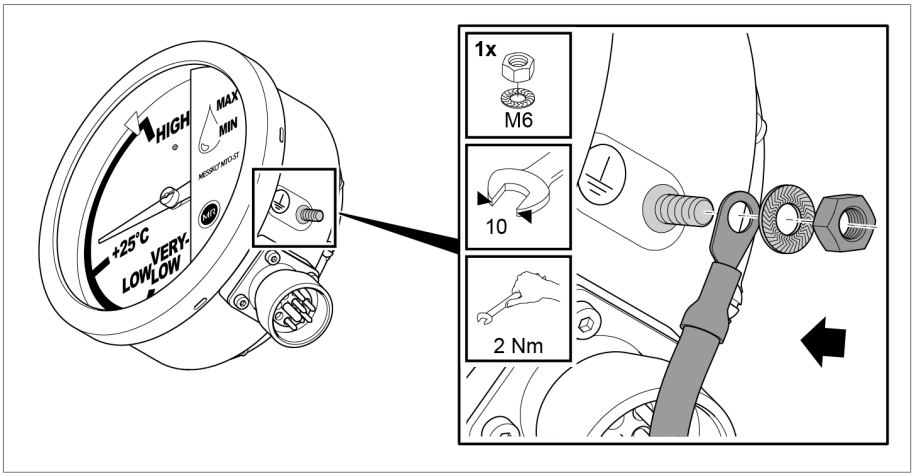

Figure 51: Grounding the device

2. Remove the bayonet seal ring and open the cover plate.

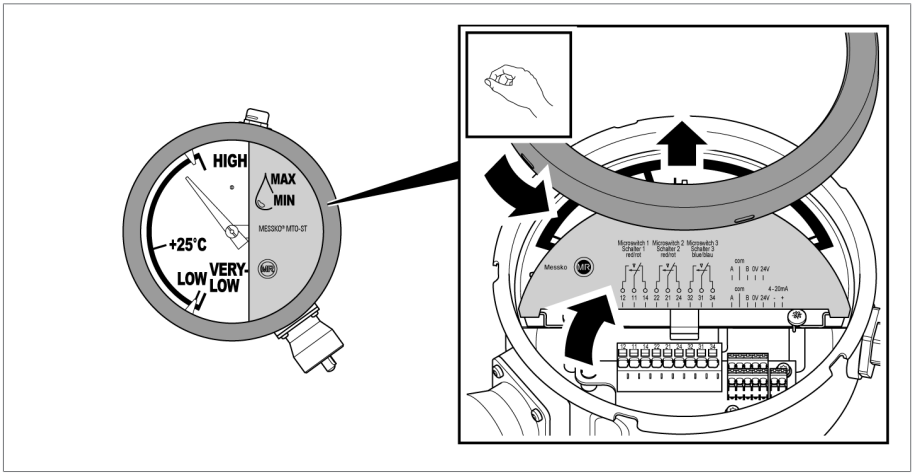

Figure 52: Opening the cover plate

3. Observe the connection diagram and connect the wires at the free end of the connection cable in the control cabinet.
4. Close the cover plate and the bayonet seal ring.
5. Connect the socket connection cable to the device.
   NOTICE! Damage to cables and lines! When plugging the socket connection cable into the socket, the cable can become rotated, leading to cable breaks. To avoid this, hold the cable tightly and only turn the threaded cap clockwise up to the stop.
   ⇨ The cable may not rotate while this is happening.

6.4.3 MTO with relay box (optional)

The relay box has four relays. The switching thresholds (dependent on the oil level) can be set individually via Modbus. The switching symbols in the relay box indicate the de-energized state (LED off).

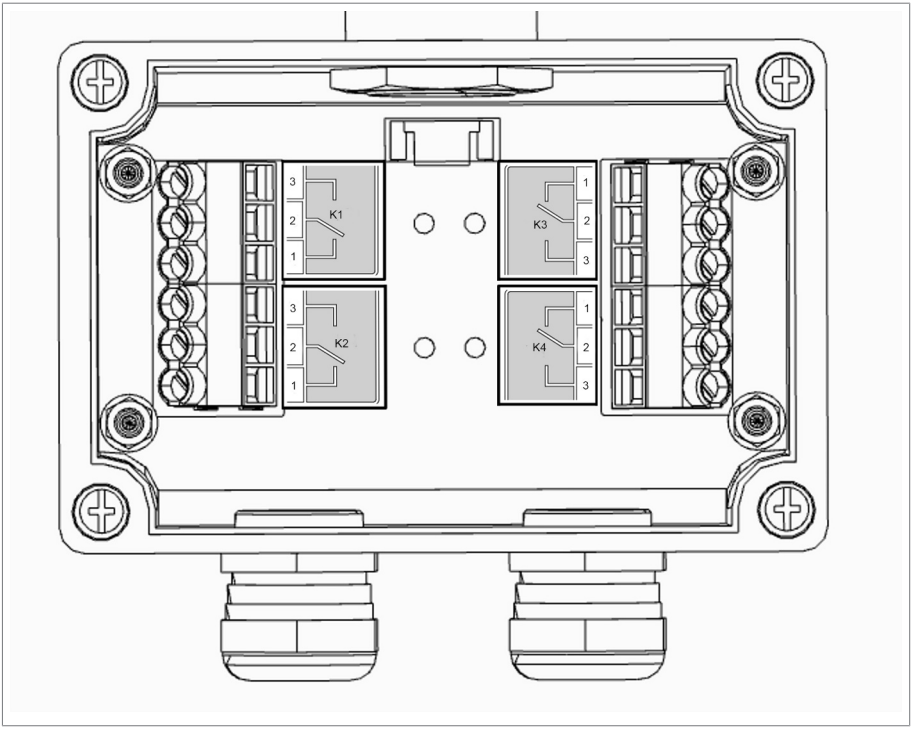

Figure 53: Relay box structure

1	Normally closed contacts	2	Coil
3	Normally open contacts		

⚠ WARNING

Electric shock!

The entire relay may be connected either to only extra-low-voltage circuits or to only low-voltage circuits. Mixed voltages are not permitted.

The cable glands on the relay box are used only to connect the relay. No cables may be routed to the device.

The relays are deactivated in the default settings. They can be configured via Modbus; to do so, see chapter Commissioning – Configuring Modbus.

Connect wires to the terminal strip according to the connection diagram, to do so:

1. Strip the cable to 8 mm.
2. Loosen the screw on the respective relay.
3. Insert cable into the screw terminal.
4. Tighten screw terminal with 0.55 Nm.

7.1 Transporting in the installed state

If transportation of the entire assembled unit is necessary between mounting the device onto the transformer / oil conservator and commissioning it, please also refer to the information on further transport [▶Section 5.6, Page 29].

NOTICE

Damage to the device

The device can become damaged during transport due to unsuitable packaging.

- ► Use suitable packaging for transporting the device in the installed state.
- ► Protect the device against mechanical damage.
- ► Prevent the ingress of rain water.
- ► Ensure sufficient air ventilation without the formation of condensation.

7.2 Function tests

Check the following after mounting the oil level indicator:

- Are all connections sealed tight?
- Is the bayonet seal ring of the viewing glass closed tightly [▶Section 6.4.1.10, Page 72] enough that it seals the device all around?
- Is the correct oil level being displayed?

If oil escapes, proceed as follows:

1. Lower the oil level in the oil conservator far enough that oil will not escape from the oil conservator flange when removing the oil level indicator.
2. Remove the oil level indicator.
3. Remove the flange and flange gasket and clean them, or replace them if necessary. Observe the sections "Checking the flanges" [▶Section 6.1.4, Page 35] and "Gasket requirements" [▶Section 6.1.5, Page 37].
4. Install a new gasket.
5. Attach the oil level indicator to the oil conservator [▶Section 6.3, Page 43].
6. Refill the oil conservator with oil.

⇨ The pointer on the oil level indicator moves.

7 Commissioning

You can check if the main switching contacts are working correctly by performing a **sink test**:

1. Adjust the fill level of the oil conservator to the mark of the filling temperature and check.
2. Continue filling the oil conservator to the MAX mark and check.
3. Lower the fill level to the MIN mark and check.

⇨ The pointer shows the exact fill level at each switching mark.

Should the listed measures not be sufficient, contact Maschinenfabrik Reinhausen GmbH.

► Once the function check has been successfully completed, fill the oil conservator to the correct fill level.

7.3 Configuring Modbus

You can change the Modbus configuration settings.

You need a MODBUS configuration tool for this (e.g. the ASE2000 available on the market).

1. Connect the device individually to the RS-485 BUS.
2. Change the Modbus address if necessary.
3. Adjust the parity and baud rate if necessary.

⇨ These will be adopted automatically five seconds after the new values are entered.

For more information (e.g. register content), see chapter Modbus RTU [►Section 11.2.5, Page 95] technical data.

Modbus baud rate setting

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

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

Setting the Modbus address

The following values are available for the Modbus address:

Modbus address	
MTO delivery status	25
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
Optional	Odd / none

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

Also refer to:

Modbus RTU [►Section 11.2.5, Page 95]

8 Maintenance, inspection and care

Maintenance

The device is maintenance-free.

Inspection

Depending on the conditions of use of the device and the national regulations in the respective country of use, the transformer manufacturers can specify different inspection intervals.

► Observe the inspection intervals defined in CIGRE Publication No. 445 "Guide for Transformer Maintenance" or the inspection intervals specified by the transformer manufacturer.

During occasional visual inspections of the transformer, you can inspect and clean the device as follows:

1. Clean the housing of the device with a dry cloth.
2. Ensure that the pressure equalization element is free of dirt and deposits; see Ventilation.
3. Check the device for external damage and contamination.

Checking the switching points

⚠ WARNING

Electric shock

Danger of death or serious injury

► Only work on the open device when it is de-energized.

► Perform live tests only when the device is closed.

The switch functions can be tested against the resistance of the magnetic coupling by moving the pointer by hand:

1. Open the device [►Section 6.4.1.1, Page 57] and open the cover plate.
2. Lead the pointer over each switching point respectively by hand.
3. Measure the electrical signal using a multimeter set to "Continuity measurement".

   ⇨ The respective switch must audibly trigger.
4. Close the cover plate and close the device [►Section 6.4.1.10, Page 72].

This chapter describes how to eliminate operating faults.

If a solution cannot be found for a fault, contact Maschinenfabrik Reinhausen GmbH:

Maschinenfabrik Reinhausen GmbH

MR Service & Complaint
Falkensteinstrasse 8
93059 Regensburg
Germany

E-mail: service@reinhausen.com

E-mail: complaint@reinhausen.com

Please have the following data at hand:

- Serial number
- Software version

Please have the answers to the following questions ready:

- Has there previously been a problem with this device?
- Have you previously contacted Maschinenfabrik Reinhausen about this issue? If yes, then who was the contact?

To make troubleshooting easier and to ensure the product improvement process, please perform the following steps.

If the device is working but not reporting plausible values, check, document and compare the following:

- The measured value reported by the 20 mA current loop serial interface
- The measured value reported by Modbus
- The measured value reported by the pointer on the scale
- The actual physical measured value (measured or estimated)

✓ The target current of the 20 mA interface calculated as follows:

► I_{target} = 4 mA + (16 mA * current_pointer value / 100%)

⇨ Calculation example: The indicator value is 25%.

⇨ I_{target} = 4 mA + (16 mA * 25% / 100%)= 4 mA + (16 mA * 0.25) = 8 mA

- When did the error first occur? Is there a correlation with events such as lightning surge testing (transformer station), thunderstorms, transformer disconnection/reconnection after short circuit or ground fault...?
- Is the error constant or sporadic? Is it correlated with other events/conditions, such as extreme ambient temperatures?
- Do you use shielded lines for the 20 mA circuit? Twisted pair? Is the shielding applied on both sides? What conductor lengths?
- Do you use shielded lines for Modbus and together for Modbus and 24 V DC? Twisted pair? Is the shielding applied on both sides?
- Which receiver do you use as 20 mA receiver (load resistance...)? If so, where is it located? What conductor lengths?
- Which receiver (master) do you use for RS485, and is it also located on this transformer or say in a distant control room? Are there other devices on the bus?
- For TTM and TTMR versions, please tell us the value of the status register.

9.1 General malfunctions (type TT)

You are using a device with passive 4…20 mA analog output.

Characteristics/ details	Cause	Remedy
No function (4...20 mA)	Power supply not present	▪ Check cables ▪ Check power supply (18… 30 VDC) ▪ Check 4…20 mA receiver (loop into multimeter)

Table 5: General faults

9.2 General malfunctions (types TTM and TTMR)

You are using a Modbus and an active 4...20 mA current loop serial interface.

Characteristics/ details	Cause	Remedy
No function (4...20 mA)	Power supply not present	▪ Check cables ▪ Check power supply (18… 30 VDC) ▪ Check 4…20 mA receiver (loop into multimeter) ▪ Check the Modbus receiver (supply, configuration, etc.)
No function (Modbus)		

Table 6: General faults

9.3 Malfunctions of the 4...20 mA current loop

Characteristics/ details	Cause	Remedy
Loop current is approx. 3 mA	▪ Device signals detected error	▪ At 3 mA: The self-diagnosis has detected an error that does not allow a reliable indication of the measurement; ▪ TTM and TTMR versions: For possible causes/remedies, see section Data point status
The receiver does not measure any 4…20 mA loop current	▪ 4…20 mA analog output was deactivated by holding register 4 ▪ Conductor break, open terminal point ▪ Short circuit ▪ Power supply not present ▪ Device defective	▪ Activate 4…20 mA analog output: switch holding register 4 from 0 to 1 ▪ Loop in multimeter and measure ▪ Check cables ▪ Check device supply (18… 30 VDC)

9 Fault elimination

Characteristics/ details	Cause	Remedy
The receiver measures a 20 mA loop current that is too low	▪ A part of the current is running through a parallel path ▪ Load resistance too high ▪ Supply voltage too low ▪ Device defective	▪ Loop in multimeter and measure ▪ Check cables ▪ Check receiver (load resistance)
The receiver measures a 4…20 mA loop current that is too high	▪ Device defective	▪ Loop in multimeter and measure

Table 7: Malfunction of the 4...20 mA current loop

9.4 Modbus communication malfunctions (types TTM and TTMR)

Characteristics/ details	Cause	Remedy
No communication possible (continuous)	Power supply not present	▪ Check cables ▪ Check device supply (18… 30 VDC)
	▪ RS485 lines A, B not connected or interrupted ▪ Short-circuit A, B ▪ Ground fault A and/or B ▪ RS485 connections swapped	Info: A = D0 = D+; B = D1 = D- ▪ Check wiring. ▪ Take a voltage measurement with a multimeter if necessary (A against B; A against Com; B against Com) ▪ Reconnect A, B if necessary
	▪ Modbus address incorrect ▪ Modbus address assigned multiple times ▪ Baud rate ▪ Parity	Info: For default settings, see chapter Configuring Modbus [►Section 7.3, Page 78] ▪ Check parameters (those of the device and those of the master) ▪ Change parameters if necessary; see chapter Configuring Modbus [►Section 7.3, Page 78]
	▪ Device defective	-
No communication possible (sporadic)	▪ Modbus address assigned multiple times	▪ Check parameters (those of the device and those of the master) ▪ Change parameters if necessary; see chapter Configuring Modbus [►Section 7.3, Page 78]
	▪ Device defective	-

Table 8: Modbus communication malfunction

9 Fault elimination

9.5 Relay box malfunctions (type TTMR)

Characteristics/ details	Cause	Remedy
Relay does not shut on/off and Modbus and/or 20 mA is not working	▪ Power supply not present ▪ Device defective	▪ Check cables ▪ Check device supply (18… 30 VDC)
Relay does not shut on/off and Modbus and/or 20 mA is working	▪ Relay incorrectly configured (threshold, hysteresis, upward/downward) ▪ Wiring to the relay box: Conductor break, open terminal ▪ Device (relay control) defective ▪ Device (relay) defective	▪ Relay box: Open cover and check LEDs (LED lit => relay active) ▪ Configure relay; see chapter Setting up Modbus [▶Section 7.3, Page 78] ▪ Check cables

Table 9: Relay box malfunctions

9.6 Self-diagnostic device status (types TTM and TTMR)

The device checks its own functionality cyclically (self-diagnostic).

In Modbus input register 0 (data type: UINT16), the device reports a corresponding status via status bits. Multiple bits can also be set at the same time.

Status "0" means that the device has not detected any error.

All errors are reversible.

Status bit value/characteristic/detail	Cause	Remedy
0: no error detected	-	-
1 and **2**: Internal error	▪ Device defective	▪ See Modbus communication malfunction [▶Section 9.4, Page 85] ▪ Contact Maschinenfabrik Reinhausen GmbH.

Status bit value/characteristic/detail	Cause	Remedy
4: Pointer out of measuring range: Pointer angle is 20 angular degrees smaller than the minimum angle (MIN mark on scale) or 20 angular degrees larger than the maximum angle (MAX mark)	▪ Device defective ▪ Extremely low oil level ▪ Extremely high oil level	▪ Contact Maschinenfabrik Reinhausen GmbH. ▪ Is the oil level really extremely low or high? Compare the reported oil level with the pointer position.
8: 20 mA output: deviation between target current and read-back current too high	▪ Current loop is open (continuous load resistance) because you do not want to use the current loop at all ▪ Interruption of the 20 mA current loop ▪ Load resistance too high (take conductor lengths and cross-sections into account if necessary) ▪ Supply voltage too low ▪ Moisture in the device ▪ Device defective	▪ If the 20 mA current interface is operated open because you do not want to use it, then you should deactivate it via Modbus (recommended). Alternatively, you can clamp a resistor as load resistance. (Recommendation: 590 Ohm +-20%/0.5 W; if a resistor is not available: wire bridge) ▪ Check cables (loop open? Parallel paths? Current leaks?) ▪ 20 mA cable: shielded, if possible with shielding on both sides; use twisted pair; do not run next to cables with interference ▪ Check for moisture/creep inside the device

Table 10: Status codes

Observe the national disposal regulations in the country of use.

10.1 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):

- Aluminum alloy
- Brass alloy
- Standard parts with a low property class

11 Technical data

11.1 Ambient conditions

Permissible ambient conditions		
Location of use	Indoors and outdoors, tropic-proof	
Operating temperature[1)]	-40...+80 °C	
Storage temperature[1)]	-50...+80 °C	
Ambient air temperature[1)]	-40...+80 °C*	
Relative humidity	Fog-free up to 80%	
Ventilation	Pressure equalization element in the indicator for the prevention of water condensation	
Installation altitude[1)]	Up to 2,000 m above mean sea level	
Degree of protection in accordance with IEC 60529	IP66	MTO with WADI cable gland, offshore cable gland or EMC double cable gland
		MTO without electrical connection
	IP55	MTO with standard cable gland or 1/2"-14 NPT adapter
		MTO with plug connection
Protection class	I	
Overvoltage category	III	
Contamination level	2 (in the closed housing)	

[1)]Extended ranges on request.

Insulating fluid

- Unused insulating oils derived from petroleum products[1)] in accordance with IEC 60296 and ASTM D3487 (equivalent standards on request)
- Unused insulating oils derived from other virgin hydrocarbons in accordance with IEC 60296, or blends of these oils with petroleum products[1)] in accordance with IEC 60296, ASTM D3487 or equivalent standards on request
- Alternative insulating fluids, such as natural and synthetic esters or silicone oils, on request

[1)] Gas-to-liquid oils (GTL oils) are understood in this context as petroleum products

11.2 Electrical connection

11.2.1 Micro-switches

Micro-switches	Freely adjustable	Permanently set (version F)
Quantity	1…3	1…3 Only adjustable at the factory
Display area	Depending on device configuration; Standard; MAX... +20 °C...MIN	
Switch points (depending on order)	Depending on device configuration; Standard; 5° before MIN, 5° before MAX	
	Smallest distance between micro-switches: 10°	–
Switching function: Change-over contact for fill level	NO: Fill level rising or falling	
	NC: Fill level falling or rising	
Protection	Miniature circuit breaker 6 A, type C	Miniature circuit breaker 16 A, type C
Rated insulation voltage in accordance with IEC 60076-22-1	2,500 VAC/1 min; terminals to ground 1,000 VAC/1 min; between open terminals	
Lightning impulse withstand voltage in accordance with IEC 60076-22-1	4,000 V; terminals to ground 3,000 V; between open contacts	
Contact material	Standard: silver alloy Optional: gold-plated contacts	Standard: silver alloy
Contact type	Change-over contact	Change-over contact

11 Technical data

Utilization category for freely adjustable micro-switch[1)]

Utilization category in accordance with IEC 60947-5-1	Typical application	Rating/nominal operation	
		U_N	I_N
AC-12 (50/60 Hz)	Regulation of resistive load and semi-conductor load resistance with disconnection via optocoupler	230 V	5 A
AC-15 (50/60 Hz)	Regulation of electromagnetic load resistance with AC voltage	230 V	0.26 A
		120 V	0.5 A
		24 V	2 A
DC-12	Regulation of resistive load and semi-conductor load resistance with disconnection via optocoupler	220 V	0.2 A
		120 V	0.4 A
		30 V	5 A
DC-13	Regulation of electromagnets with DC voltage	220 V	0.11 A
		120 V	0.21 A
		24 V	1.04 A

[1)] Extended ranges on request.

Switching capacity for freely adjustable micro-switch[1)]

Micro-switch version	U_N	Switching capacity in accordance IEC 60076-22-1
Standard switch	230 V AC	Making capacity: 250 VA, cos φ > 0.5
		Breaking capacity: 60 VA, cos φ > 0.5
	250 V AC	Making capacity: 250 VA, cos φ > 0.5
		Breaking capacity: 60 VA, cos φ > 0.5
	24…220 VDC	Making capacity: 130 W, L/R < 40 ms
		Breaking capacity: 25 W, L/R < 40 ms
Switch with gold-plated contacts[2)]	230 V AC	Max. 6.9 VA, cos φ = 0.9
	24…220 VDC	Max. 6.6 W, L/R < 25 ms

[1)] Extended ranges on request.

[2)] Switching higher loads destroys the gold plating.

Switching capacity for permanently set micro-switch[1)]

Micro-switch version	U_N	Switching capacity
Permanently set	250 V AC	15 A, cos φ = 1 With MIL plug: 13 A, cos φ = 1
	250 VDC	0.25 A with resistive load
	12 VDC	5 A with resistive load

[1)] Extended ranges on request.

11.2.2 4…20 mA outputs

4…20 mA output (type TT)	
Feed-in voltage of the passive current loop	18…30 VDC unregulated, max. 10% residual ripple, protected against polarity reversal
Output signal	4…20 mA; passive; 2-conductor wiring <3.6 mA: Device diagnoses error
Max. load resistance	750 Ω at U_b= 24 VDC
Repetition accuracy	≤ ±0.1% from the end value

4…20 mA output (types TTM and TTMR)	
Supply voltage	24 VDC unregulated, max. 10% residual ripple, protected against polarity reversal
Output signal	4…20 mA; active; 4-conductor wiring <3.6 mA: Device diagnoses error
Max. current consumption	40 mA without relay 80 mA with four active relays
Max. load resistance	750 Ω at U_b= 24 VDC
Repetition accuracy	≤ ±0.1% from the end value

11.2.3 RS485 interface (types TTM and TTMR)

RS485 interface	
Supply voltage	24 VDC unregulated, max. 10% residual ripple, protected against polarity reversal
Max. current consumption	40 mA without relay 80 mA with four active relays
Standard	EIA/TIA-485
Wiring	2-wire; half-duplex
Terminal designation	Polarity: A = D+; B = D-; COM = common ground Expected voltage between A and B in the idle state: >+200 mV

11.2.4 Relay box relays (type TTMR)

Relay box relays	
Relay type	4 change-over contacts
Protection	Miniature circuit breaker 6 A, type C
Max. voltage	250 V AC 220 V DC
Switching capacity	5 A at 230 VAC, resistive load 5 A at 30 VDC, resistive load 0.3 A at 220 VDC, resistive load

11.2.5 Modbus RTU

Factory settings

Modbus address	Baud rate	Parity
25	19200	EVEN

Input register

Function code "04" to read the information

Validity of the measured value stored in the INPUT register addresses 1…3:
It can be seen via the DISC register with address 4 (Boolean) whether the measured value is invalid (0) or valid (1).
We strongly recommend evaluating this register in parallel to the measured value query.

Device status:
The INPUT register with address 0 indicates the device status (0: the device self-diagnostic could not find any errors). We recommend querying the device status either parallel to the measured values or when needed (e.g. during troubleshooting, fault elimination). For details, see Fault elimination.

Register	Data type	Designation
0	UINT16	Device status
1, 2	FLOAT32	Oil level in % (floating decimal)
3	SINT16	Oil level in % (integer)
4-16	-	Reserved for future use
17	UINT16	Firmware version major
18	UINT16	Firmware version minor
19	UINT16	Firmware version patch

Configuration via holding register

Each address must be unique in the BUS system. For example, when using two identical devices (same default address!), configure them to different addresses before commissioning.

Function code "03" to read the information

Function code "06/16" to write the information

Register	Data type	Designation	Setting option
0	UINT16	Modbus address	1…247 25[1)]
1	UINT16	Modbus baud rate	0: 4800 1: 9600 2: 19200[1)] 3: 38400 4: 57600 5: 19200
2	UINT16	Modbus parity	0: None 1: Even[1)] 2: Odd
3	-	Reserved	-
4	-	4…20 mA interface	0: Deactivated 1: Activated[1), 2)]
5	SINT16	Switching point relay 1	-300…+500[1)] in percent [%] Scale_min = 0% Scale_max = 100% 500: Relay function deactivated
6	UINT16	Hysteresis relay 1	1 to 100, 2[1)]
7	UINT16	Switching direction relay 1	0: Rising[1)] 1: Dropping
8.9, 10	See 5, 6, 7	Relay 2	See 5, 6, 7
11, 12, 13	See 5, 6, 7	Relay 3	See 5, 6, 7
14, 15, 16	See 5, 6, 7	Relay 4	See 5, 6, 7
17-72	-	Reserved	-
73-79[3)]	STRING	Serial number	7-digit, 1 number per register in ASCII-format

[1)]Delivery condition/default settings

[2)] We recommend deactivating the 4...20 mA analog output when it is not needed. This will prevent the pseudo-error "4...20 mA output defective". This will also reduce the power loss in the device and extend its service life.

[3)]Cannot be overwritten by the customer

Float parameters are saved in big-endian word order.

Relay information and relay functions via DISC register 0…3

Function code "02" to read the information

Register	Data type	Designation
0	BOOL	Status relay 1
1	BOOL	Status relay 2
2	BOOL	Status relay 3
3	BOOL	Status relay 4

Validity of the measured value via DISC register

Function code "02" to read the information from DISC register address 4.

Register	Data type	Designation
4	BOOL	Validity of the measured value (input register 1…3): 0: Invalid 1: Valid

11 Technical data

11.2.6 Connection options

Standard cable gland
M25x1.5 nickel-plated brass
Clamping range 9...20 mm

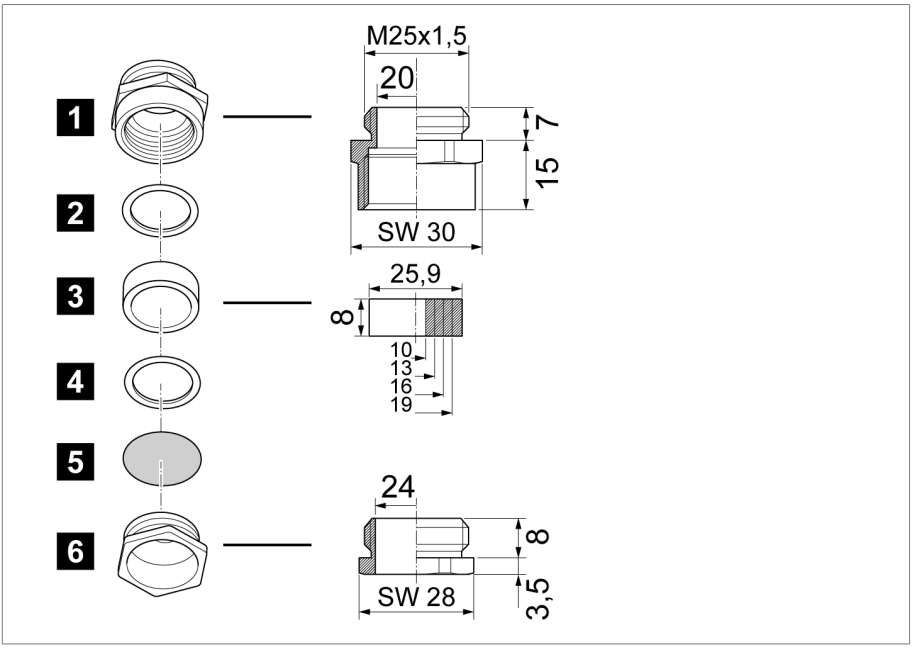

Figure 54: Standard cable gland

1	Gland base	2	Pressure ring
3	Universal sealing ring, NBR	4	Pressure ring
5	Dust protection disk	6	Pressure screw

WADI cable screw connection (water-tight; optional)

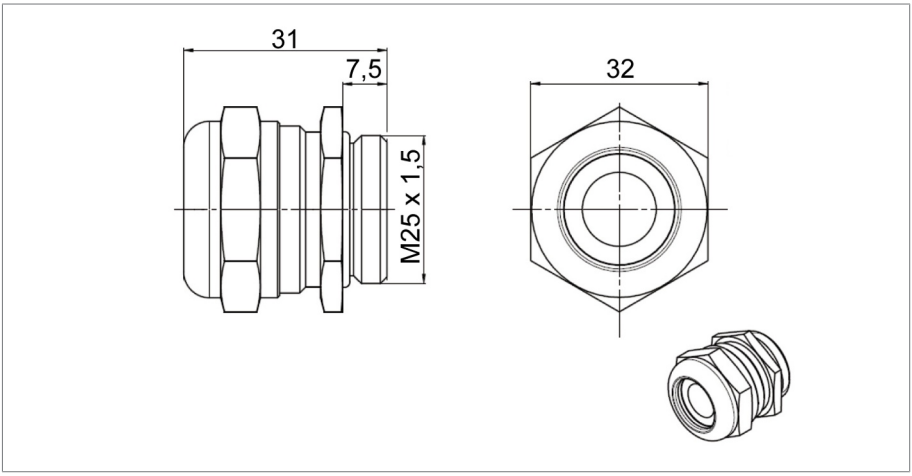

Figure 55: WADI cable screw connection; material: nickel-plated brass; clamping range 13...20 mm

Offshore cable screw connection (optional)

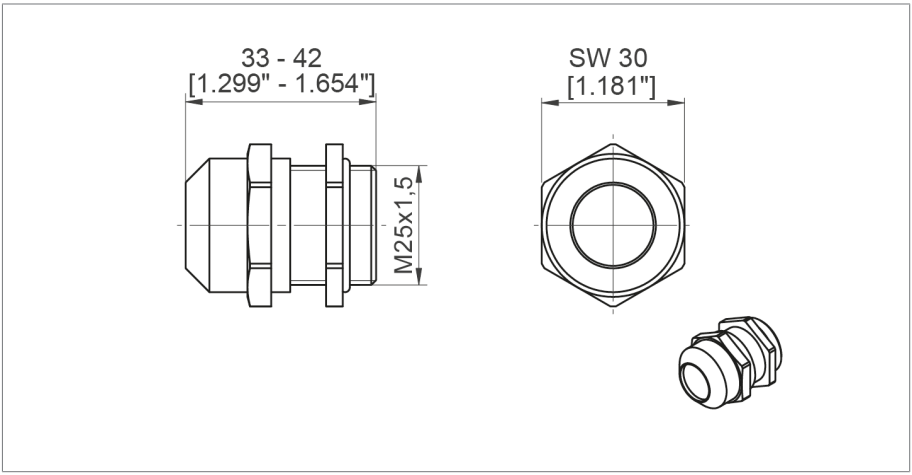

Figure 56: Offshore cable screw connection; material: stainless steel (V4A); clamping range 9...17 mm

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EMC double cable gland (optional)

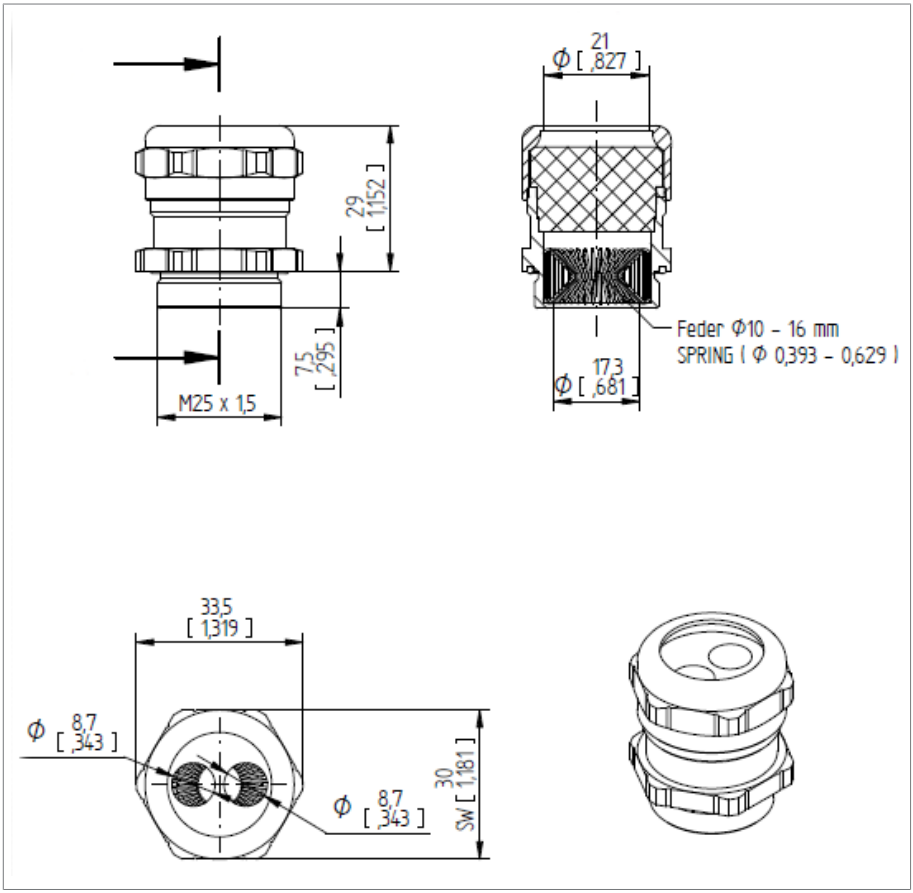


Figure 57: EMC double cable gland

1/2" NPT screw connection (optional)

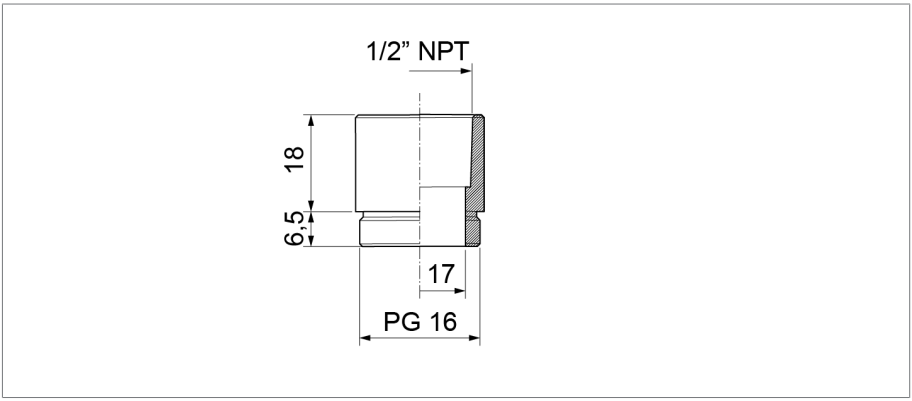


Figure 58: Connecting joint for NPT screw connection; material: nickel-plated brass

ANSI plug (optional)
Connecting cable with ANSI socket not included in the scope of delivery; can be ordered separately

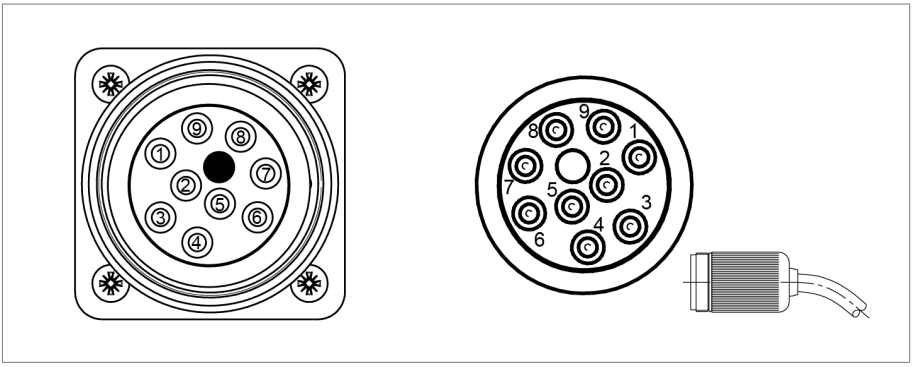


Figure 59: ANSI plug on the device (left); Connecting cable with ANSI socket (right)

PIN	Color	Terminal	PIN	Color	Terminal
1	Black	12	4	Orange	22
2	Red	11	5	Yellow	21
3	Blue	14	6	Brown	24
Additionally for 3 micro-switches (longer terminal strip); these colors may differ depending on the configuration:			7	Red-black	32
			8	Blue-black	31
			9	Orange-black	34

11 Technical data

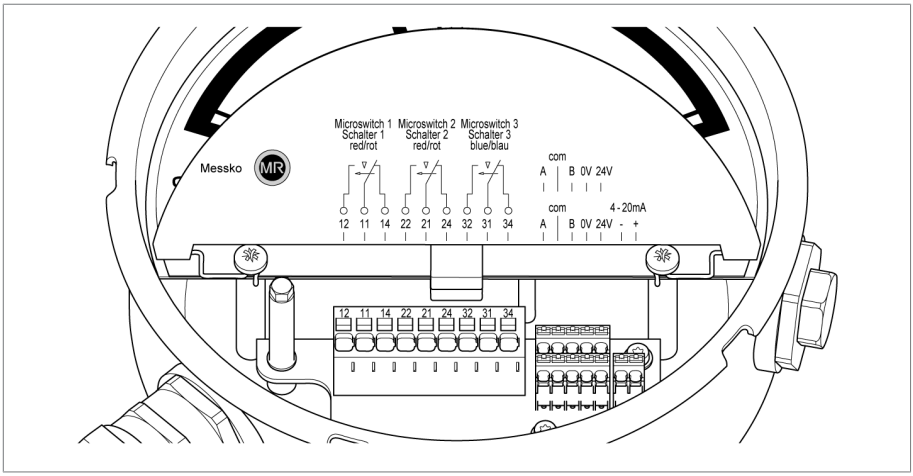


Figure 60: Terminal strip assignment

11.3 Dimensions and weight

	MESSKO® MTO
Housing of the gauge part	Ø 173 mm [Ø 6.81″]; height 213 mm [8.39″]; depth 81 mm [3.19″]
	Height with MESSKO® TT30 (optional): 322 mm [12.68″]
Weight	3.7 kg
	With relay box (optional): 4.4 kg

Please refer to the Appendices [►Section 12, Page 110] for further specification and details on the MTO versions.

11.3.1 Dimensions (radial float movement)

Standard version

For an example with cable gland and relay box, refer to the drawing in the appendix.

Inclined version

For installation dimensions for possible inclinations with a relay box, refer to the drawing in the appendix.

For an example with NPT gland and an inclination of α = 45°, refer to the drawing in the appendix.

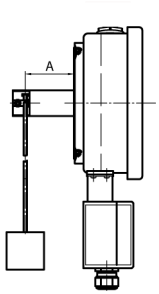
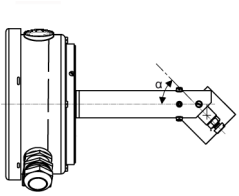
11.3.2 Dimensions (axial float movement)

For the MESSKO® MTO-ST160 with axial float movement, refer to the drawing in the appendix.

11.3.3 Float gauge

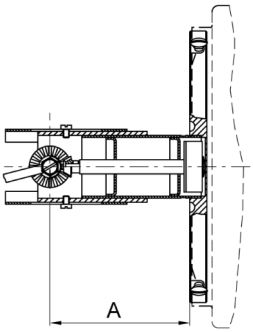
The values specified may vary depending on the configuration of the oil level indicator.

11.3.3.1 Float gauge for radial float movement

Design	Projection A		Inclination α (depending on order)
Straight: 	Standard	59 mm; 100 mm Max. 350 mm	–
Angled: 	Standard	150 mm; 274 mm Max. 350 mm	15°; 30°; 45°

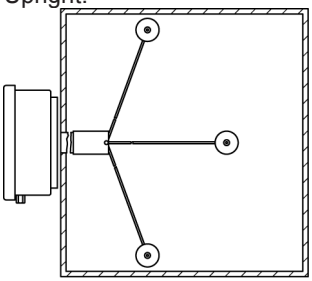
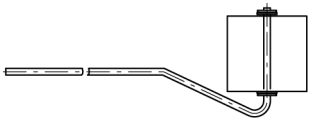
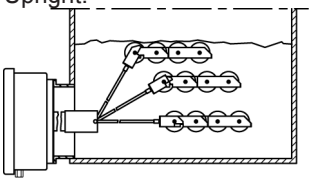
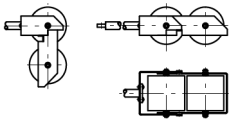
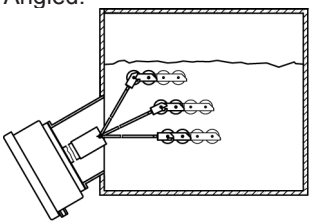
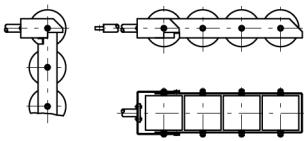
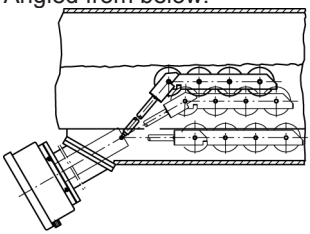
Float gauge length	Dimensions
Standard	680 mm; 800 mm Max. 1,000 mm

11.3.3.2 Float gauge for axial float movement

Design		Projection A
Straight: 	Standard	69 mm or 268 mm Max. 350 mm

Float gauge versions

The float gauge design depends on the layout of the oil conservator:

Mounting position	Breathing sack	Float gauge design
Upright: 	Without	▪ **1 rolling float gauge (L ≤ 1,000 mm)** 
Upright: 	With	▪ **2 rolling float gauges (L ≤ 1,000 mm)** 
Angled: 	With	▪ **4 rolling float gauges (L > 1,000 mm, max. 2,500 mm)** 
Angled from below: 	With	

11.3.3.3 Installation positions for axial MTO

MTO axial, option 1 without breathing sack

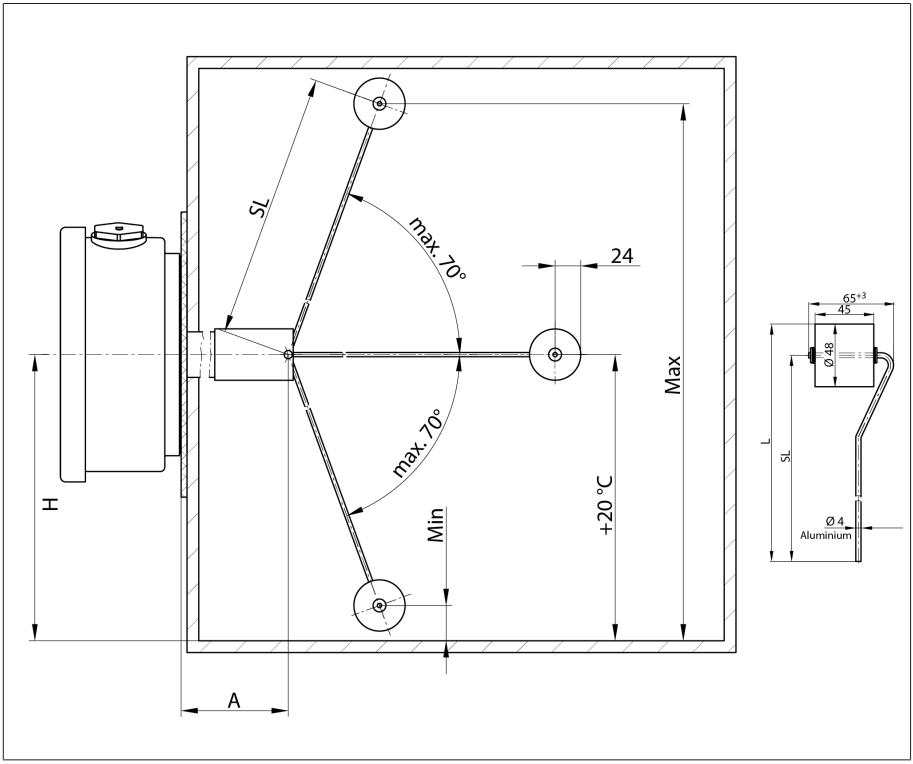


Figure 61: Option 1 without breathing sack, with associated float gauge

A	Projection	SL	Float gauge length for dimensioning
H	Installed height, depending on float gauge length	L =	SL + 1/2 diameter of the float buoy

MTO axial, option 2 and 3, with breathing sack

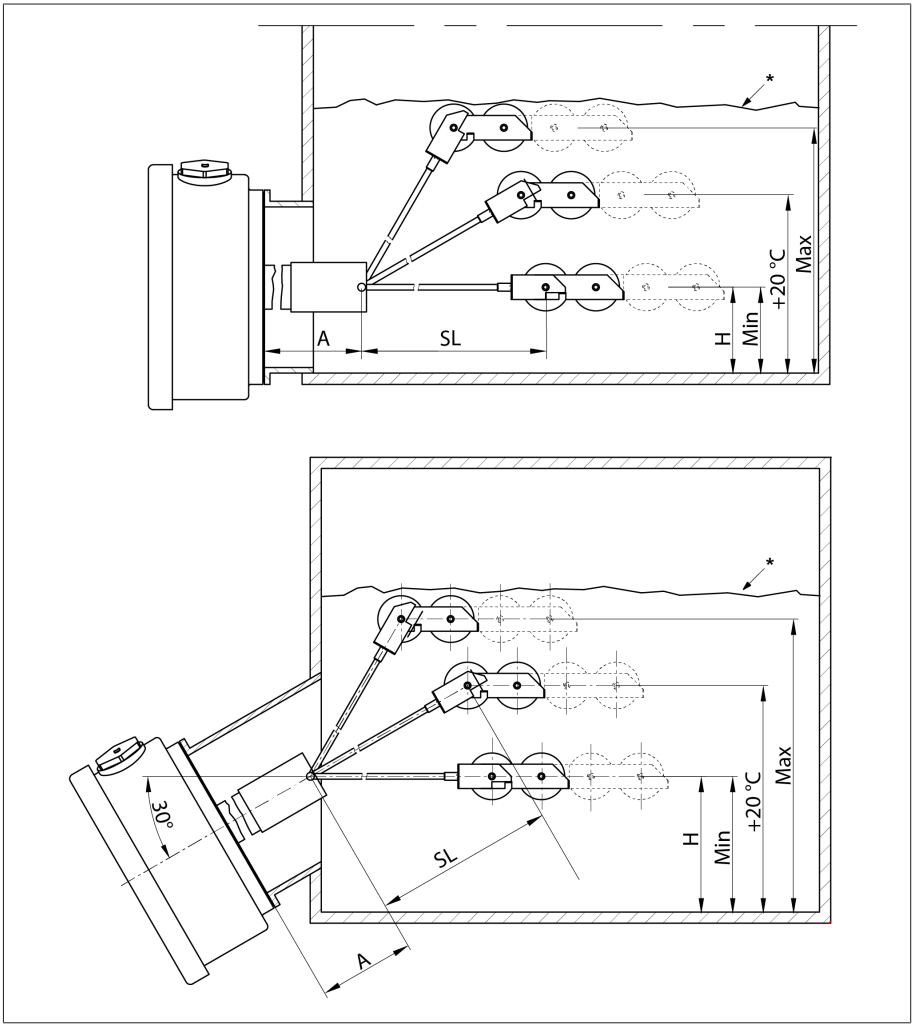


Figure 62: Option 2 with upright installation; Option 3 with angled installation; float gauge see also option 4

A	Projection	SL	Float gauge length for dimensioning
H	Installed height, depending on mounting position	*	Breathing sack

11 Technical data

MTO axial, option 4, with breathing sack and float gauge

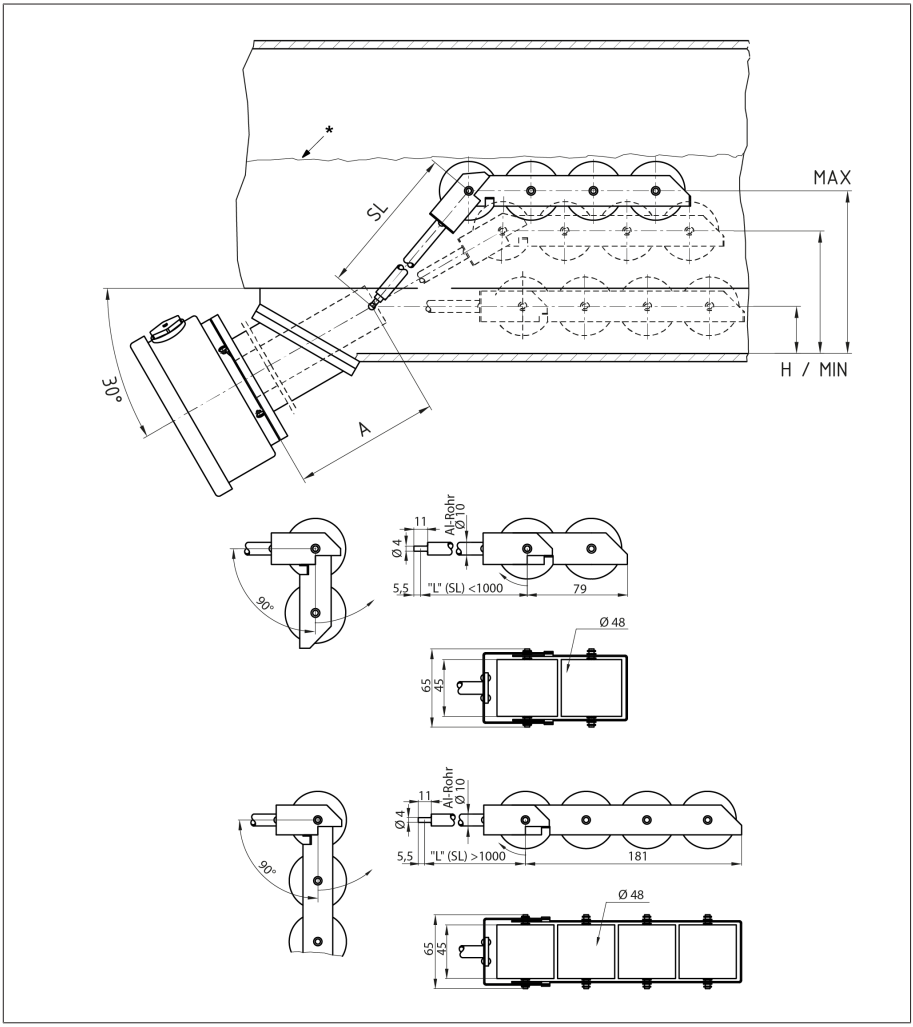


Figure 63: Option 4 with installation angled from below; float gauge for options 2, 3, 4

A	Projection	SL	Float gauge length for dimensioning
H	Installed height, depending on mounting position	*	Breathing sack

11.3.3.4 Further types of float gauges

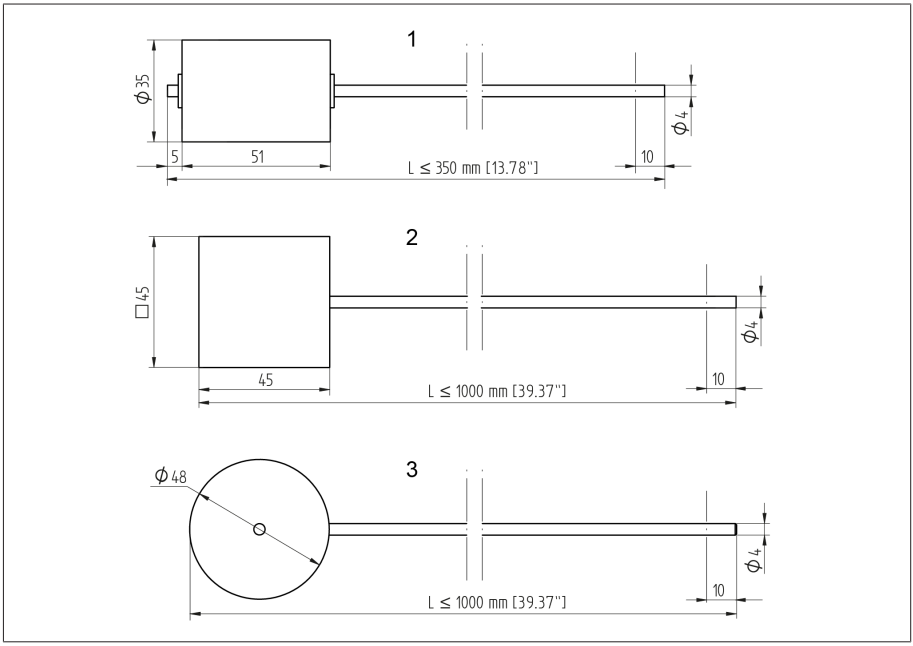
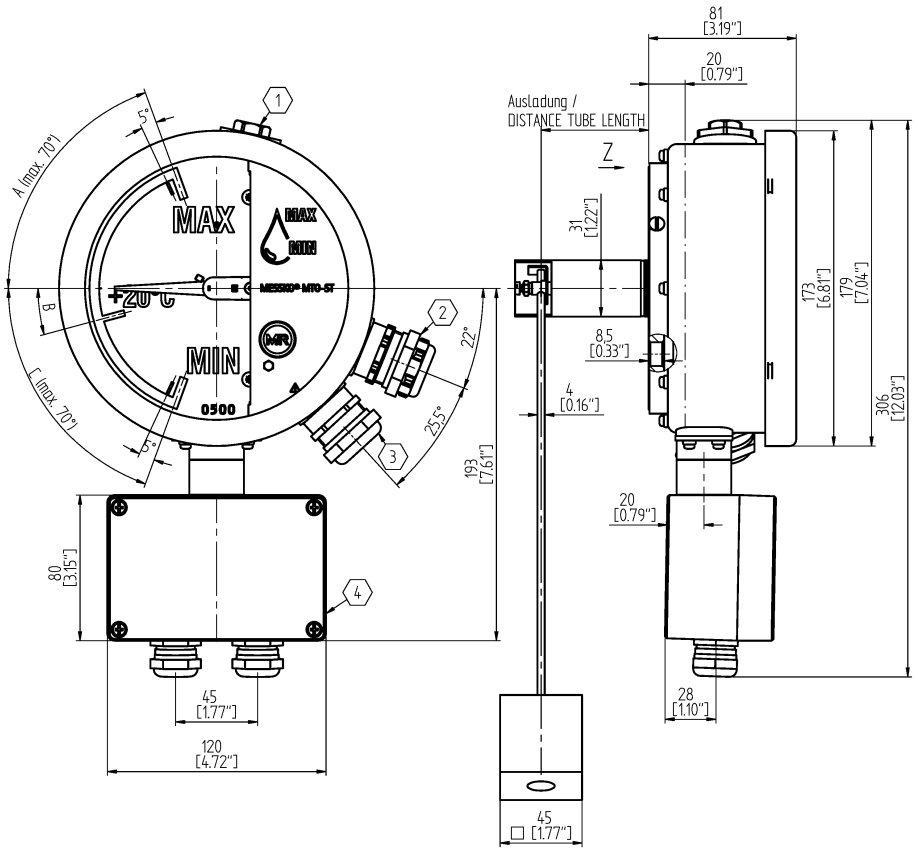


Figure 64: Types of float gauges

1	RM float gauge (rod: brass)	MTO-ST160RM	For radial and axial
2	Cubic float gauge (rod: aluminum)	MTO-ST160	For radial
3	Cylindrical float gauge (rod: aluminum)	MTO-ST160 (TT)	For radial angled design 15° / 30° / 45°

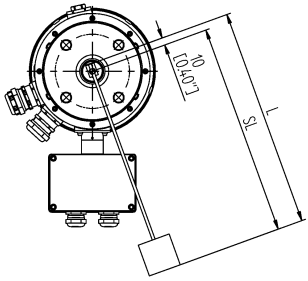
Float length SL = L - 10 mm.

12 Appendix



1:5

Ansicht / VIEW Z



1. Druckausgleichselement / PRESSURE COMPENSATION ELEMENT
2. Kabelverschraubung Modbus / CABLE GLAND MODBUS
3. Kabelverschraubung Schalter / CABLE GLAND SWITCH
4. Relais Box / RELAIS BOX

	DATE	NAME	DOCUMENT NO.
DFTR.	15.02.2023	REHNELT	SED 9144260 000 01
EHKD.	16.02.2023	THIELEK	CHANGE NO. / SCALE
STAND	17.02.2023	WANNINGER	1118584 / 1:2

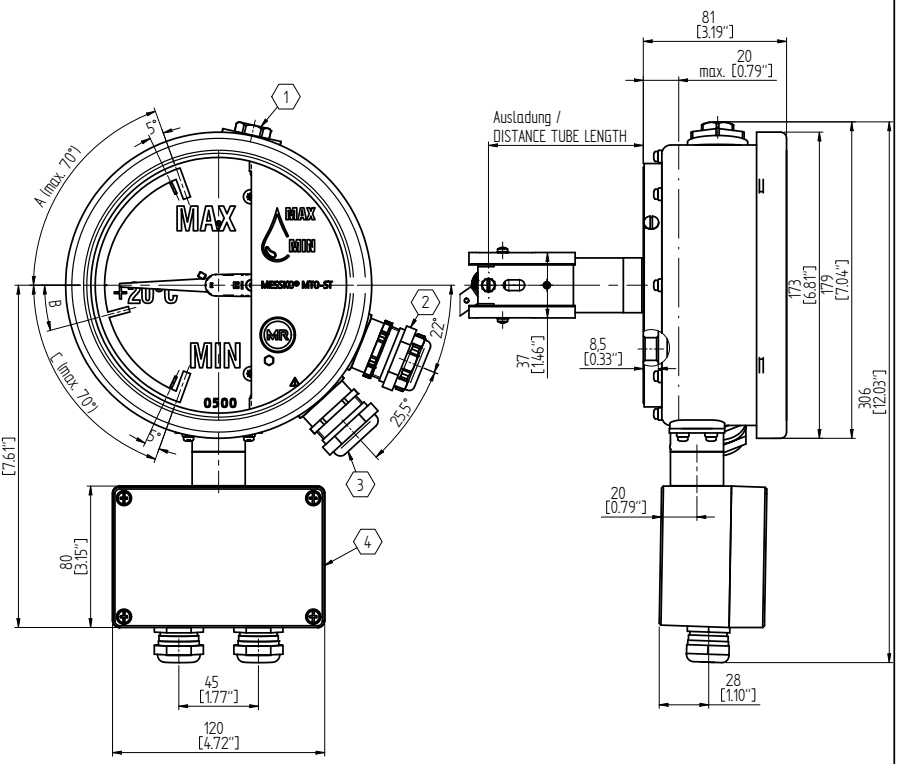
DIMENSION IN mm EXCEPT AS NOTED

TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO-ST160TTMR
RADIAL DESIGN, TERMINAL BOX

SERIAL NUMBER

MATERIAL NUMBER 101736710M | SHEET 1 / 1

A3



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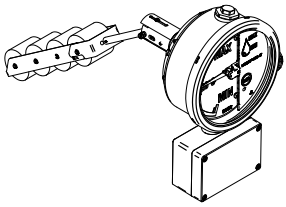


1 Druckausgleichselement / PRESSURE COMPENSATION ELEMENT

2 Kabelverschraubung Modbus / CABLE GLAND MODBUS

3 Kabelverschraubung Schalter / CABLE GLAND SWITCH

4 Relais Box / RELAIS BOX

	DATE	NAME	DOCUMENT NO.	
DFTR.	10.11.2022	REHNELT	SED 91146521 000 00	
CHKD.	10.11.2022	THIELEK	CHANGE NO.	SCALE
STAND.	11.11.2022	WANNINGER	1118584	1:2

DIMENSION IN mm EXCEPT AS NOTED

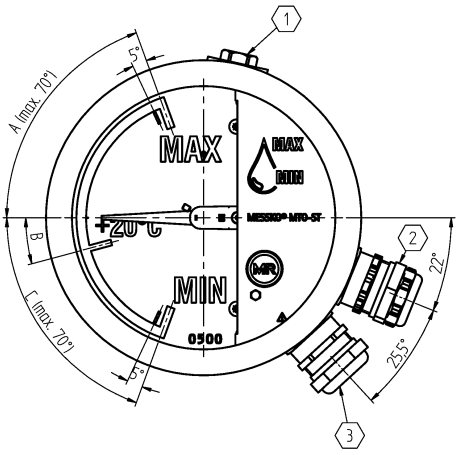
TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO-ST160/TTMR
AXIAL DESIGN, TERMINAL BOX

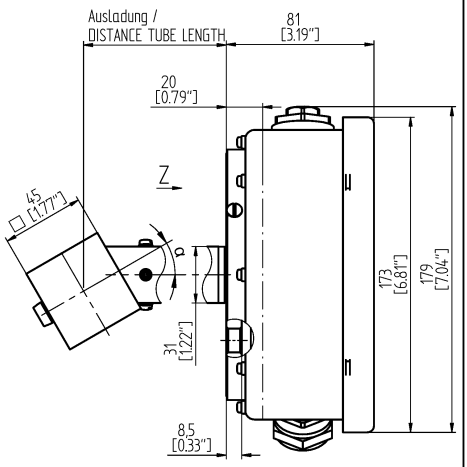
SERIAL NUMBER

MATERIAL NUMBER 101736690M

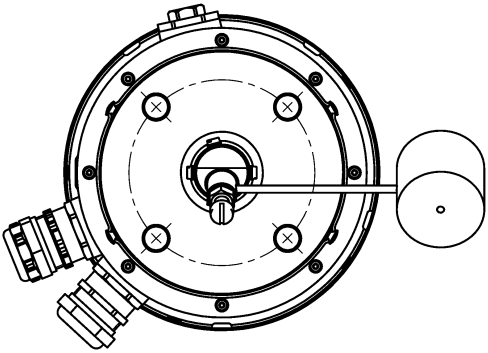
SHEET 1 / 1

A3



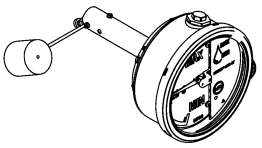


Ansicht Z



1 Druckausgleichselement / PRESSURE COMPENSATION ELEMENT
2 Kabelverschraubung Modbus / CABLE GLAND MODBUS
3 Kabelverschraubung Schalter / CABLE GLAND SWITCH

1:5



	DATE	NAME	DOCUMENT NO.	
DFTR.	15.02.2023	REHNELT	SED 9146747 000 01	
EHKD.	16.02.2023	THIELEK	CHANGE NO.	SCALE
STAND	17.02.2023	WANNINGER	1118584	1:2

DIMENSION IN mm EXCEPT AS NOTED

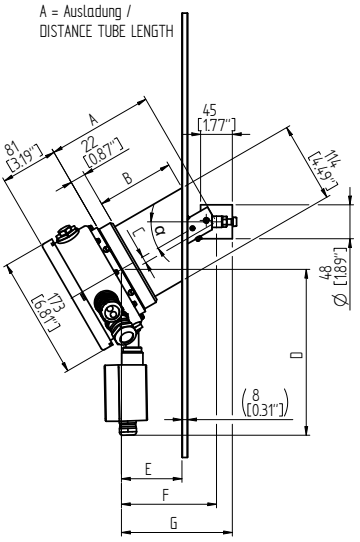
TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO-ST160V/TTM
RADIAL DESIGN

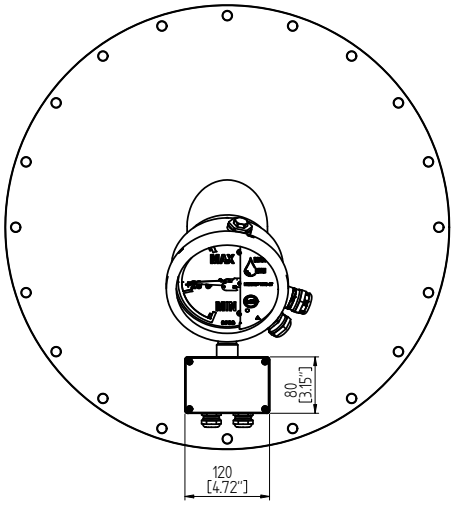
SERIAL NUMBER

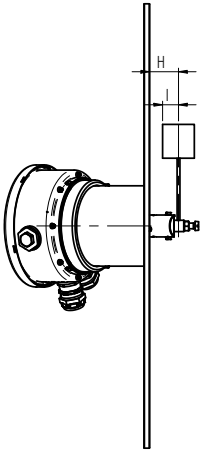
MATERIAL NUMBER 101736600M

SHEET 1 / 1

A3







Maße / DIMENSIONS mm / [IN]	Neigung / INCLINATION α = 15°	Neigung / INCLINATION α = 30°	Neigung / INCLINATION α = 45°
A	150 +1	150+1	274 +1
	[5.91" +.04"]	[5.91" +.04"]	[10.79" +.04"]
B	97	109,5	251
	[3.82"]	[4.31"]	[9.88"]
C	5	9	13
	[.2"]	[.35"]	[.51"]
D	230	236	245
	[9.1"]	[9.29"]	[9.65"]
E	<100	<86	<135
	[<3.94"]	[<3.39"]	[<5.31"]
F	146	135	203
	[5.75"]	[5.31"]	[7.99"]
G	168,5	157,5	225,5
	[6.63"]	[6.2"]	[8.27"]
H	38	41	44,5
	[1.5"]	[1.61"]	[1.75"]
I	16	18	22
	[.62"]	[.71"]	[.87"]

	DATE	NAME	DOCUMENT NO.
DFTR.	-	-	SED 9147750 000 00
CHKD.	-	-	CHANGE NO. / SCALE
STAND.	-	-	1118584 / 15

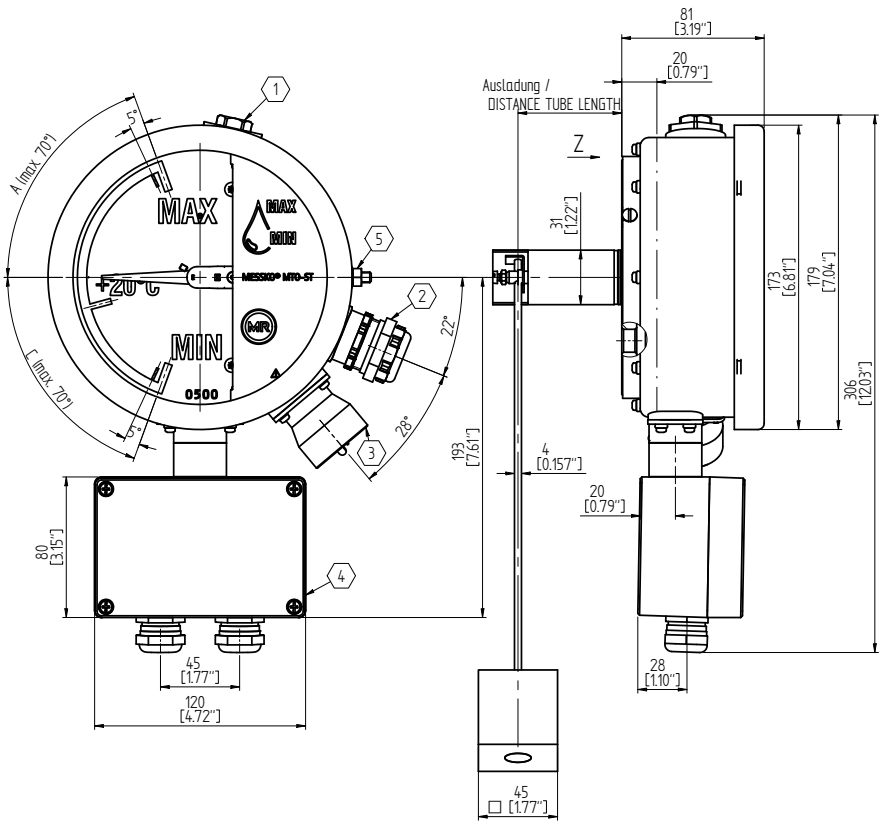
DIMENSION IN mm EXCEPT AS NOTED

TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO-ST160V/TTMR
RADIAL DESIGN, TERMINAL BOX

SERIAL NUMBER

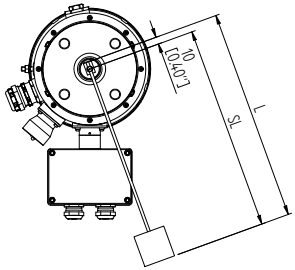
MATERIAL NUMBER 101736610M | SHEET 1 / 1

A3



1:5

Ansicht / VIEW Z



1. Druckausgleichselement / PRESSURE COMPENSATION ELEMENT
2. Kabelverschraubung Modbus / CABLE GLAND MODBUS
3. Steckeranschluss ANSI od. Westinghouse / CONNECTION ANSI OR. WESTINGHOUSE
4. Relais Box / RELAIS BOX
5. Anschluss Masseausgleich / COONECTION MASS BALANCING

	DATE	NAME	DOCUMENT NO.
DFTR.	10.11.2022	REHNELT	SED 914 7922 000 00
CHKD.	10.11.2022	THIELEK	CHANGE NO. / SCALE
STAND	11.11.2022	WANNINGER	1118584 / 1:2

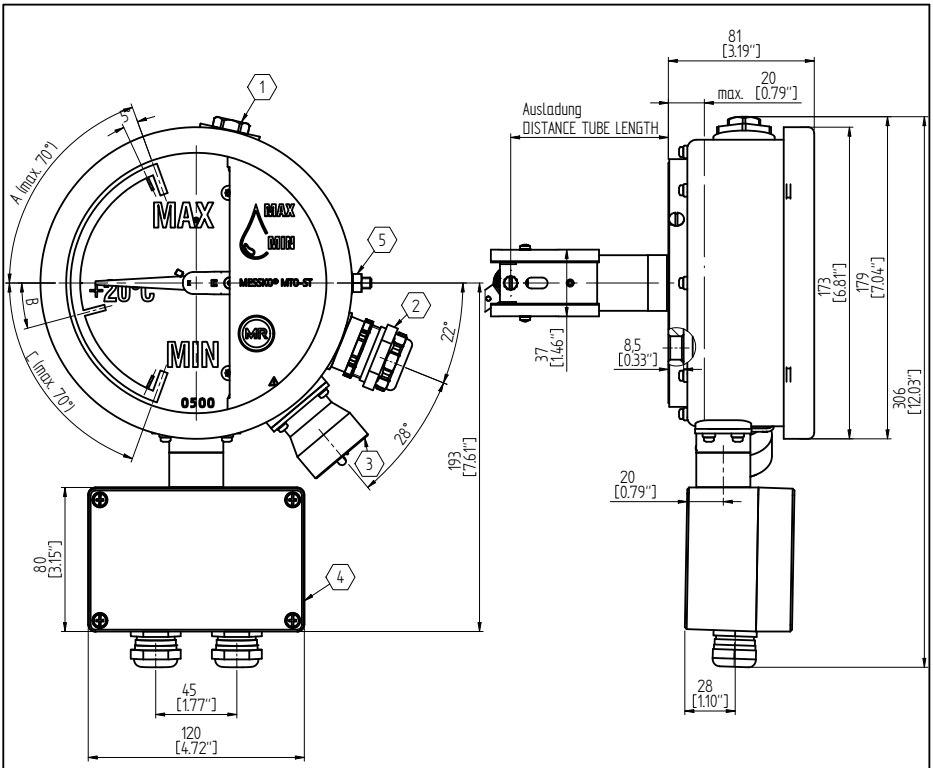
DIMENSION IN mm EXCEPT AS NOTED

TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO-ST/TTMR ANSI
RADIAL DESIGN, TERMINAL BOX

SERIAL NUMBER

MATERIAL NUMBER 101736700M | SHEET 1 / 1

A3



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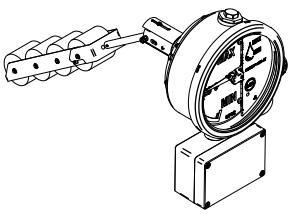


1. Druckausgleichselement / PRESSURE COMPENSATION ELEMENT
2. Kabelverschraubung Modbus / CABLE GLAND MODBUS
3. Steckeranschluss ANSI od. Westinghouse / CONNECTION ANSI OR. WESTINGHOUSE
4. Relais Box / RELAIS BOX
5. Anschluss Masseausgleich / COONECTION MASS BALANCING

	DATE	NAME	DOCUMENT NO.
DFTR.	10.11.2022	REINELT	SED 9150605 000 00
CHKD.	10.11.2022	THIELEK	CHANGE NO. / SCALE
STAND	11.11.2022	WANNINGER	1118584 / 1:2

DIMENSION IN mm EXCEPT AS NOTED

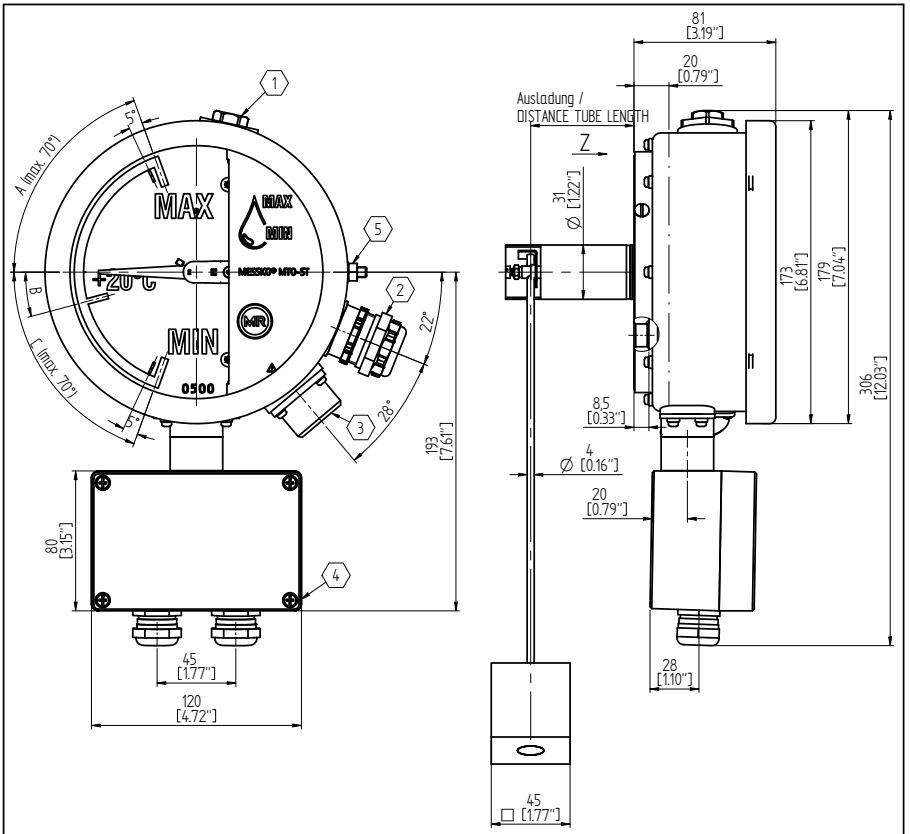
TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO-ST160/TTMR ANSI
AXIAL DESIGN, TERMINAL BOX

SERIAL NUMBER

MATERIAL NUMBER 101736740M

SHEET 1 / 1

A3



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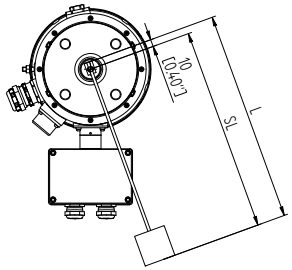
Ansicht / VIEW Z



1. Druckausgleichselement / PRESSURE COMPENSATION ELEMENT
2. Kabelverschraubung Modbus / CABLE GLAND MODBUS
3. Steckeranschluss Mil. od. M /
   CONNECTION MIL. OR. M
4. Relais Box / RELAIS BOX
5. Anschluss Masseausgleich / COONECTION MASS BALANCING

	DATE	NAME	DOCUMENT NO.	
DFTR.	10.11.2022	REHNELT	SED 9150921 000 00	
EHKD.	10.11.2022	THIELEK	CHANGE NO.	SCALE
STAND	11.11.2022	WANNINGER	1118584	1:2

DIMENSION IN mm EXCEPT AS NOTED

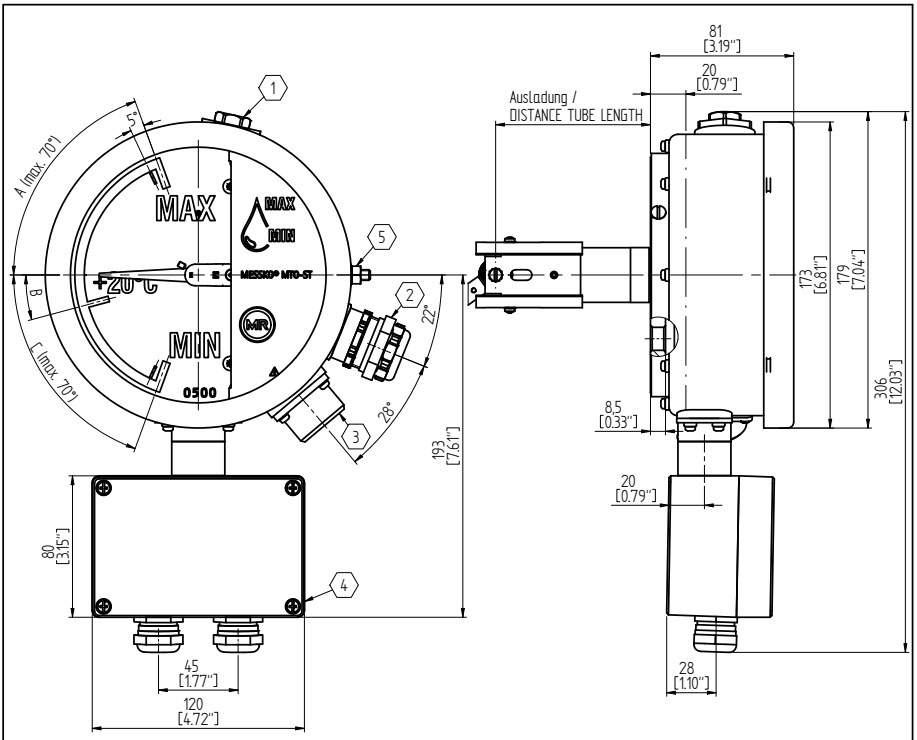
TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO-ST/TTMR Mil od. M Stecker
RADIAL DESIGN, TERMINAL BOX

SERIAL NUMBER

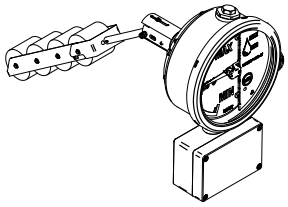
MATERIAL NUMBER 101736790M

SHEET 1 / 1

A3



1:5



1 Druckausgleichselement / PRESSURE COMPENSATION ELEMENT
2 Kabelverschraubung Modbus / CABLE GLAND MODBUS
3 Steckeranschluss MIL. od. M /
CONNECTION MIL. OR. M
4 Relais Box / RELAIS BOX
5 Anschluss Masseausgleich / COONECTION MASS BALANCING

	DATE	NAME	DOCUMENT NO.	
DFTR.	10.11.2022	REHNELT	SED 9151305 000 00	
EHKD.	10.11.2022	THIELEK	CHANGE NO.	SCALE
STAND	11.11.2022	WANNINGER	1118584	12

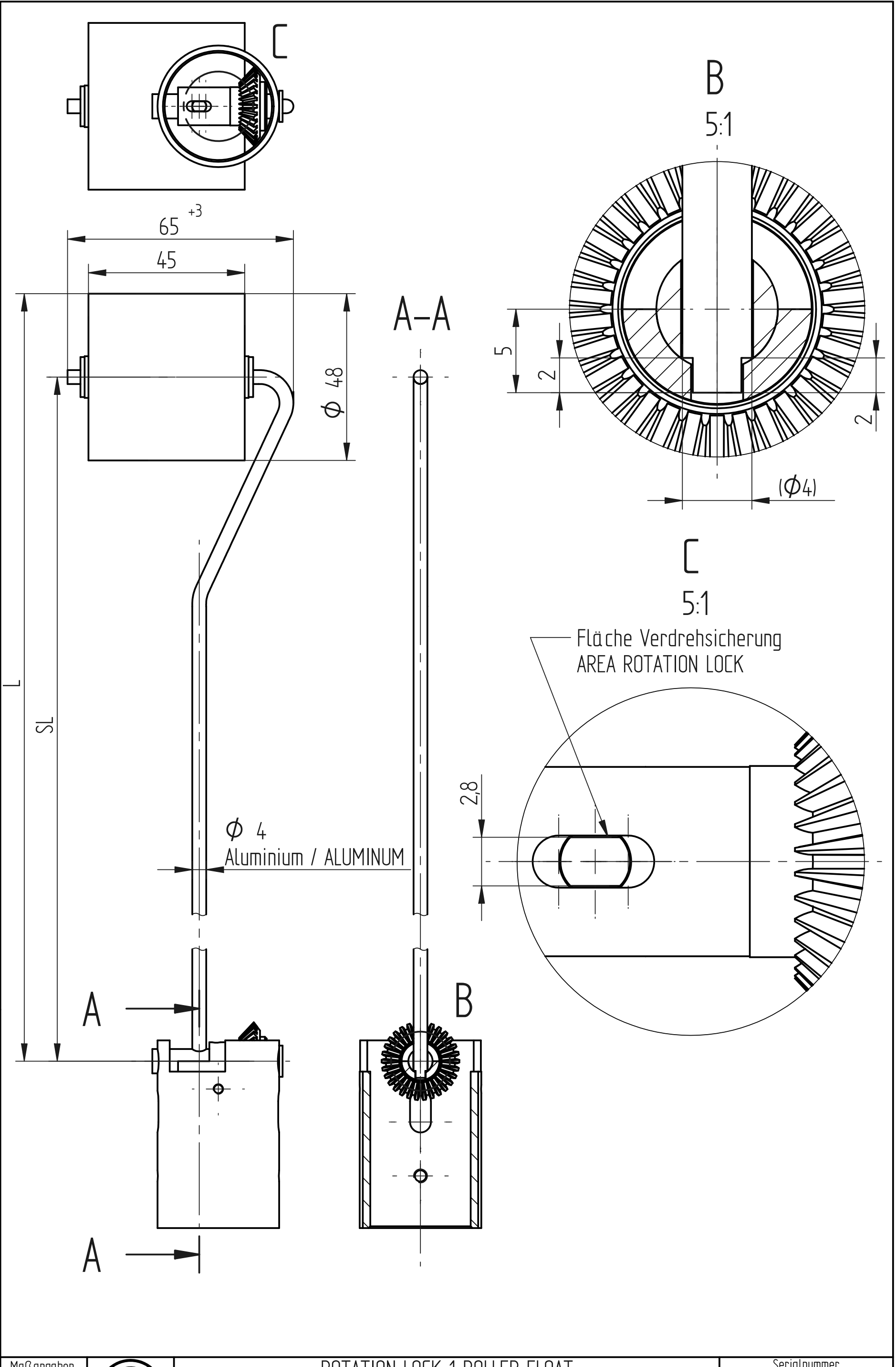
DIMENSION IN mm EXCEPT AS NOTED

TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO-ST160/TTMR MIL.od. M PLUG
AXIAL DESIGN, TERMINAL BOX

SERIAL NUMBER

MATERIAL NUMBER 101736800M | SHEET 1 / 1

A3



	Datum	Name	Dokumentnummer	
Gez.	20.09.2019	REHNELT	SED 7036358 000 00	
			Änderungsnummer	Maßstab
Gepr.	20.09.2019	SCHAEFERB	1096774	1:1
Norm.	20.09.2019	SCHAEFERB		

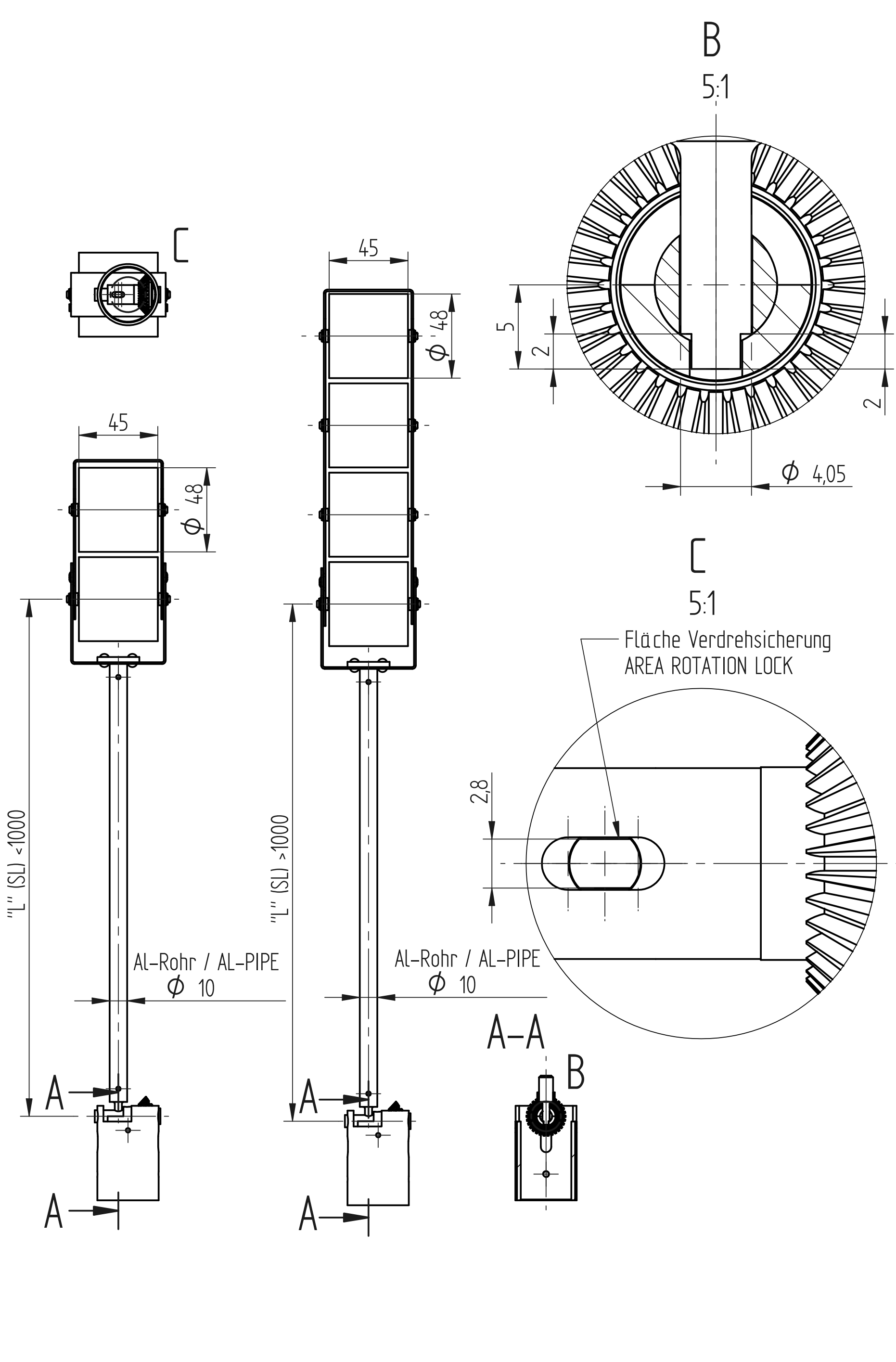
Maßangaben in mm, soweit nicht anders angegeben

MR

ROTATION LOCK 1 ROLLER FLOAT
OIL LEVEL INDICATOR MTO-ST160G(TT)
AXIAL DESIGN

Serialnummer	
–	
Materialnummer	Blatt
101266900M	1/ 1

A3



	Datum	Name	Dokumentnummer	
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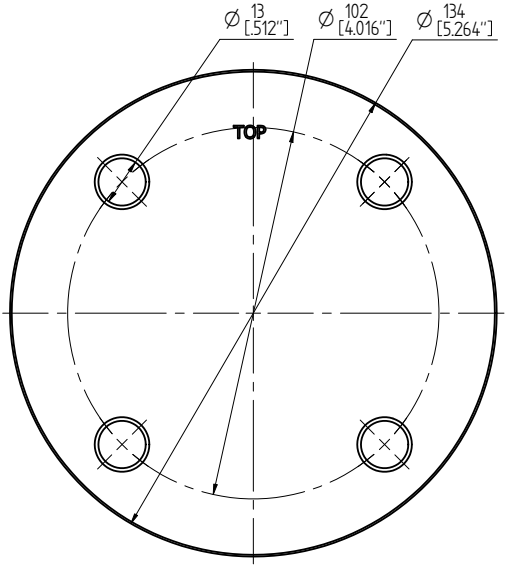
Gepr.	20.09.2019	SCHAEFERB	Änderungsnummer	Maßstab
Norm.	20.09.2019	SCHAEFERB	1096774	1:2

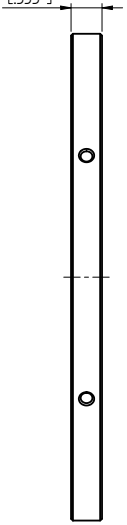
Maßangaben in mm, soweit nicht anders angegeben

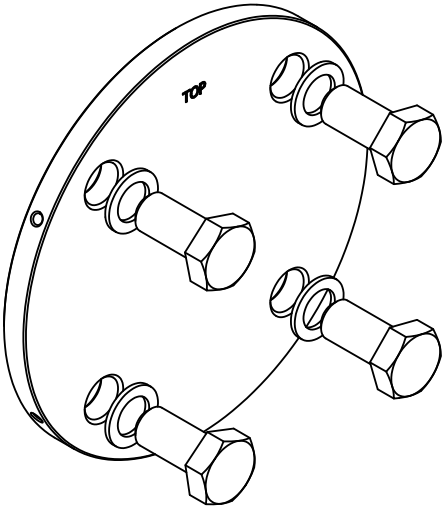
ROTATION LOCK 2 AND 4 ROLLER FLOAT OLI LEVEL INDICATOR MTO-ST160G(TT) AXIAL DESIGN

Serialnummer	
–	
Materialnummer	Blatt
101266890M	1/ 1

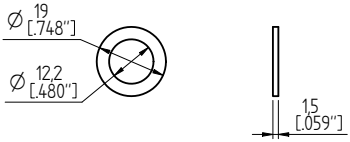
A3



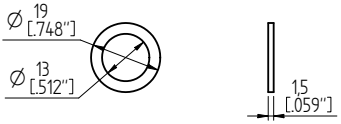




4x Dichtungsscheibe / GASKET M12
Material / MATERIAL:
EN AW – 1200 (Al99) ; H14 ; 32 ... 45 HB
ANSI H35.1 (M)–1200 ; H14 ; 32 ... 45 HB
GB/T 3190–1200 ; H14 ; 32 ... 45 HB



4x Dichtungsscheibe / GASKET 1/2" – 13 UNC
Material / MATERIAL:
EN AW – 1200 (Al99) ; H14 ; 32 ... 45 HB
ANSI H35.1 (M)–1200 ; H14 ; 32 ... 45 HB
GB/T 3190–1200 ; H14 ; 32 ... 45 HB



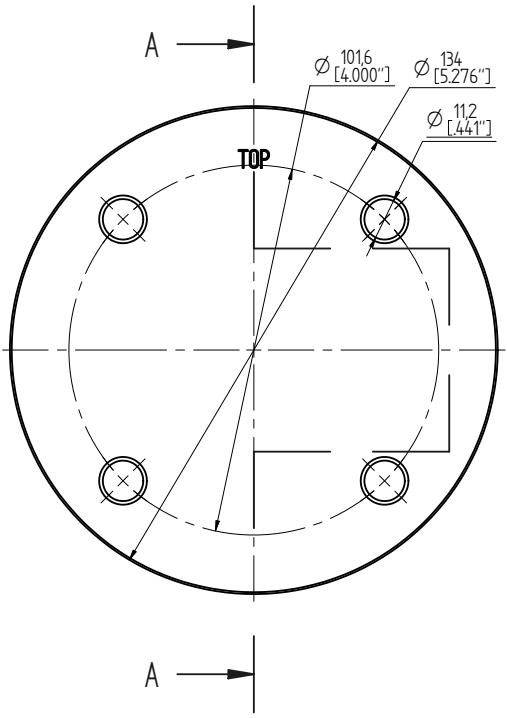
Für Varianten / FOR VARIANTS:
MTO-ST160 ; MTO-ST160TT ; MTO-STF160 ; MTO-STF160TT ; MTO-ST160V ; MTO-ST160VTT ;
MTO-STF160V ; MTO-STF160VTT ; MTO-ST160G ; MTO-ST160GTT ; MTO-STF160G ; MTO-STF160GTT

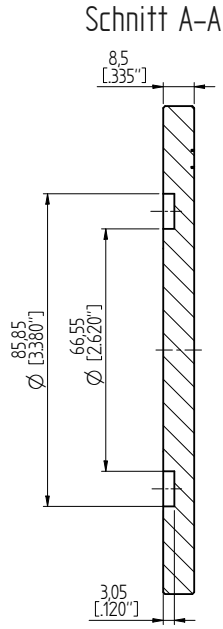
	DATE	NAME	DOCUMENT NO.
DFTR.	-	-	SED 6771687 000 00
EHKD.	-	-	CHANGE NO. / SCALE
STAND.	-	-	1090955 / 1:1

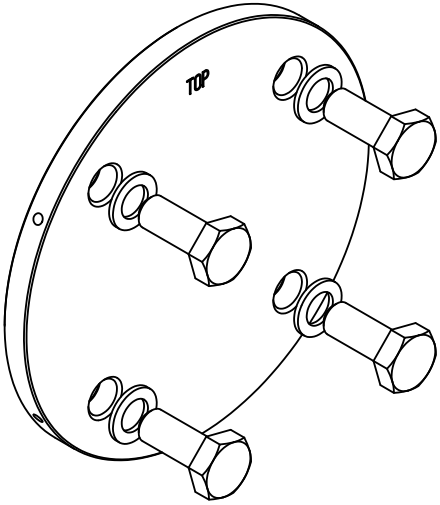
DIMENSION IN mm EXCEPT AS NOTED

TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO
STANDARD FLANGE LK 102

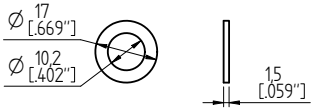
SERIAL NUMBER –
MATERIAL NUMBER 101242570M
SHEET 1 / 1
A3



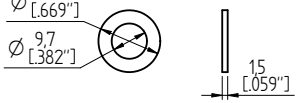




4x Dichtungsscheibe / GASKET M10
Material / MATERIAL:
EN AW – 1200 (Al99) ; H14 ; 32 ... 45 HB
ANSI H35.1 (M)-1200 ; H14 ; 32 ... 45 HB
GB/T 3190-1200 ; H14 ; 32 ... 45 HB



4x Dichtungsscheibe / GASKET 3/8" – 16 UNC
Material / MATERIAL:
EN AW – 1200 (Al99) ; H14 ; 32 ... 45 HB
ANSI H35.1 (M)-1200 ; H14 ; 32 ... 45 HB
GB/T 3190-1200 ; H14 ; 32 ... 45 HB



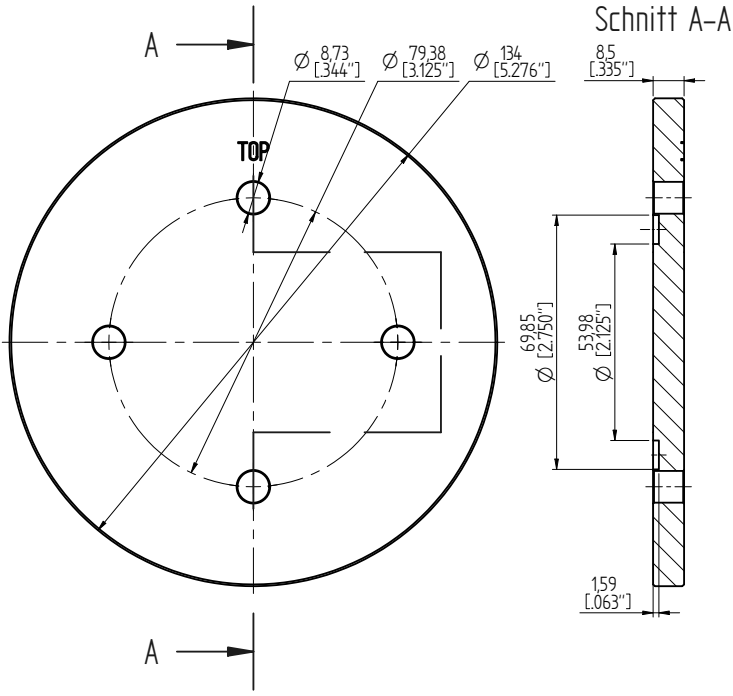
Für Varianten / FOR VARIANTS:
MTO-ST160RM
MTO-ST160RMTT
MTO-ST160GRM
MTO-ST160GRMTT

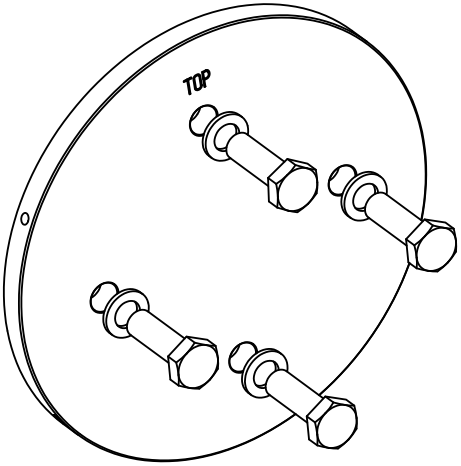
	DATE	NAME	DOCUMENT NO.
DFTR.	-	-	SED 6771692 000 00
EHKD.	-	-	CHANGE NO. / SCALE
STAND.	-	-	1090955 / 1:1

DIMENSION IN mm EXCEPT AS NOTED

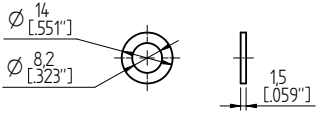
TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO
RM FLANGE LK 101,6

SERIAL NUMBER –
MATERIAL NUMBER 101242580M
SHEET 1 / 1
A3

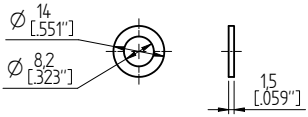




4x Dichtungsscheibe / GASKET M8
Material / MATERIAL:
EN AW – 1200 [Al99] ; H14 ; 32 ... 45 HB
ANSI H35.1 (M)-1200 ; H14 ; 32 ... 45 HB
GB/T 3190-1200 ; H14 ; 32 ... 45 HB



4x Dichtungsscheibe / GASKET 5/16" - 18 UNC
Material / MATERIAL:
EN AW – 1200 [Al99] ; H14 ; 32 ... 45 HB
ANSI H35.1 (M)-1200 ; H14 ; 32 ... 45 HB
GB/T 3190-1200 ; H14 ; 32 ... 45 HB



Für Varianten / FOR VARIANTS:
MTO-ST160RM (NAT/DS)
MTO-ST160RMTT (NAT/DS)
MTO-ST160GRM (NAT/DS)
MTO-ST160GRMTT (NAT/DS)

	DATE	NAME	DOCUMENT NO.	
ÜFTR.	-	-	SED 6771696 000 00	
EHKD.	-	-	CHANGE NO.	SCALE
STAND	-	-	1090955	1:1

DIMENSION IN mm EXCEPT AS NOTED

TRANSFORMER ACCESSORIES
OIL LEVEL INDICATOR MTO
NAT/DS FLANGE LK 79,38

SERIAL NUMBER
-
MATERIAL NUMBER 101242590M
SHEET 1/ 1
A3

Glossary

Ambient air temperature

Permissible temperature of the air in the surroundings of the equipment in operation on which the device is installed.

EMC

Electromagnetic compatibility

Operating temperature

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

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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