



Operating instructions

MESSKO® Retrofit Kit. Pointer thermometer

10584949/01 EN



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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.

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1 Introduction

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

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

1.1 Manufacturer

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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:

- Order confirmation

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).

1. 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
...>...>...	Menu paths	Parameter > Control parameter
<i>Italics</i>	System messages, error messages, signals	<i>Function monitoring alarm triggered</i>
[► Number of pages]	Cross reference	[► Page 41].
<u>Dotted underscore</u>	Glossary entry, abbreviations, definitions, etc.	<u>Glossary entry</u>

Table 2: Typographic conventions used in this technical file

2 Security

Read this technical file through carefully to familiarize yourself with the product. This technical file is a part of the product.

- Read and observe the safety instructions provided in this chapter in particular.
- Observe the warnings in this technical file to avoid function-related dangers.

The product is manufactured based on state-of-the-art technology. Nevertheless, danger to life and limb for the user or impairment of the product and other material assets may arise in the event of improper use.

2.1 Appropriate use

The pointer thermometer measures the temperature in transformers, shunt reactors and similar equipment.

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.
- Operate the product in electrical energy systems and facilities.

- Only operate the product in industrial areas.
- Observe the notices in this technical document regarding electromagnetic compatibility and the technical data.

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 a repair is not carried out by our Technical Service department, please ensure that the personnel who carry out the maintenance are trained and authorized by Maschinenfabrik Reinhausen GmbH to carry out the work.

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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 Product description

3.1 Scope of delivery

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

- Pointer thermometer with temperature sensor
- Multifunctional mounting plate
- Installation kit for mounting plate
- Set of various adapter sleeves
- Cover plate for oil temperature and winding temperature
- Technical documents

Optional:

- 1/2"-14NPT screw connection
- 3/4"-14NPT screw connection
- ANSI plug
- Passive 4...20 mA analog output

Please note the following:

- Check the shipment for completeness on the basis of the shipping documents.
- Store the parts in a dry place until installation
- The product must remain in its airtight, protective wrapping and may only be removed immediately before installation

3.2 Function description

Depending on the version, the pointer thermometer measures the oil temperature in power transformers, distribution transformers or reactors. When using an external device to determine a thermal image, the thermometer can also be used to display the winding temperature. The cover plate can be changed so that the print on the cover corresponds to the displayed temperature (oil temperature or winding temperature).

The sensor of the pointer thermometer is located in the thermometer pocket mounted in the transformer tank. The measured value is displayed directly on the pointer thermometer or, as an option, on an analog or digital display using a signal converter.

The Retrofit Kit is for replacing older pointer thermometers. The mounting position of the temperature sensor can be adjusted. The sensor diameter can be adapted with various adapter sleeves. The multifunctional mounting plate can be affixed in various ways.

3.3 Design

3.3.1 Pointer thermometer with ANSI plug

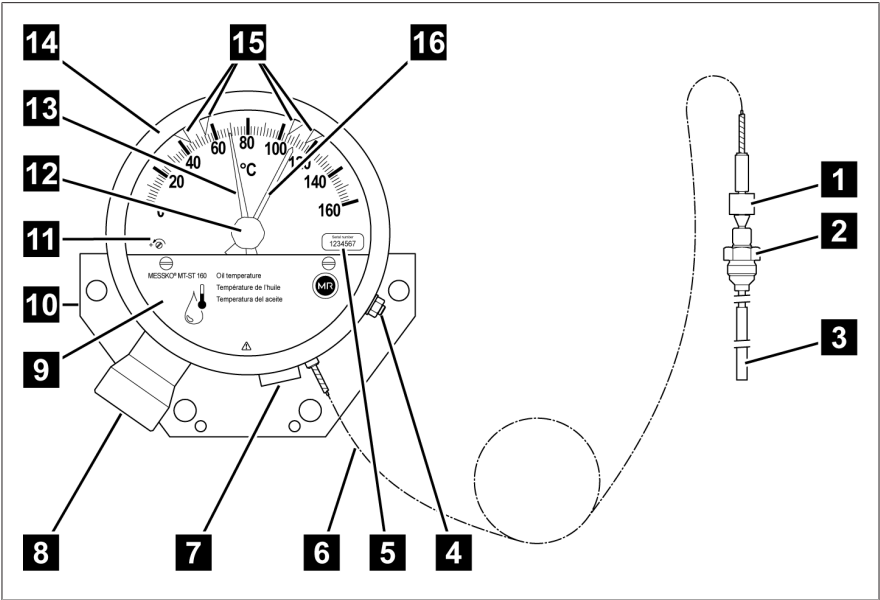


Figure 1: Pointer thermometer

1	Pressure screw	2	Fixing screw
3	Temperature sensor	4	Ground connection

5	Label with serial number	6	Capillary line
7	NPT adapter ¹⁾	8	ANSI plug
9	Cover plate	10	Mounting plate
11	Adjustment screw ²⁾	12	Drag hand reset button
13	Pointer	14	Bayonet seal ring
15	Micro-switches	16	Drag hands

1) optional, only type TT

2) The pointer thermometer is calibrated at the factory. Do not adjust the adjustment screw, or else the device's warranty will become void!

If the device also has a 4...20 mA output (type TT), the signal will be output via a 1/2" 14NPT adapter **7**.

3.3.2 Pointer thermometer with 3/4" 14NPT adapters

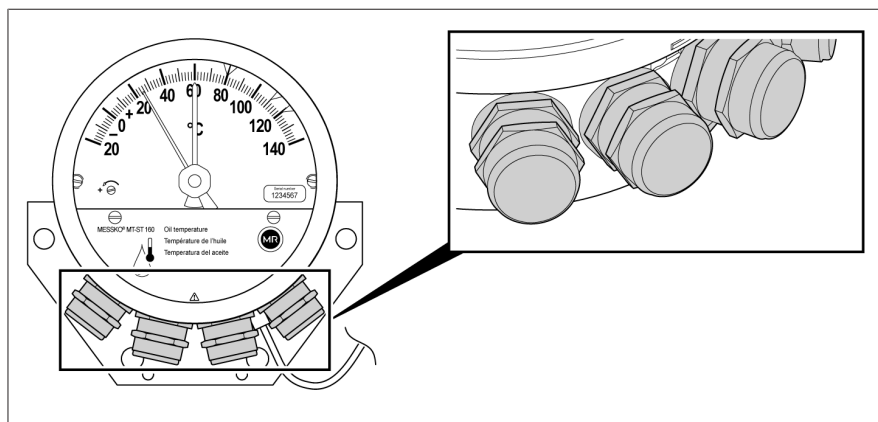


Figure 2: 3/4" 14NPT adapters

3.3.3 Ventilation

The pointer thermometer features ventilation to prevent the formation of condensate.

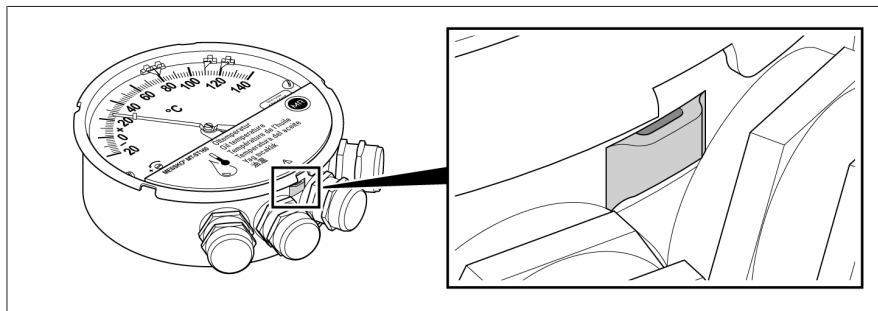


Figure 3: Ventilation

3.4 Device versions

The pointer thermometer is available in 2 device versions. Both versions are available with plug connection or with four 3/4" 14NPT adapters.

MT-ST160R

This pointer thermometer is equipped with four adjustable micro-switches as standard. The mechanical measurement system functions independently and without a power source.

MT-ST160R/TT

The pointer thermometer transmits the measured temperature via a passive 4...20 mA analog output. The sensor requires a 12...30 V DC supply voltage.

Device versions overview

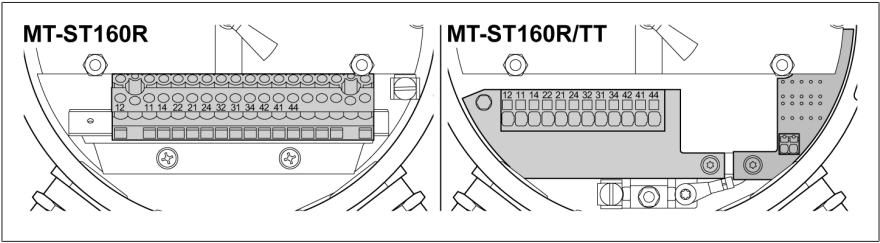


Figure 4: Device versions overview

MT-ST160R	Version without analog output with screw terminals
MT-ST160R/TT	Version with analog output with push-in terminals

Use for oil temperature

- Use the cover plate for displaying the oil temperature.
- The temperature displayed is that of the oil temperature at the temperature sensor of the pointer thermometer.

Use for winding temperature

- Use the cover plate for displaying the winding temperature.
- The temperature transition between the insulating fluid and winding depends, among other things, on the current in the transformer winding, which is transmitted via a current transformer.

3.5 Safety markings

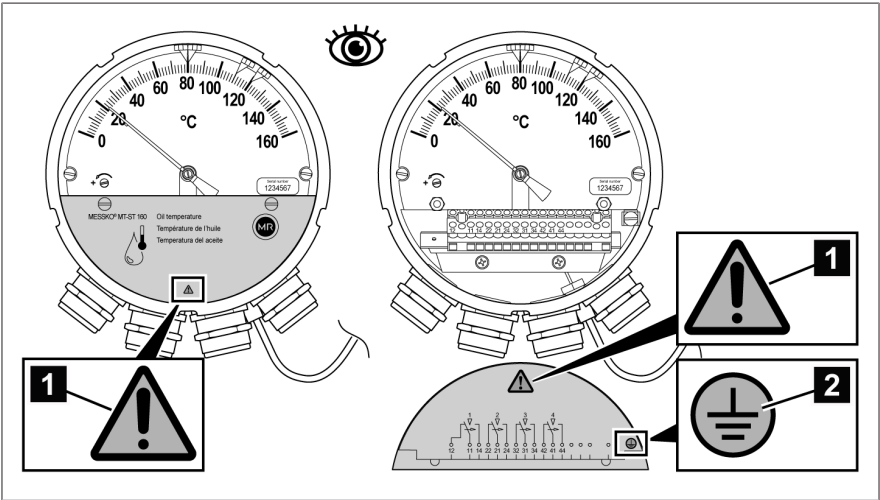


Figure 5: MT-ST retrofit safety markings

1	Observe the documentation	2	Protective conductor connection
---	---------------------------	---	---------------------------------

Additional safety marking for the version with plug connection

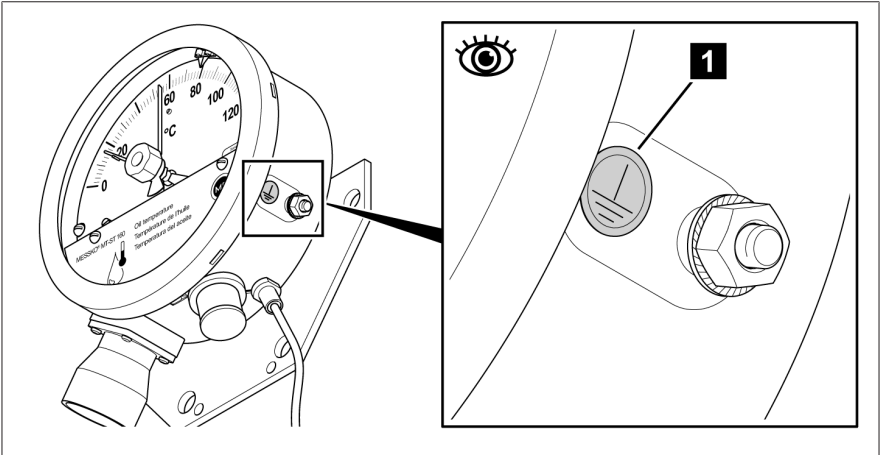


Figure 6: Additional safety marking for plug connection

1	Protective conductor connection
---	---------------------------------

3.6 Nameplate

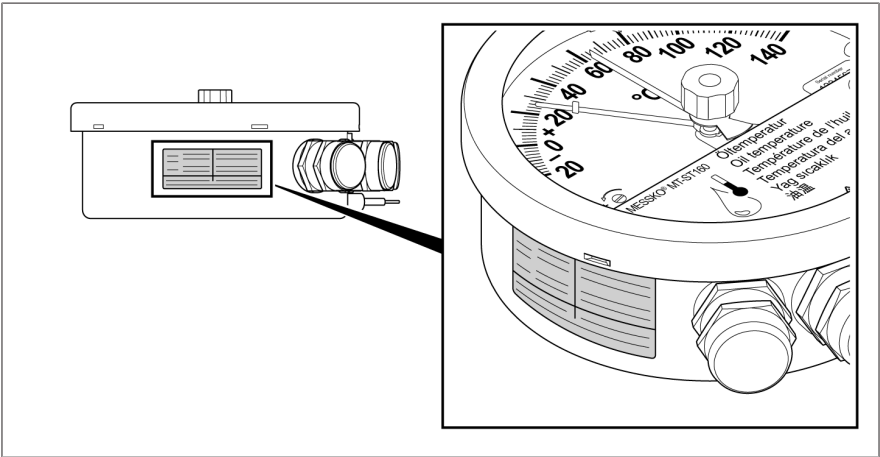


Figure 7: Nameplate

4 Packaging, transport and storage

4.1 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.

4.2 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.

4.3 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

4.4 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.

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.

4.5 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.

4.6 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.

5 Installation and commissioning

This chapter describes how to mount and connect the device correctly. Observe the following hazard notices prior to opening the device:

⚠ DANGER



Electric shock!

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

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

⚠ CAUTION



Risk of injury and damage to the device

The measurement system is hermetically sealed. If you cut the capillary line, harmful liquid can escape and the measurement system will be destroyed.

- Never cut the capillary line.
- Do not damage the capillary lines or sensors.

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.

NOTICE

Damage to the device!

If you kink the capillary line or carry the device by the capillary line, the device can become damaged and display incorrect measured values as a result.

- Carefully remove the device from the packaging.
- Never carry the device by the capillary line.
- Do not damage the capillary line and sensor.
- Unroll the capillary line without bending or kinking it.
- Observe the minimum bending radius of 50 mm.

5.1 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 4.6, Page 26].

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.

5.2 Checking measured temperature values

Before attaching the pointer thermometer, you can check the accuracy of the display with a reference measurement. The pointer thermometer is calibrated at the factory.

- ✓ Only perform a reference measurement in moving liquid baths. We recommend using the Messko® MZT1650S calibration bath.
- ✓ The temperature of the liquid bath must remain constant for 15 minutes.

- ✓ Use an additional, calibrated glass thermometer to perform the reference measurement.
1. Immerse the temperature sensor of the pointer thermometer and a calibrated glass thermometer in the liquid bath for approx. 15 minutes.
 2. Compare the measured temperature values of the pointer thermometer and glass thermometer with each other.
 - » If the measured temperature values deviate from each other significantly (maximum permitted deviation $\pm 3\text{ }^{\circ}\text{C}$), contact the service department of Maschinenfabrik Reinhausen GmbH [► Section 2.3, Page 13].

5.3 Mounting the pointer thermometer

5.3.1 Attaching the pointer thermometer to the transformer

When attaching the thermometer to the transformer, note the following information:

- Ensure that the pointer thermometer is mounted vertically.

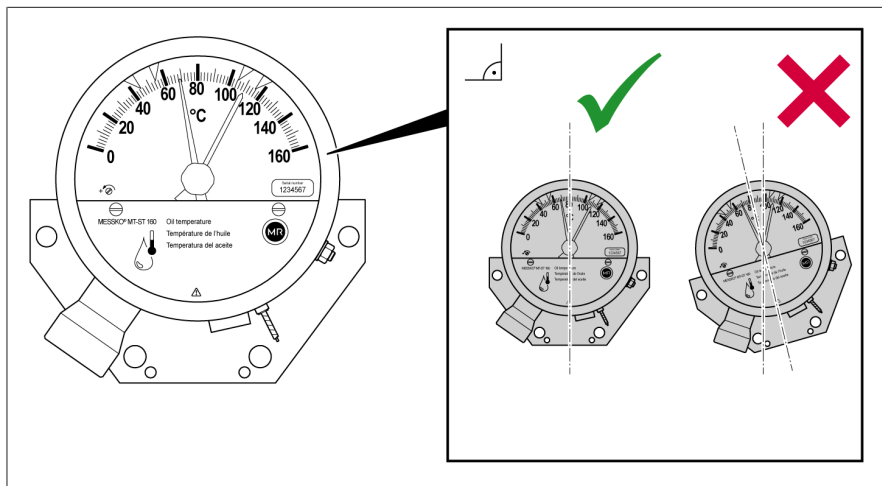


Figure 8: Mounting position

- Ensure that the pointer thermometer is not subjected to any vibrations at the installation location.
- Comply with EMC standards [► Section 5.4.1.1, Page 40].
- Observe the dimensions in the chapter "Drawings" [► Section 11, Page 74].

You can use the following screws to attach the pointer thermometer:

- M12 hexagon screws or cylinder screws (as an alternative, also 7/16-14 UNC).
- Use a screw length that is appropriate based on the installation situation.

To attach the pointer thermometer to the transformer, proceed as follows:

1. Drill 4 holes into a suitable bracket on the outside of the transformer, on the control cabinet mounting plate or on another suitable structure in accordance with the following drawing.

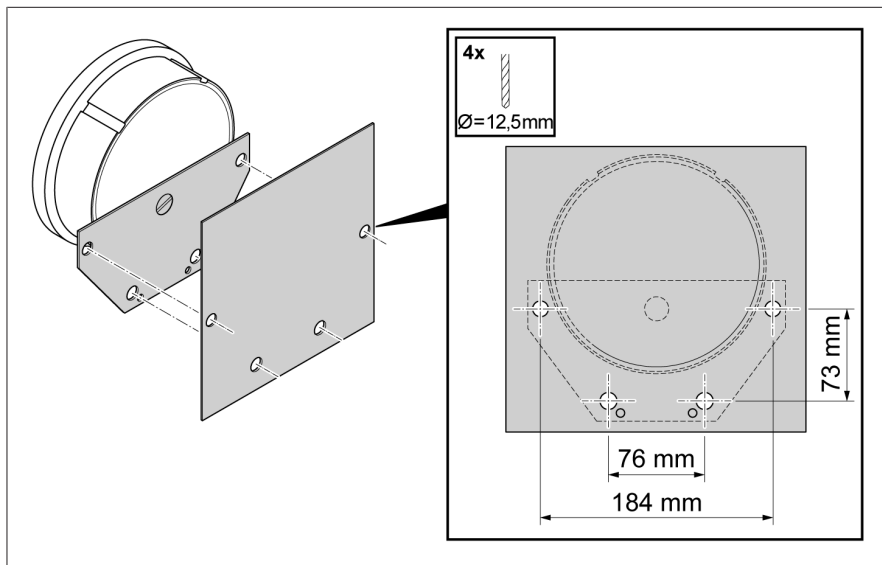


Figure 9: Drill holes

2. Attach the pointer thermometer with mounting plate on the bracket.

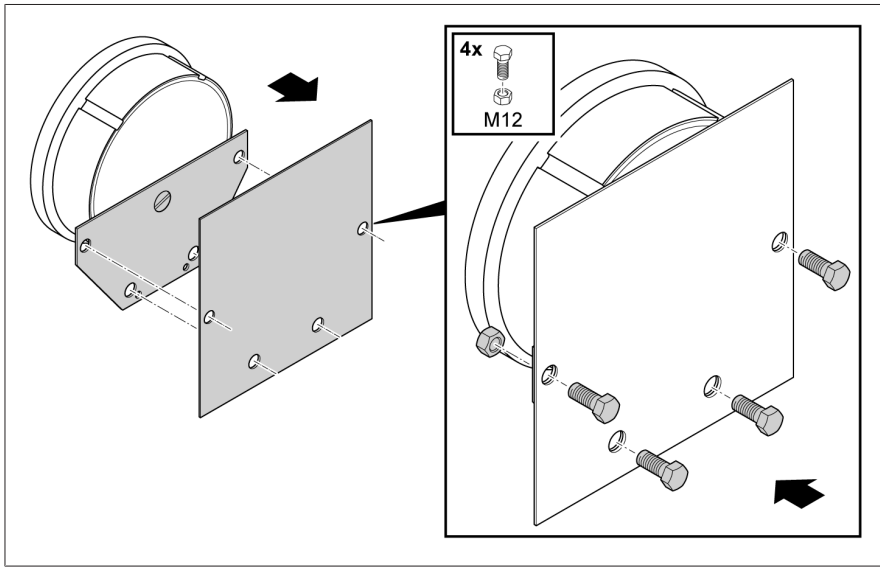


Figure 10: Attaching the pointer thermometer

5.3.2 Securing the capillary line

When securing the capillary line, note the following information:

NOTICE

Damage to the device!

A capillary line bending radius that is too narrow or damage to the capillary line can lead to a loss of device function.

- Ensure compliance with the minimum bending radius of 50 mm (1.97").
- Attach the capillary line to the transformer so that it cannot be damaged during transport or operation due to factors such as impact, scuffing, pressure, vibrations or crushing.

Proceed as follows:

1. Route the capillary line to the transformer and secure it with cable ties.
2. Wind up any excess capillary line with a minimum winding diameter of 80 mm (3.15").

5.3.3 Inserting the temperature sensor into the thermometer pocket

By using the included adapter sleeves, the sensor diameter can be adjusted to the inner diameter of the thermometer pocket.

Observe the dimensions of the individual adapter sleeves in the chapter Technical data.

To insert the temperature sensor into the thermometer pocket, proceed as follows:

1. Fill 2/3 of the thermometer pocket of the transformer with oil or heat-conducting paste.

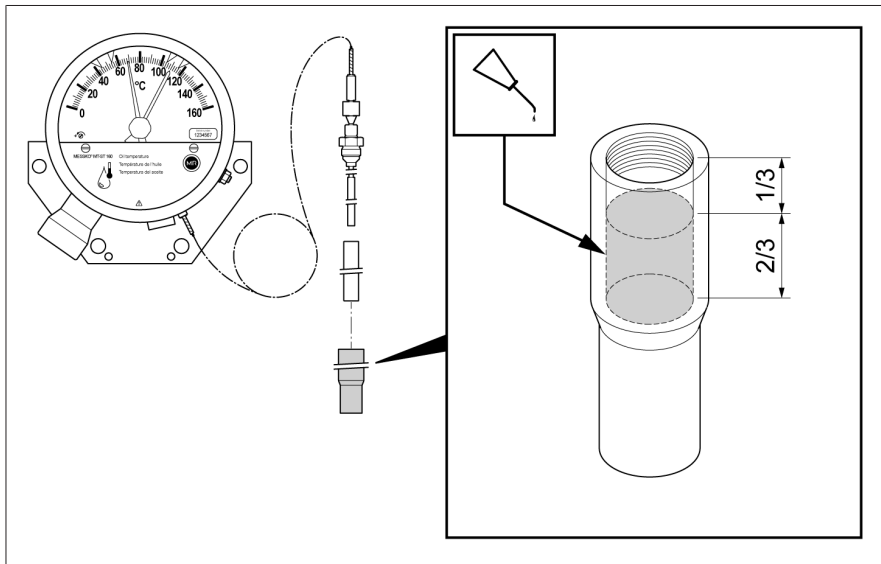


Figure 11: Filling the thermometer pocket

2. Insert the temperature sensor into the adapter sleeve up to the stop.

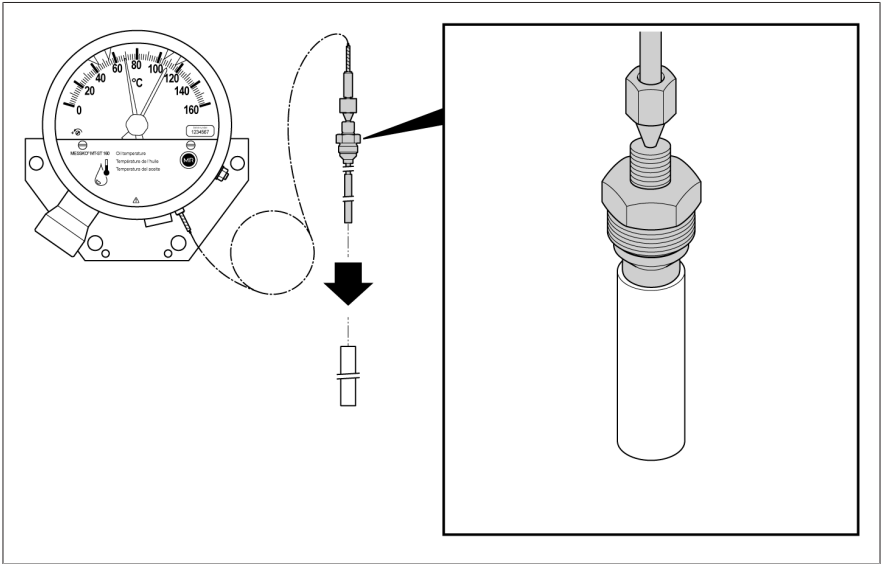


Figure 12: Inserting the temperature sensor into the adapter sleeve

3. Insert the temperature sensor with adapter sleeve into the thermometer pocket up to the stop and secure via the fixing screw.

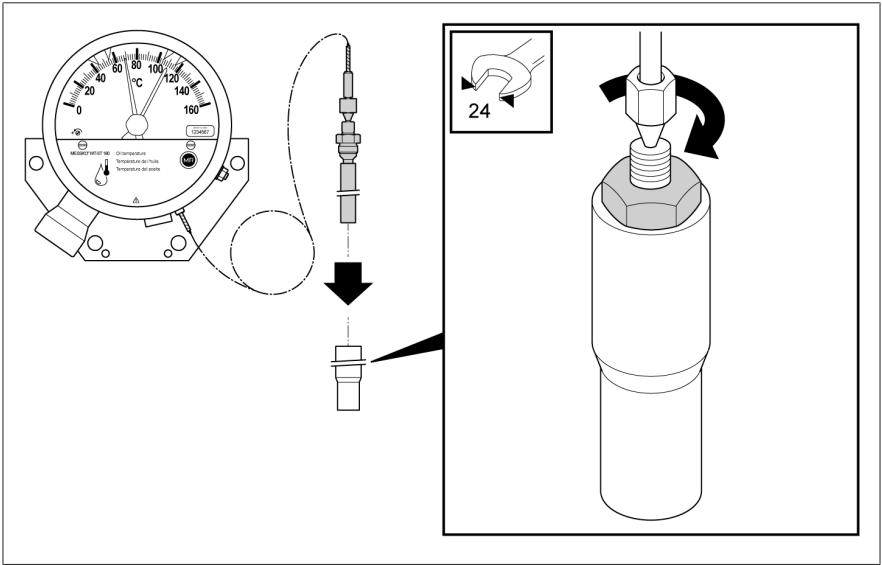


Figure 13: Inserting the temperature sensor with adapter sleeve

4. Tighten the temperature sensor via the pressure screw so that it cannot slip back out of the thermometer pocket. **NOTICE!** If the temperature sensor is angled after installation, it can be damaged. The bend radius must not be less than 50 mm.

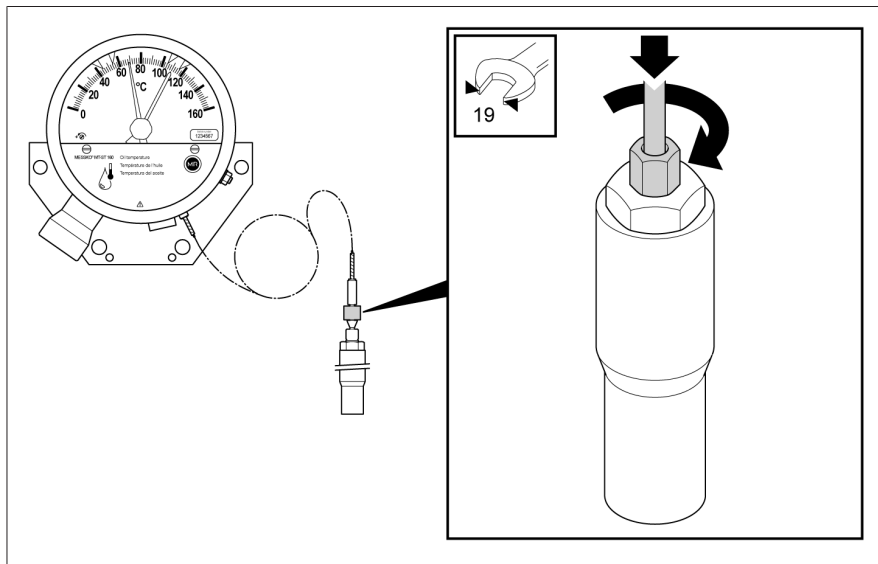


Figure 14: Attaching the temperature sensor

5.3.4 Changing the cover plate

You can change the cover plate so that the print on the cover corresponds to the displayed temperature – the oil temperature or winding temperature.

1. Loosen the screws.

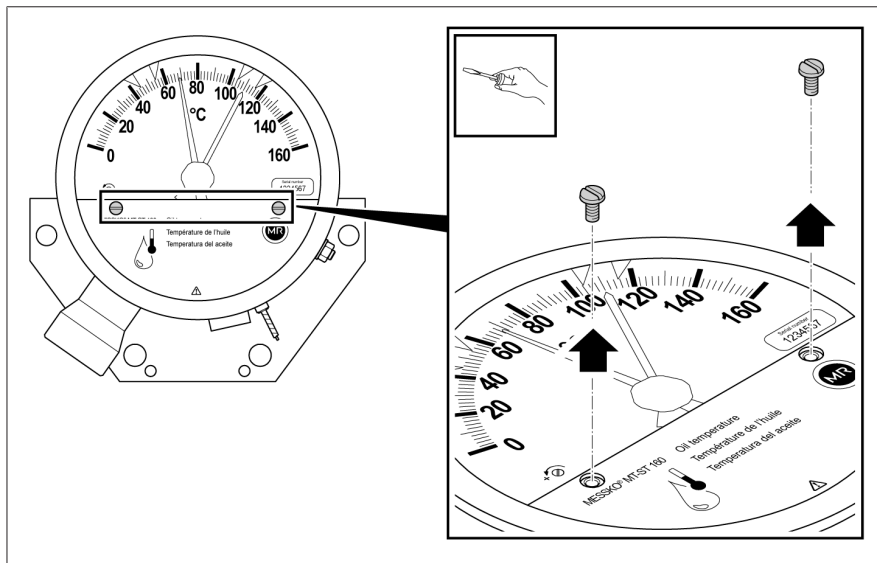


Figure 15: Loosening the screws

2. Change the cover plate.

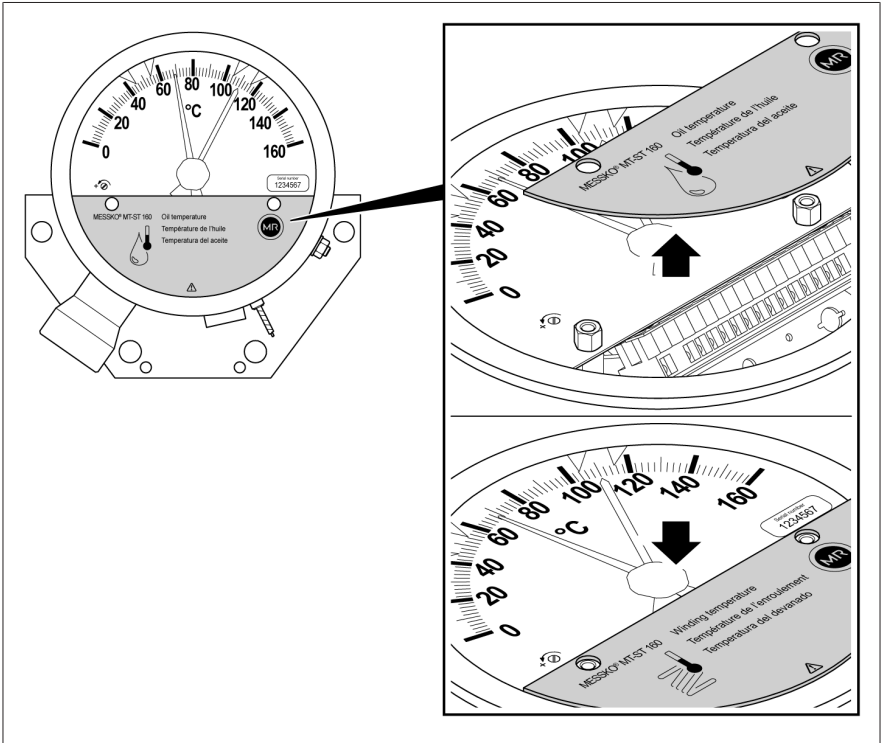


Figure 16: Changing the cover plate

3. Secure the screws.

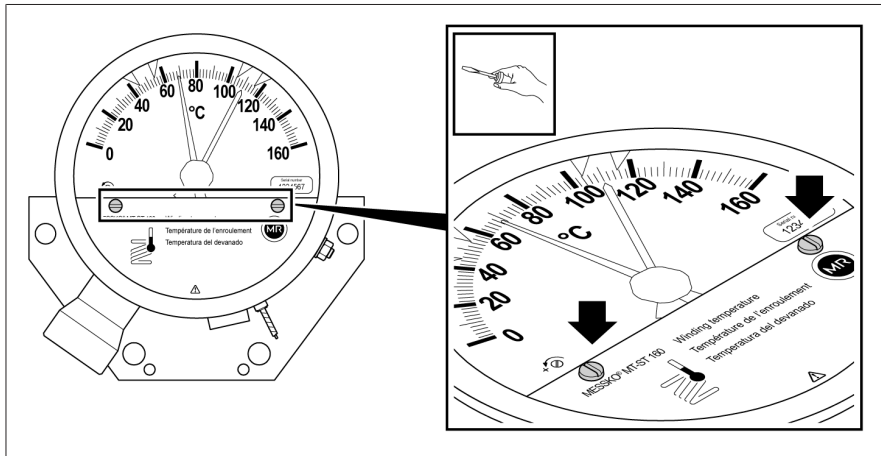


Figure 17: Securing the screws

5.4 Electrical connection

⚠ DANGER



Electric shock!

Danger of death due to electrical voltage when assembling/dis-assembling 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.

⚠ DANGER



Electric shock

Risk of fatal injury due to lack of protective conductor connection.

- Always connect the protective conductor connection before connecting any potentially dangerous circuits.

⚠ 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.

5.4.1 Preparation

Observe the following information for the electrical connection.

5.4.1.1 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.

5.4.1.1.1 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.

5.4.1.1.2 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.
- Never connect the device with a multi-wire collective pipe.
- Use shielded cables for signal transmission.

5.4.1.2 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 with a 6 A miniature circuit breaker with triggering characteristic C.

Conductor cross-section

For all mains circuits, you must use a conductor cross-section that is appropriate for the miniature circuit breaker you have selected.

5.4.1.3 Cable recommendation

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

- The connection cables used must have a temperature resistance of at least +105 °C (ambient temperature max. +80 °C plus intrinsic device heating of +25 K).
- The cables used must be flame-resistant in accordance with IEC 60332-1-2 or UL 2556 VW-1.
- It must be possible to apply a nominal voltage of at least 300 V to all above-listed connection cables. Rigid and flexible cables can be used.
- 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.
- 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 that have a dangerous contact voltage with a cable tie.
 - In the same way, secure wire bundles that have an extra-low voltage with a cable tie.
- Devices with a plug connection may be connected via the device plug to either only extra-low-voltage circuits or only low-voltage circuits.


Cable	Terminals	Cross section
PE protective conductor connection		≥ all other conductors
Micro-switches	12, 11, 14; 22, 21, 24; 32, 31, 34; 42, 41, 44	1.5...2.5 mm ² /16...12 AWG
Analog output	(+), (-)	1.5...2.5 mm ² /16...12 AWG

Table 5: Recommendation for connection cable (standard connections)

5.4.2 Removing the bayonet seal ring

Before connecting, setting or testing the pointer thermometer, the bayonet seal ring must be removed.

- Turn the bayonet seal ring counter-clockwise to the stop.

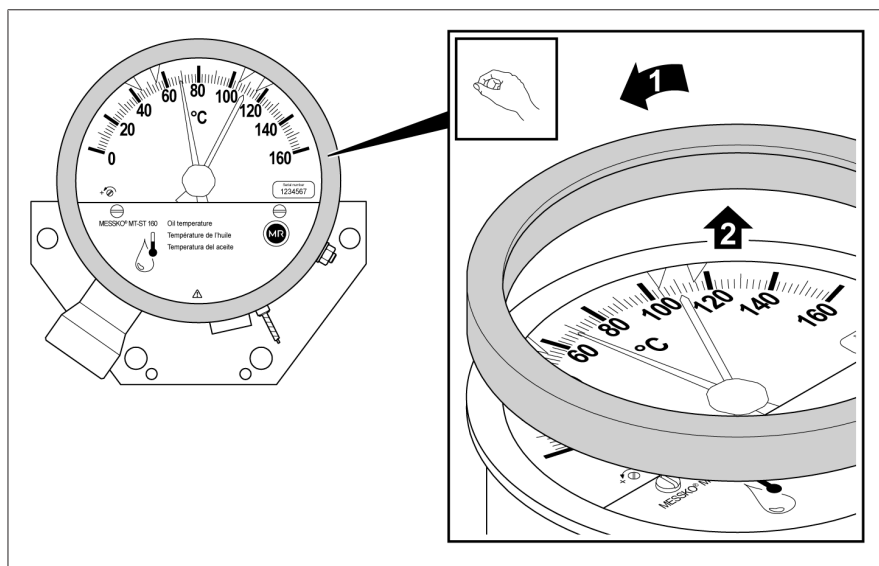


Figure 18: Removing the bayonet seal ring

- Lift off the bayonet seal ring along with the viewing glass and rubber gasket and place them safely on a clean, even storage surface.

5.4.3 Removing the cover plate

1. Loosen the screws.

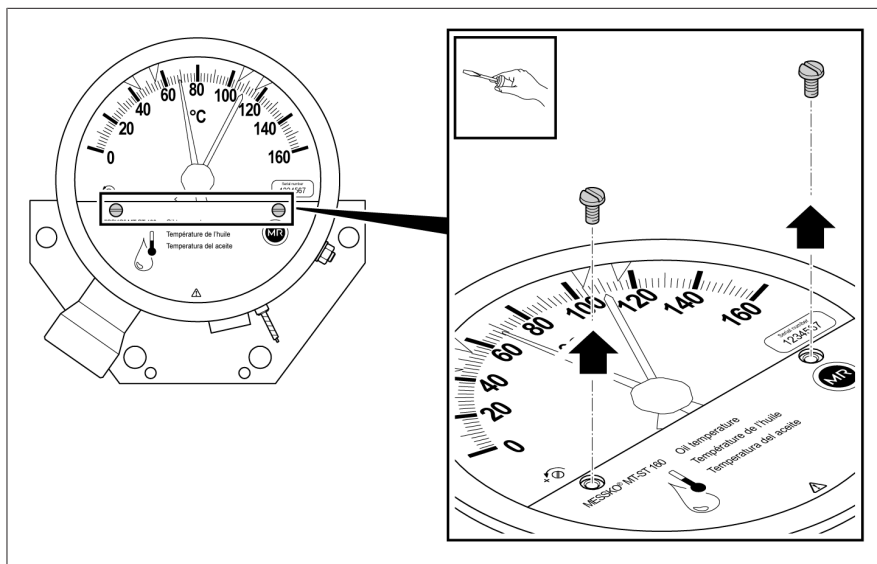


Figure 19: Loosening the screws

2. Remove the cover plate.

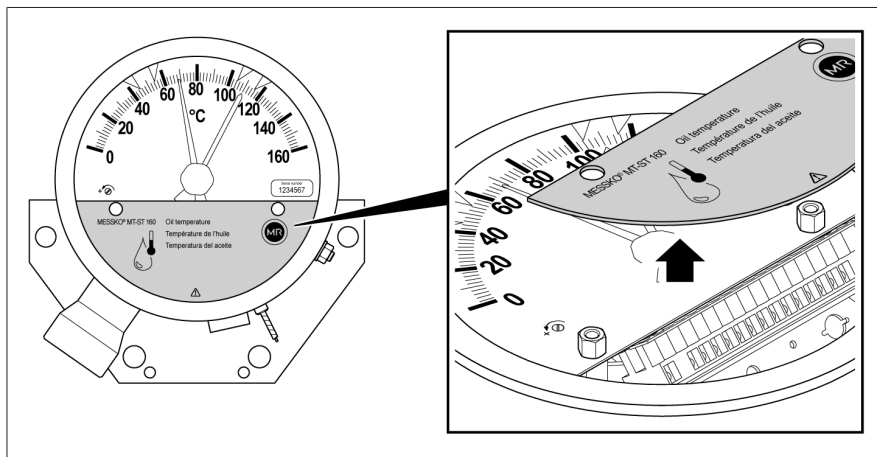


Figure 20: Removing the cover plate

5.4.4 Connections – MS-ST160R(/TT) with ANSI plug

1. Note cable recommendation.
2. Route the connection cables without tension and attach them so that neither the device nor the cable gland is subjected to mechanical stress.

Connecting the protective conductor

⚠ DANGER



Electric shock

Risk of fatal injury due to lack of protective conductor connection.

- Always connect the protective conductor connection before connecting any potentially dangerous circuits.
1. Strip a sufficient length (approx. 8 mm, 0.32") of the protective conductor (PE) and fit with a ring cable lug.
 2. Connect the pointer thermometer with protective conductor to the grounding point of the transformer via the PE connecting bolt attached to the housing. Check the electrical contact of the protective conductor connection.

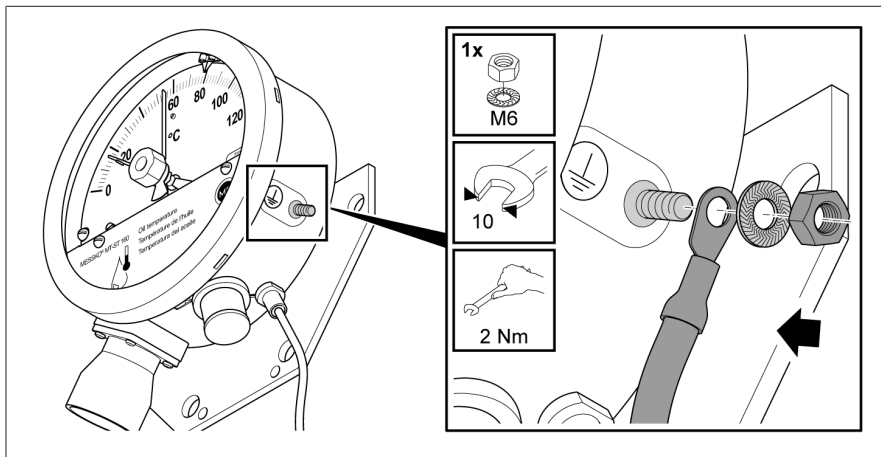


Figure 21: Connecting the protective conductor on the outside

3. Ensure that the protective conductor connection is corrosion-resistant.

Connecting the micro-switches using the ANSI plug

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Devices with a plug connection may be connected via the device plug to either only extra-low-voltage circuits or only low-voltage circuits.

To connect the micro-switches, proceed as follows:

1. **NOTICE!** Damage to cables and conductors! When installing the ANSI plug connector on the ANSI plug, the cable can twist. Twisting can cause cable breaks. Push the plug connector onto the device plug, hold the cable and turn the threaded cap clockwise to the stop. The cable may not rotate while this is happening.

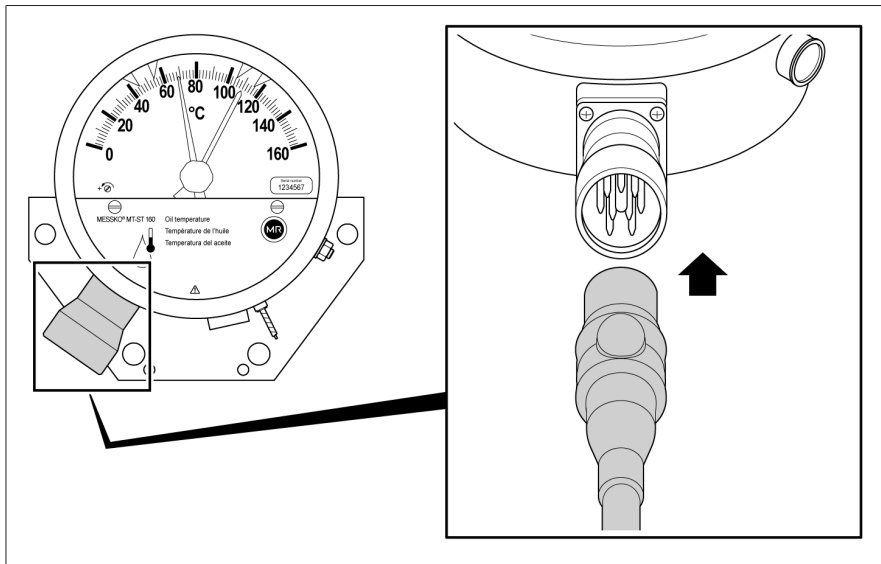
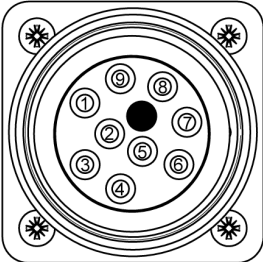


Figure 22: ANSI plug connection

2. **NOTICE!** Interruption of the plug connection! If the connection cable is not routed and secured sufficiently, the plug connector can be ripped out of the housing plug. Secure the connection cable sufficiently and make sure that the plug connector is not under tension.

3. Connect the wires at the free end of the connection cable in the control cabinet in accordance with the supplied connection diagram.



1	Black	2	Red
3	Blue	4	Orange
5	Yellow	6	Brown
7	Red/black	8	Blue/black
9	Orange/black		

Connecting the passive 4...20 mA analog output (type TT)

- Strip the cable to a suitable length.
- Strip a length of approx. 8 mm (0.32") of insulation from the wires.
- With flexible conductors, use ferrules for the wires.
- Remove the locking cap from the 1/2" 14NPT adapter.
- Route a sufficient length of the cable through a cable hose or cable conduit with a 1/2" 14NPT external thread.

6. Route the cable into the device through the 1/2" 14NPT adapter and attach to the terminal "4...20 mA (+/-)".

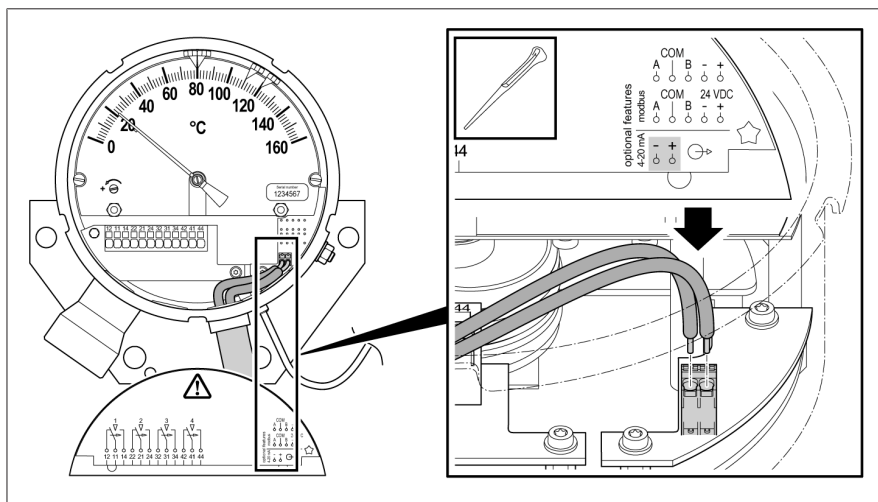


Figure 23: Analog output connection, plug version

7. Screw a cable conduit or cable tube with an external thread of 1/2" 14NPT into the adapter correctly and tightly.
8. On the other cable end, connect an evaluation unit with driving output (18...30 VDC) or, if necessary, an additional power supply (24 VDC).

5.4.5 Connections – MS-ST160R with 3/4" 14NPT adapters

1. Note cable recommendation.
2. Route the connection cables without tension and attach them so that neither the device nor the cable gland is subjected to mechanical stress.
3. Remove the locking caps on the 3/4" 14NPT adapters.
4. Hold the adapter with an open-end wrench.

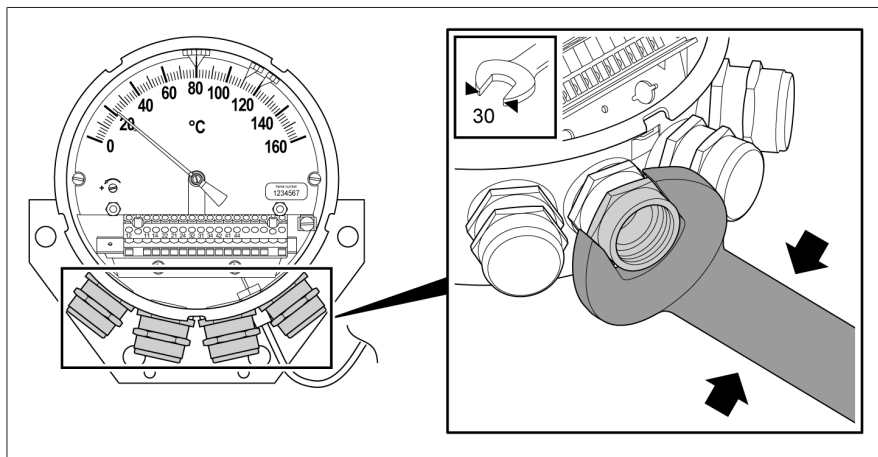


Figure 24: Holding the adapter with an open-end wrench

5. Screw a cable conduit or cable tube with an external thread of 3/4" 14NPT into the adapter correctly and tightly. Feed through a sufficient length of cable.

Connecting the protective conductor

DANGER



Electric shock

Risk of fatal injury due to lack of protective conductor connection.

- Always connect the protective conductor connection before connecting any potentially dangerous circuits.

1. Equip the protective conductor (PE) with a forked cable shoe or ferrule and secure it to the protective conductor screw of the pointer thermometer.

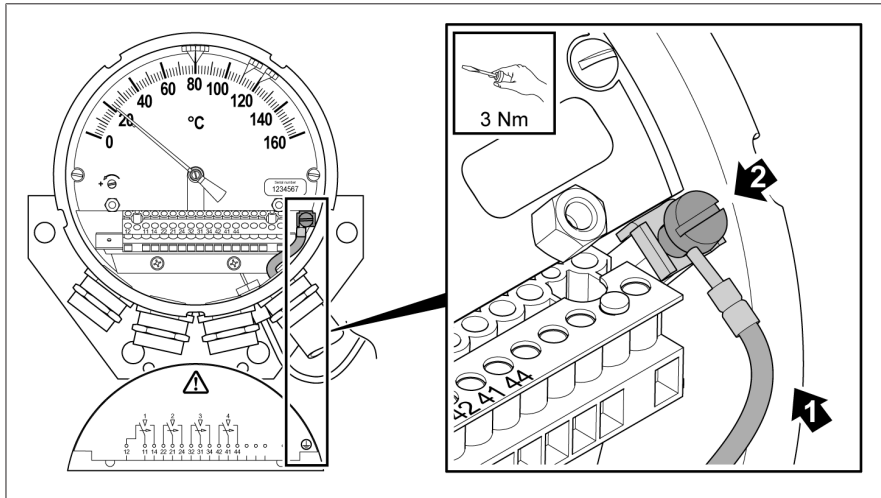


Figure 25: Protective conductor connection

Preparing the micro-switch cables

1. Strip the cable to a suitable length.
2. Strip a length of 6 mm (0.24") of insulation from the wires.
3. Use ferrules for flexible lines (with a collar of max. 0.75 mm²).

Connecting the micro-switches

1. Connect the wires to the terminal strip in accordance with the connection diagram.

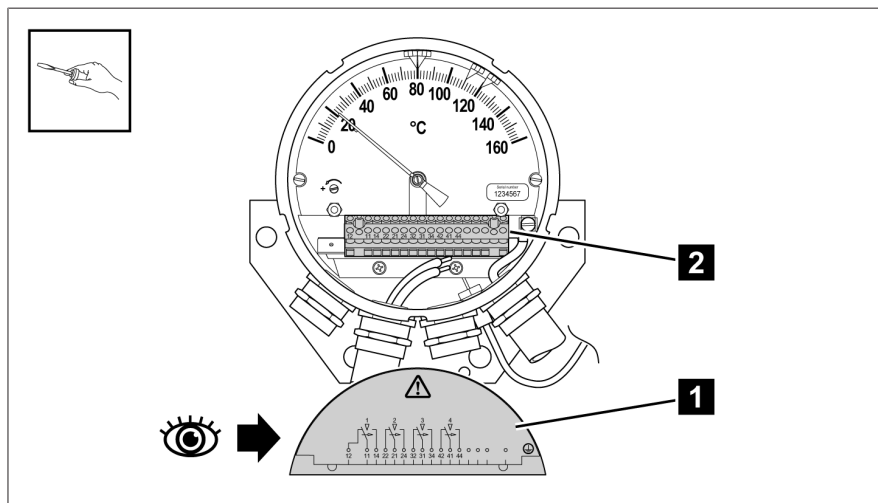


Figure 26: Screw terminals and connection diagram

1	Connection diagram	2	Terminal strip
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Closing off open NPT adapters

NOTICE

Damage to the device!

The supplied locking screws are intended to protect the device from moisture and the like during transport. If you do not use any locking screws or if you use the wrong ones, the IP55 degree of protection and the necessary flame protection cannot be guaranteed.

Metal locking screws are available as accessories.

- Seal unneeded cable glands/NPT adaptors with suitable locking screws and gaskets to ensure the IP55 degree of protection and the flame protection.

1. Remove unneeded M25 to 3/4" 14NPT adapters.
2. The device still has the PG16 to M25 adapter. Screw the locking screw into this M25 thread.

Metal locking screws are available as accessories:

- Brass locking screw: material no. MS960750
- Stainless steel locking screw: material no. 781711.

5.4.6 Connections – MT-ST160R/TT with 3/4" 14NPT adapters

1. Note cable recommendation.
2. Route the connection cables without tension and attach them so that neither the device nor the cable gland is subjected to mechanical stress.
3. Remove the locking caps on the 3/4" 14NPT adapters.
4. Hold the adapter with an open-end wrench.

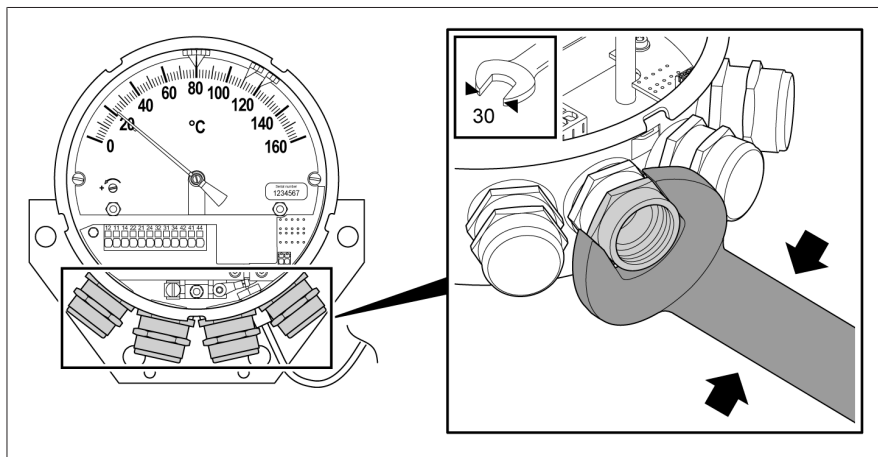


Figure 27: Holding the adapter with an open-end wrench

5. Screw a cable conduit or cable tube with an external thread of 3/4" 14NPT into the adapter correctly and tightly. Feed through a sufficient length of cable.

Connecting the protective conductor

⚠ DANGER



Electric shock

Risk of fatal injury due to lack of protective conductor connection.

- Always connect the protective conductor connection before connecting any potentially dangerous circuits.

1. Equip the protective conductor (PE) with a forked cable shoe and secure it to the protective conductor screw of the pointer thermometer.

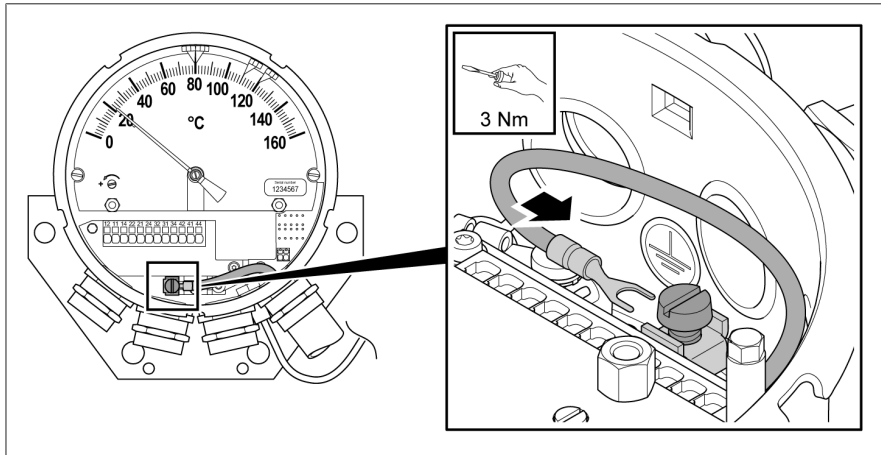


Figure 28: Protective conductor connection for type TT

Preparing the micro-switch cables

1. Strip the cable to a suitable length.
2. Strip a length of 10 mm (0.4") of insulation from the wires.
3. Use ferrules for flexible lines (with a collar of max. 2.5 mm²).

Connecting the micro-switches

i

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.

1. Insert the actuator tool (width 2.5 mm) into the opening behind the respective connection in accordance with the connection diagram.
2. Route the cable through the front opening until the stop.

3. Remove the actuator tool.

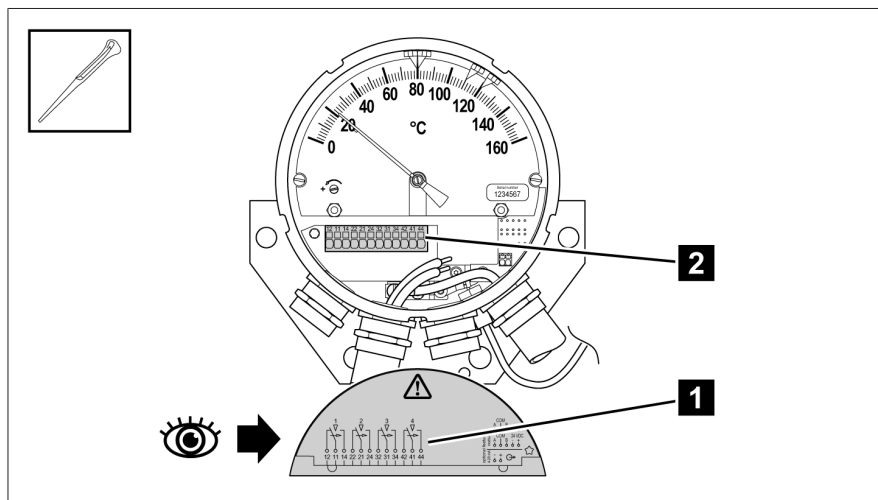


Figure 29: Push-in terminals and connection diagram

1	Connection diagram	2	Terminal strip
---	--------------------	---	----------------

Preparing the cable for the passive 4...20 mA analog output

1. Strip the cable to a suitable length.
2. Strip a length of 8 mm (0.32") of insulation from the wires.
3. Use ferrules for flexible lines (with a collar of max. 0.75 mm²).

Connecting the passive 4...20 mA analog output

NOTICE

Damage to the device!

Applying an incorrect test voltage to the terminals for the 4...20 mA analog outputs can cause damage to the device.

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

1. Insert the actuator tool (width 2.5 mm) into the opening behind the respective connection in accordance with the connection diagram.
2. Route the cable through the front opening until the stop.

3. Remove the actuator tool.

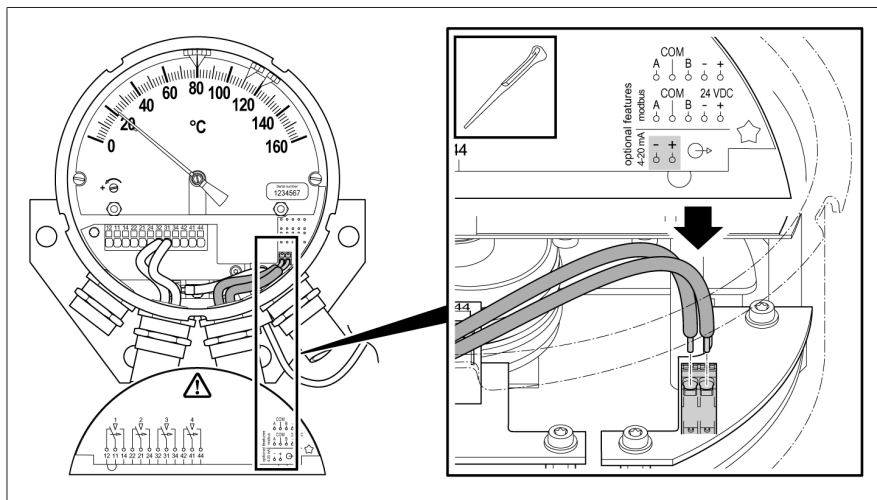


Figure 30: Analog output connection

4. On the other cable end, connect an evaluation unit with driving output (18...30 VDC) or, if necessary, an additional power supply (24 VDC).

Closing off open NPT adapters

NOTICE

Damage to the device!

The supplied locking screws are intended to protect the device from moisture and the like during transport. If you do not use any locking screws or if you use the wrong ones, the IP55 degree of protection and the necessary flame protection cannot be guaranteed.

Metal locking screws are available as accessories.

- Seal unneeded cable glands/NPT adaptors with suitable locking screws and gaskets to ensure the IP55 degree of protection and the flame protection.

1. Remove unneeded M25 to 3/4" 14NPT adapters.
2. The device still has the PG16 to M25 adapter. Screw the locking screw into this M25 thread.

Metal locking screws are available as accessories:

- Brass locking screw: material no. MS960750
- Stainless steel locking screw: material no. 781711.

5.5 Checking micro-switches

NOTICE

Damage to the device!

If you move the micro-switches on the colored indicator points, they can bend or break.

- Only move micro-switches on the retaining bridges of the indicator points.

NOTICE

Damage to the device!

Turning the pointer counter-clockwise can damage the device.

- Only turn the pointer clockwise.

5.5.1 Micro-switch to the right of the pointer

If the micro-switch is to the right of the pointer, proceed as follows:

1. **NOTICE!** Damage to the device! If the pointer jumps back to the starting position, the micro-switches can be damaged. Turn the pointer clockwise past the micro-switches by hand and do not let go. Check the function here and, if necessary, connect a continuity tester to the terminal strip to do so.

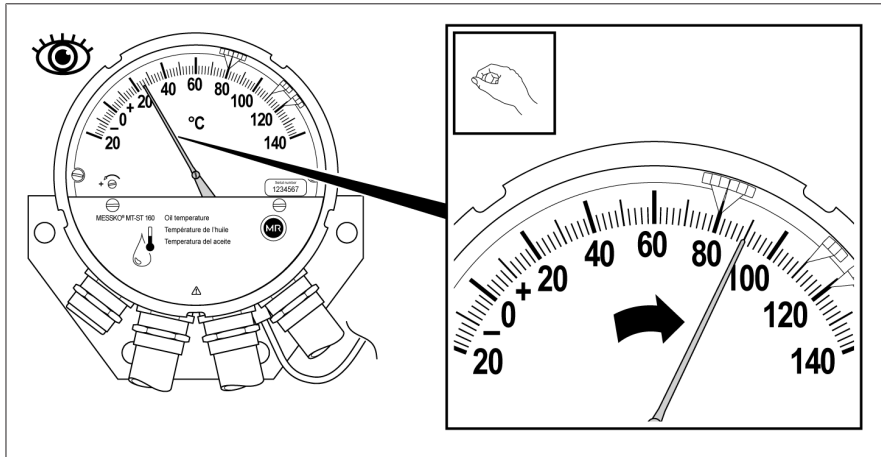


Figure 31: Moving the pointer past the micro-switches

2. Slowly return the pointer to its starting position.

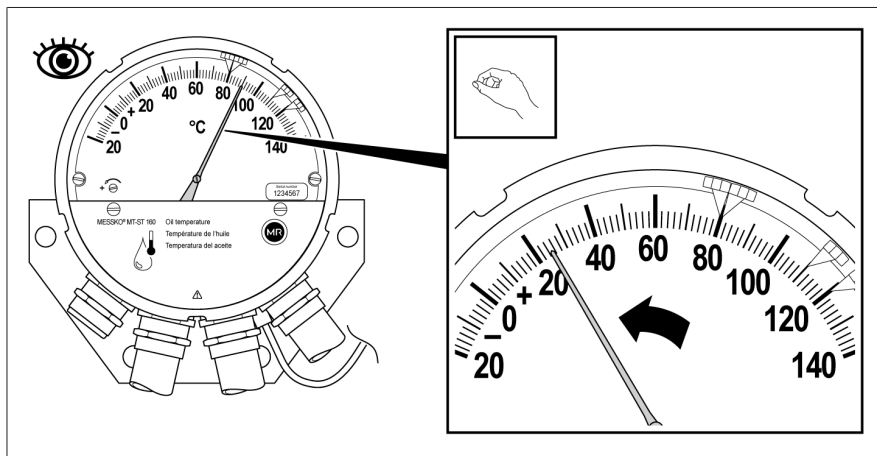


Figure 32: Returning the micro-switches

» A return spring pulls the pointer back to its exact starting position.

5.5.2 Micro-switch to the left of the pointer

If the micro-switch is to the left of the pointer, proceed as follows:

1. Move the micro-switches clockwise past the pointer individually and in succession and check the function. If necessary, connect a continuity tester to the terminal strip to do so.

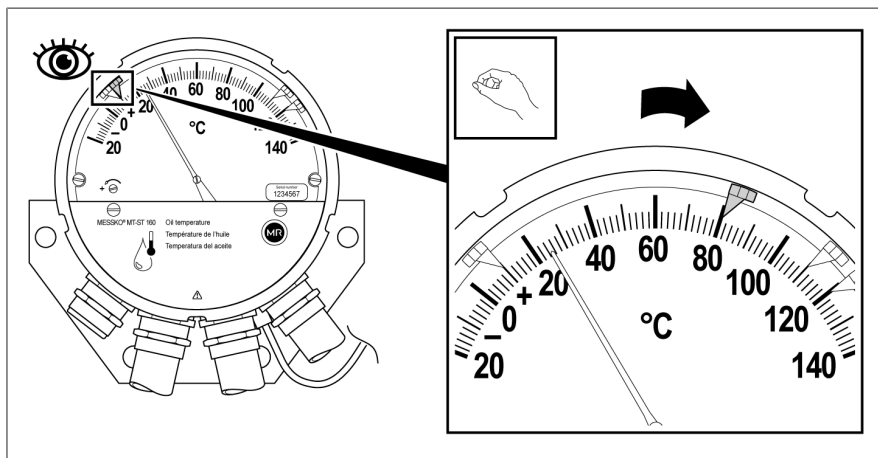


Figure 33: Moving the pointer past the micro-switch

2. Set the micro-switches back to their original value.

5.6 Closing the cover plate

1. Close the cover plate.

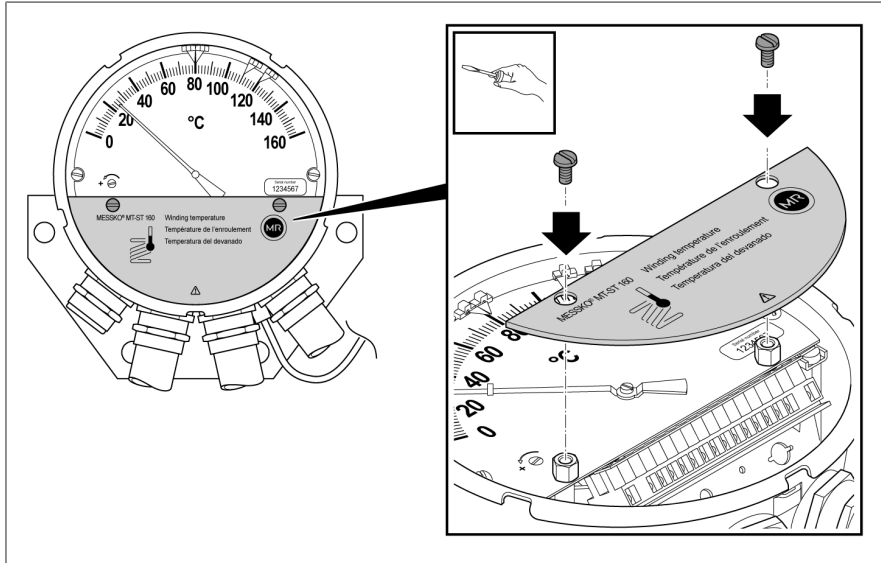


Figure 34: Closing the cover plate

5.7 Positioning the bayonet seal ring

- ✓ Ensure that the drag hand is positioned to the right of the pointer.

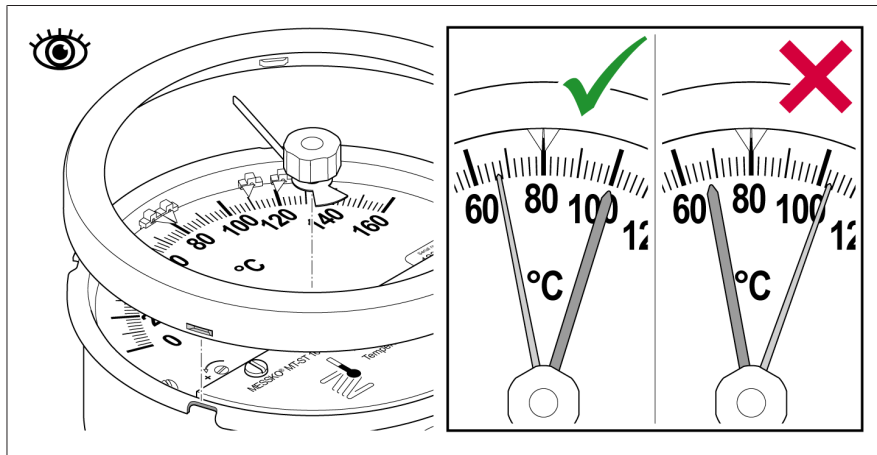


Figure 35: Position of the drag hand

1. Reposition the bayonet seal ring with viewing glass on the pointer thermometer, press down firmly and turn 30...40° clockwise so that the viewing glass is pressed firmly into the rubber gasket all the way around.

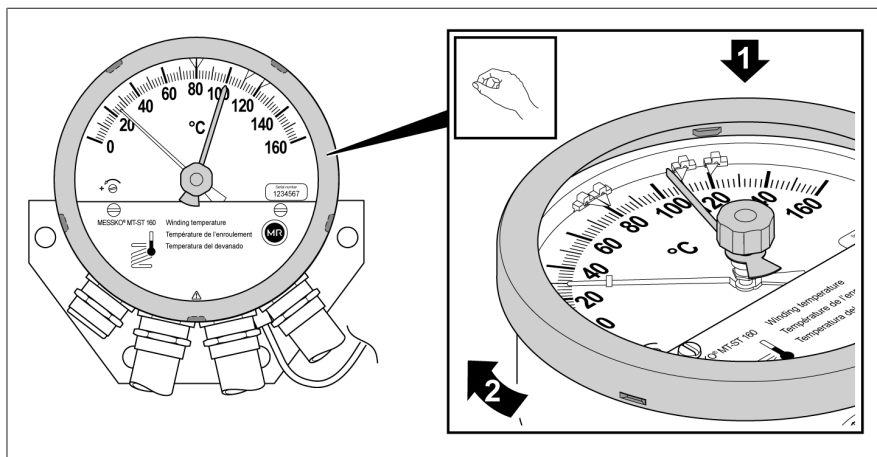


Figure 36: Positioning the bayonet seal ring

- » The pointer thermometer is ready for operation.

6 Operation

6.1 Resetting drag hands

The drag hand slides along with the pointer when measured temperature values increase and marks its maximum value. You can reset the drag hand as follows:

1. Return the drag hand to the position of the thermometer pointer manually using the drag hand reset.
 - » The drag hand and pointer are positioned one above the other.

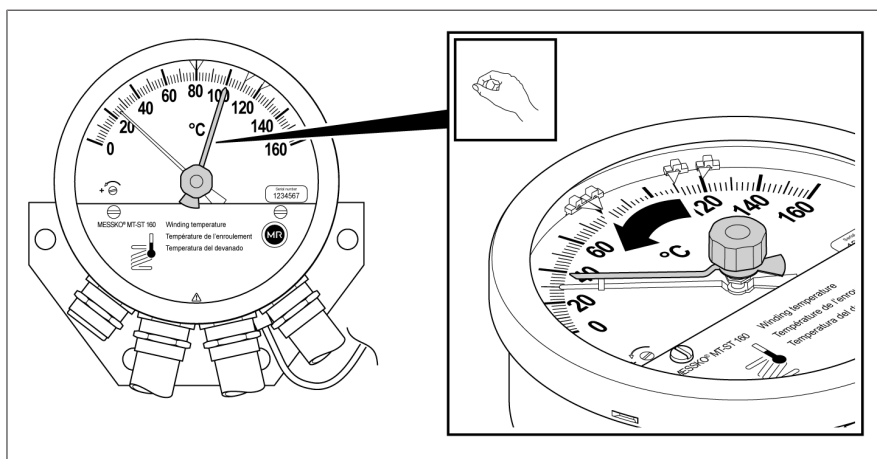


Figure 37: Resetting drag hands

7 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 ventilation is free of dirt and deposits.
3. Check the device for external damage and contamination.

In the event of questions or irregularities, contact the Technical Service department:

Maschinenfabrik Reinhausen GmbH

MR Service & Complaint

Falkensteinstrasse 8

93059 Regensburg

Germany

E-mail: service@reinhausen.com

8 Fault elimination

This chapter describes how to eliminate operating faults.

If a solution for a fault cannot be found, contact the manufacturer:

Maschinenfabrik Reinhausen GmbH

MR Service & Complaint

Falkensteinstrasse 8

93059 Regensburg

Germany

service@reinhausen.com

complaint@reinhausen.com

Please have the following data ready:

- Serial number
- Software version

Questionnaire for preparation

1. Has there previously been a problem with this device?
2. Have you previously contacted Maschinenfabrik Reinhausen GmbH about this issue? If yes, then who was the contact?
3. When did the error first occur? Is there a correlation with events such as thunderstorms, lightning surge testing in the transformer station, transformer disconnection/reconnection after short circuit or ground fault, etc.?
4. Is the error constant or sporadic? Is there a correlation with other events/ conditions, such as extreme ambient temperatures?
5. Is there an error in the transmission of the 4...20 mA analog signal?
 - Are you using shielded lines?
 - Are you using a twisted pair line?
 - Is the cable shielding attached on both sides?
 - What is the cable length?
 - Which receiver do you use as a receiver?
 - 4...20 mA analog signal: What is the load resistance?

Checking the plausibility of the measured values

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

- Measured value via 4...20 mA analog output
- Measured value via pointer on the scale
- Actual physical measured value (measured or estimated).

Calculating the target current of the 4...20 mA analog output

$$> I_{\text{target}} = 4 \text{ mA} + 16 \text{ mA} * [(\text{current measured value scale} - \text{scale}_{\text{min}}) / (\text{scale}_{\text{max}} - \text{scale}_{\text{min}})]$$

Calculation example for the oil temperature indicator:

- Scale of -20...+140 °C; the indicator points to 60 °C
=> I_{target}
= 4 mA + 16 mA * [(60 °C - -20 °C)/(140 °C - -20 °C)]
= 4 mA + 16 mA * 0.5
= 12 mA

8.1 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	<ul style="list-style-type: none">- Check cables- Check power supply (18...30 VDC)- Check 4...20 mA receiver (loop into multimeter)

Table 6: General faults

8.2 4...20 mA analog signal malfunctions (type TT)

Characteristics/details	Cause	Remedy
Loop current is approx. 3 mA	<ul style="list-style-type: none"> - Device signals detected error 	<ul style="list-style-type: none"> - At 3 mA: The self-diagnosis has detected an error that does not allow a reliable indication of the measurement.
The receiver does not measure any 4...20 mA loop current	<ul style="list-style-type: none"> - 4...20 mA analog output was deactivated by holding register 4 - Conductor break, open terminal point - Short circuit - Power supply not present - Device defective 	<ul style="list-style-type: none"> - 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)
The receiver measures a 20 mA loop current that is too low	<ul style="list-style-type: none"> - A part of the current is running through a parallel path - Load resistance too high - Supply voltage too low - Device defective 	<ul style="list-style-type: none"> - Loop in multimeter and measure - Check cables - Check receiver (load resistance)
The receiver measures a 4...20 mA loop current that is too high	<ul style="list-style-type: none"> - Device defective 	<ul style="list-style-type: none"> - Loop in multimeter and measure

Table 7: 4...20 mA analog signal malfunctions

9 Disposal

Observe the national disposal regulations in the country of use.

9.1 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

10 Technical data

10.1 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⁾	-50...+80 °C
Relative humidity	Fog-free up to 80%
Installation altitude ¹⁾	2,000 m above mean sea level
Degree of protection	IP55 in accordance with IEC 60529
Protection class	I
Overvoltage category	III
Contamination level	2 (within the device)

¹⁾ Extended ranges on request.

10.2 Technical data

Measuring range	Pointer thermometer for oil temperature	Pointer thermometer for winding temperature
Measuring range ¹⁾	0...+160 °C	0...+160 °C
Tolerance	±3 °C in accordance with DIN EN 13190 Class 1 and DIN 16196	

1. ¹⁾ Other measuring ranges on request.

Basic materials	
Front ring and housing	Sheet steel, galvanized, coated in RAL 7038 (similar to ANSI 70 light gray); corrosion protection class C4H in accordance with DIN EN ISO 12944-9
Inspection window	Laminated safety glass with UV filter
Temperature sensor	Stainless steel 316L
Mounting plate	Aluminum, coated RAL 7038 (similar to ANSI 70 light gray)
Capillary line	Copper capillary with protective jacket
Screw connection	Bare brass

Dimensions and weight	
Housing	Ø 173 mm [Ø 6.81"]; depth 73 mm [2.87"]
Weight	Approx. 2.5 kg (with 6 m capillary line)

Passive 4...20 mA analog 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
Rated insulation voltage	500 VDC/1 min; terminals to ground
Repetition accuracy	≤ ±0.1% from the end value

10.3 Micro-switches

Micro-switch technical data	
Quantity	3...4 adjustable micro-switches
Minimum switching distance	6% of the measuring range for standard switch arrangement; <1 K for narrowing
Switching hysteresis	Approx. 5 K (for decreasing temperature)
Protection	Miniature circuit breaker 6 A, type C

Micro-switch technical data	
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
Contact type	Change-over contact, normally open contact

Utilization category in accordance with IEC 60947-5-1

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

Switching capacity in accordance IEC 60076-22-1

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
	24...220 VDC	Making capacity: 130 W, L/R < 40 ms
		Breaking capacity: 25 W, L/R < 40 ms
Switch with gold-plated con- tacts ¹⁾	230 V AC	Max. 6.9 VA, cos φ = 0.9
	24...220 VDC	Max. 6.6 W, L/R < 25 ms

¹⁾ Switching higher loads destroys the gold plating.

Micro-switch arrangement (examples)

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Depending on your order, the micro-switch arrangements can deviate from the following versions.

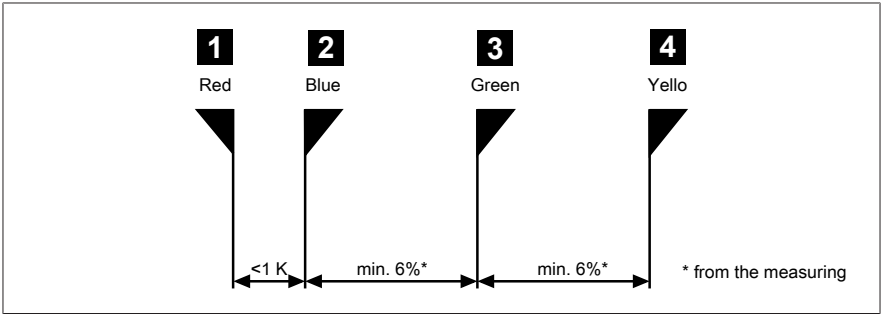


Figure 38: Switch arrangement 1+2

1 + 2	tight	<1 K	with standard model
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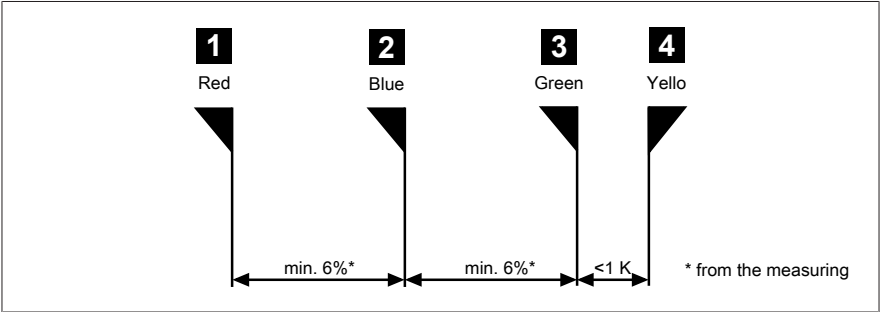


Figure 39: Switch arrangement 3+4

3 + 4	tight	<1 K
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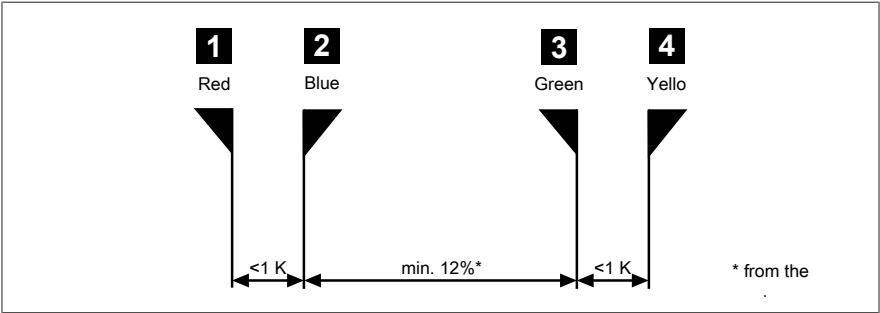


Figure 40: Switch arrangement 1+2 and 3+4

1 + 2 and 3 + 4	tight	<1 K
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11 Drawings

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

11.1 Cable gland dimensions

NPT adapters (optional)

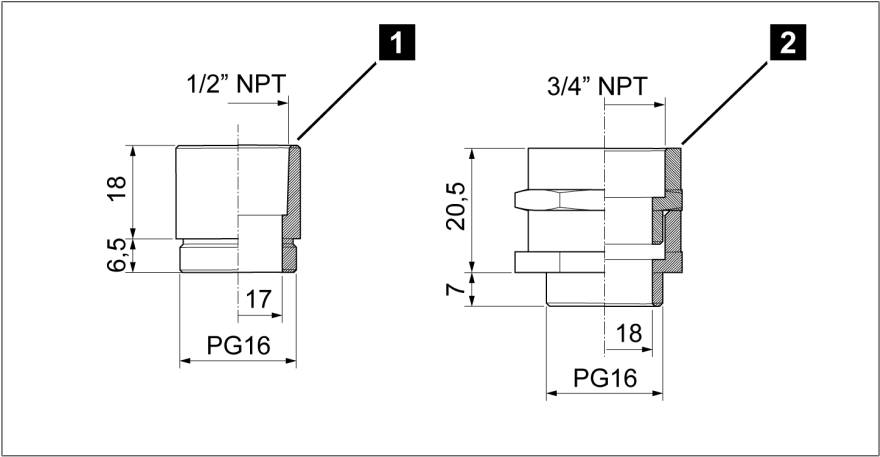


Figure 41: NPT adapters

1	1/2" NPT	2	3/4" NPT
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11.2 Dimensional drawing

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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Please note:

The data in our publications may differ from the data of the devices delivered. We reserve the right to make changes without notice.

10584949/01 EN - MESSKO® Retrofit Kit Operating instructions -

F0419801 - 02/24

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