OPTISWIRL 4200 Quick Start

Vortex flowmeter

KROHNE

Warnings and symbols used

DANGER!
This warning refers to the immediate danger when working with electricity.

DANGER!
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

DANGER!
These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.

WARNING!
Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.

CAUTION!
Disregarding these instructions can result in damage to the device or to parts of the operator's plant.

INFORMATION!
These instructions contain important information for the handling of the device.

HANDLING

- This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➲ RESULT
This symbol refers to all important consequences of the previous actions.

Safety instructions for the operator

CAUTION!
Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

LEGAL NOTICE!
The responsibility as to the suitability and intended use of this device rests solely with the user. The supplier assumes no responsibility in the event of improper use by the customer. Improper installation and operation may lead to loss of warranty. In addition, the "Terms and Conditions of Sale" apply which form the basis of the purchase contract.

INFORMATION!

- *Further information can be found on the supplied CD-ROM in the manual, on the data sheet, in special manuals, certificates and on the manufacturer's website.*
- *If you need to return the device to the manufacturer or supplier, please fill out the form contained on the CD-ROM and send it with the device. Unfortunately, the manufacturer cannot repair or inspect the device without the completed form.*

2.1 Scope of delivery

INFORMATION!
Inspect the packaging for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Do a check of the packing list to make sure that you have all the elements given in the order.

INFORMATION!
Check the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

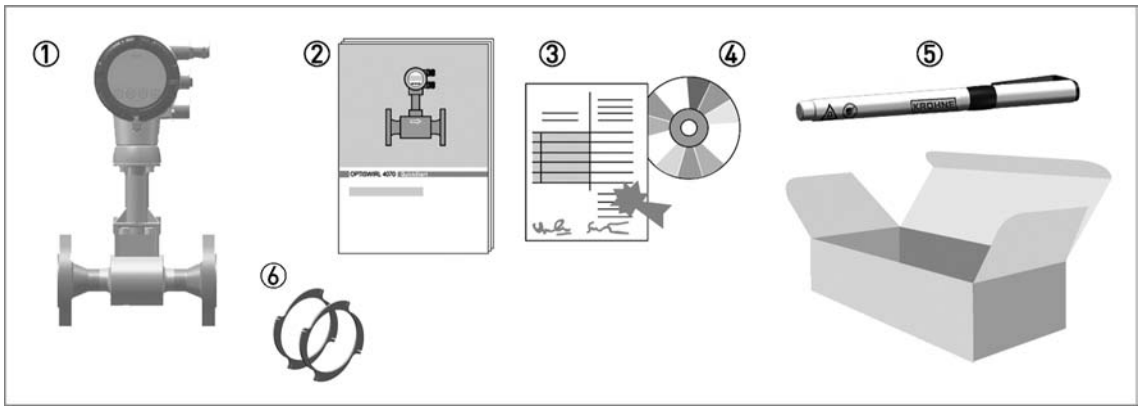


Figure 2-1: Scope of delivery

① Measuring device in ordered version
② Quick Start
③ Certificates, calibration report and parameter data sheet
④ CD with complete documentation
⑤ Bar magnet
⑥ Centering rings in sandwich devices

2.2 Installation conditions

INFORMATION!
For accurate volumetric flow measurement the measuring device needs a completely filled pipe and a fully developed flow profile.
Please observe the instructions regarding inlet and outlet pipe runs as well as the installation position.

CAUTION!
Eliminate vibrations in the pipeline by properly installing the measuring device. Any vibration will distort the measuring result.

CAUTION!

When installing the device in the piping, the following points must be observed:

- *Nominal diameter of connection pipe flange = nominal flange diameter of pipe!*
- *Use flanges with smooth holes, e.g. welding neck flanges.*
- *Align carefully the holes of the connecting flange and the flowmeter flange.*
- *Check the compatibility of the gasket material with the process product.*
- *Make sure that the gaskets are arranged concentrically. The flange gaskets must not project into the pipe cross-section.*
- *The flanges have to be concentric.*
- *There must not be any pipe bends, valves, flaps or other internals in the immediate inlet run.*
- *Devices in sandwich version may only be installed using centering rings.*
- *Never install the device directly behind piston compressors or rotary piston meters.*
- *Do not lay signal cables directly next to cables for the power supply.*

INFORMATION!

If there is a risk of waterhammers in steam networks, appropriate condensate separators must be installed.

Suitable measures must be taken to avoid water cavitation if it is a possible risk.

Sunshades

The meter MUST be protected from strong sunlight.

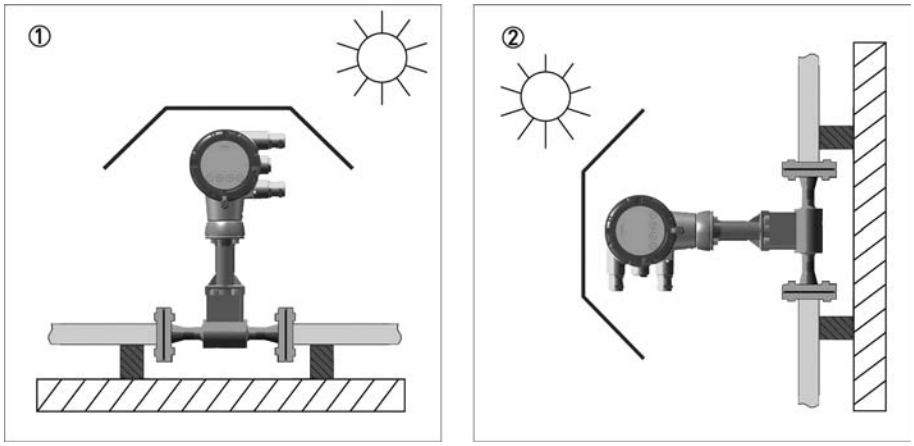


Figure 2-2: Sunshades

① Horizontal mounting
② Vertical mounting

Transport

- Use lifting straps wrapped around both process connections for transport.
- Do not lift measuring devices by the signal converter housing for transport.
- Never lift the measuring device by the pressure sensor.
- Do not use lifting chains as they may damage the housing.

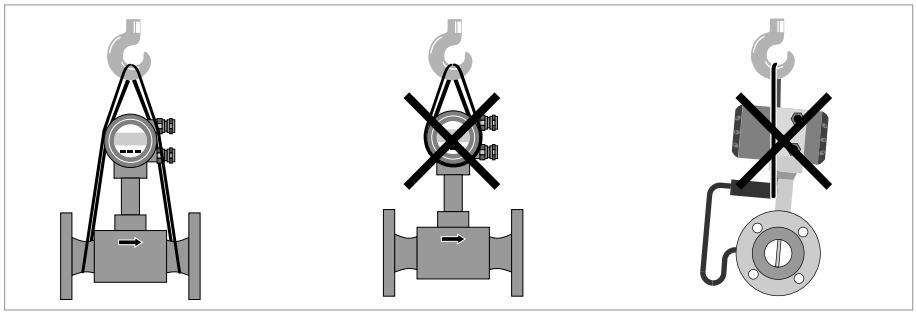


Figure 2-3: Transport instructions

CAUTION!

Non-secured devices can pose risk of injury. The centre of mass of the device is often higher than the point at which the lifting straps are attached.
Prevent the measuring device from sliding or rotating accidentally.

2.2.1 Prohibited installation when measuring liquids

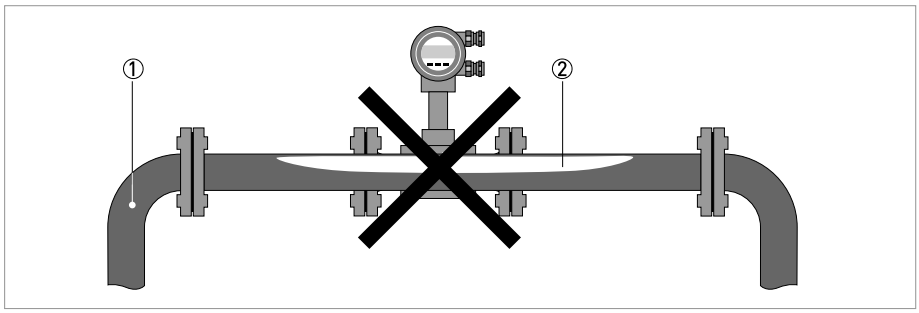


Figure 2-4: Upper pipe bend

CAUTION!
Prohibited: Installing the device in an upper pipe bend ①, because there is a risk of gas bubbles ② forming. Gas bubbles can lead to pressure surges and inaccurate measurement.

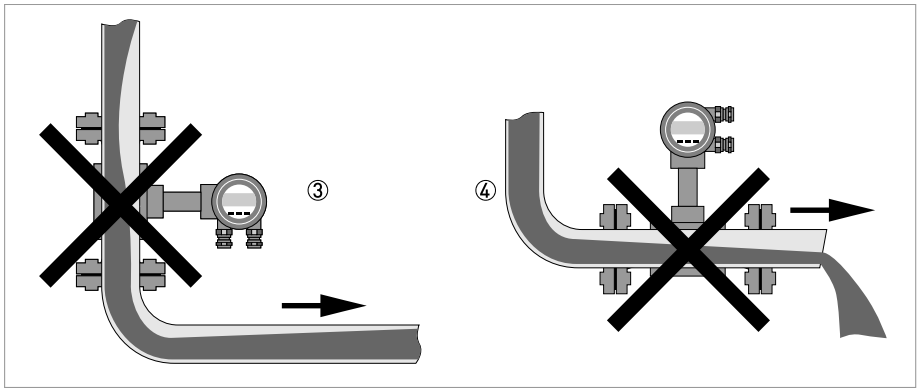
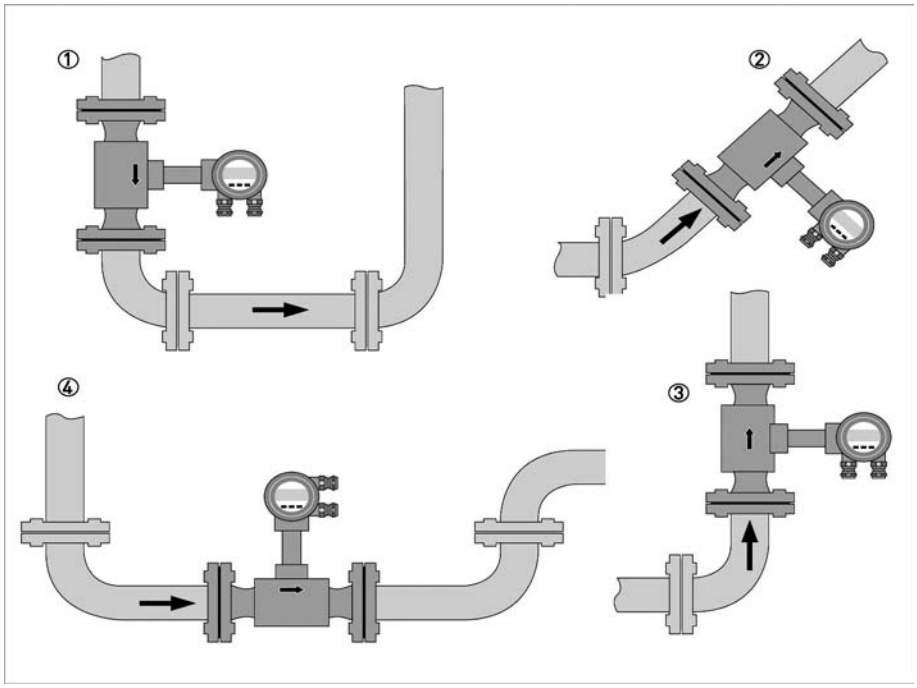


Figure 2-5: Downpipe and outlet

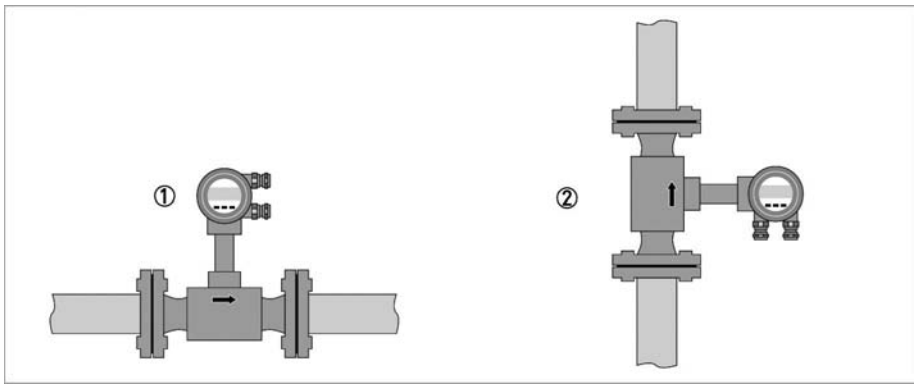
CAUTION!
Installing the device in a downstream pipe ③ or upstream pipe of an outlet ④. There is the risk of partially filled pipes leading to faulty measurements.

2.2.2 Recommended installations for measurement of liquids

CAUTION!
The required inlet and outlet sections must be observed.



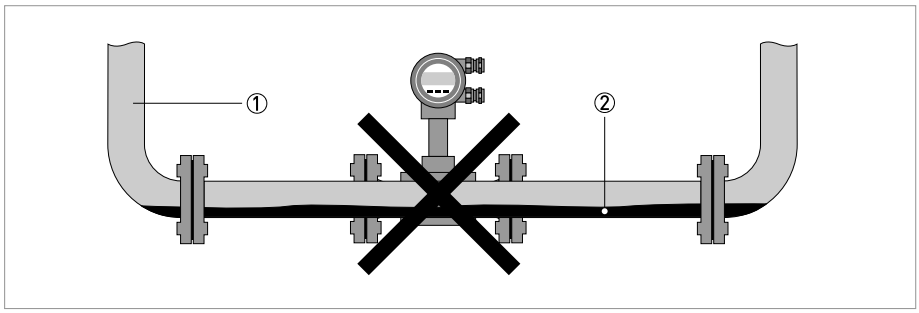
① If the device is installed in a downpipe, a standpipe must be installed immediately after it.
② Installing the device in an inclined standpipe.
③ Installing the device in a vertical standpipe.
④ Installing the device in the lower pipe bend.



① Above a horizontal pipe
② On a vertical pipe

INFORMATION!
Depending on the installation position, you may have to rotate the display and/or the connection housing.

2.2.3 Prohibited installation when measuring vapours and gases

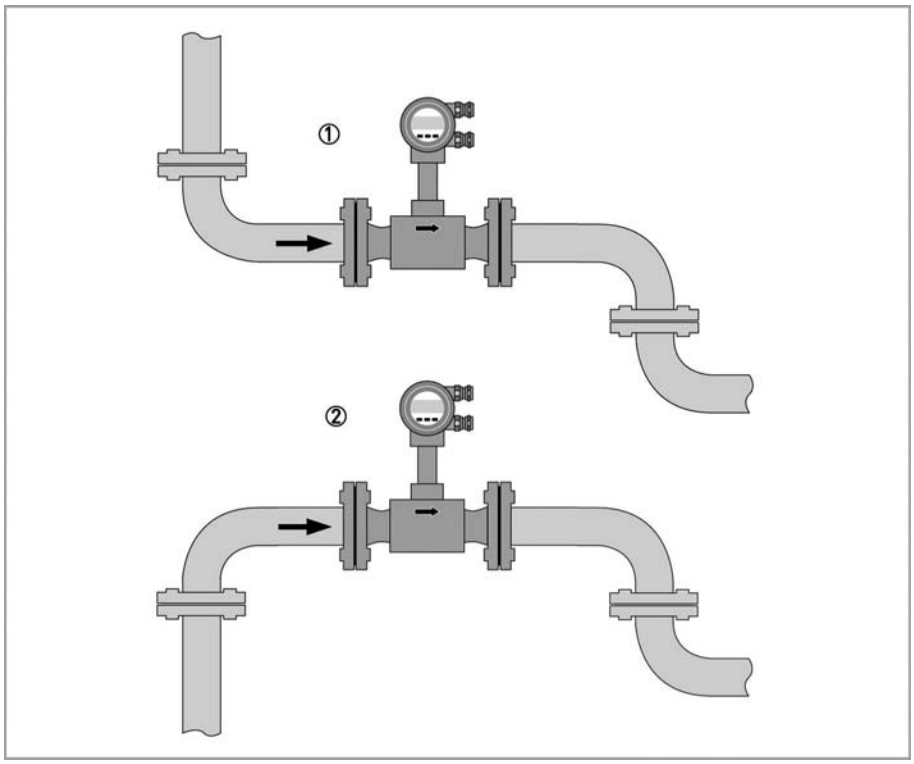


① Lower pipe bends
② Condensate

DANGER!
Prohibited: Installing the device in a lower pipe bend ①, because there is a risk of condensate forming ②.
Condensate can lead to cavitation and inaccurate measurement. Under certain circumstances the device can be destroyed and the measured product can leak.

2.2.4 Recommended installations for measurement of steam and gases

CAUTION!
The required inlet and outlet sections must be observed.



① Inlet and outlet falling
② Rising inlet - falling outlet

2.2.5 Pipelines with control valve

INFORMATION!
To ensure smooth and correct measurement, the manufacturer recommends not installing the measuring device downstream from a control valve. This would run the risk of vortex formation, which would distort the measuring result.

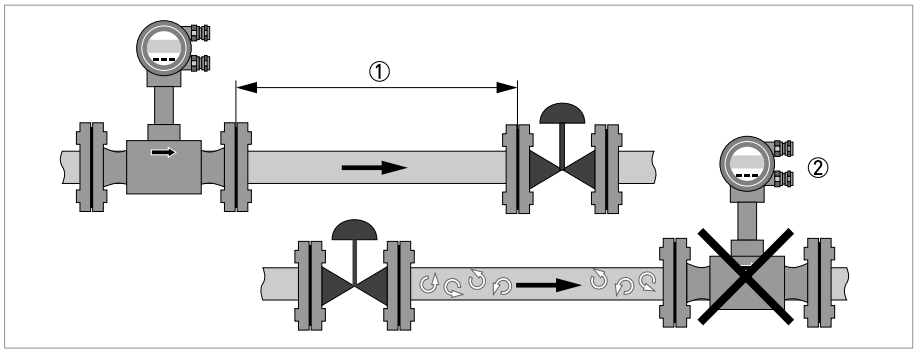
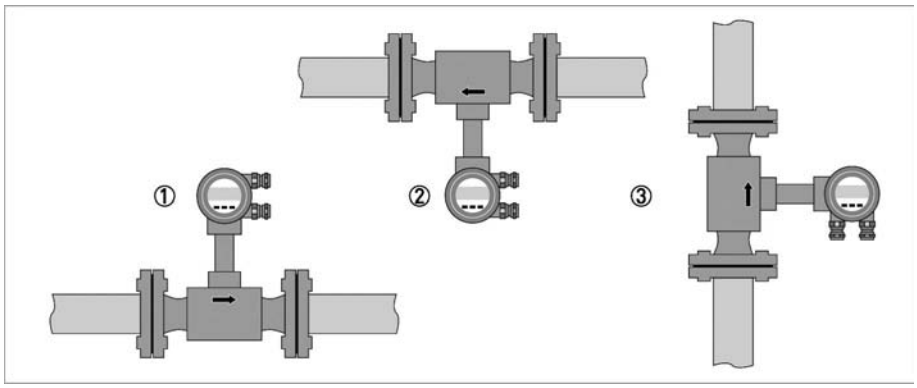


Figure 2-6: Pipeline with control valve

① Recommended: installing the device **upstream** from the control valve at a distance of ≥ 5 DN
② Not recommended: Installing the flowmeter **directly downstream** of control valves, due to vortex formation.

2.2.6 Preferred mounting position



① above a horizontal pipe
② underneath a horizontal pipe (not permitted with lines at risk for condensate)
③ on a vertical pipe

INFORMATION!
Depending on the installation position, you may have to rotate the display and/or the connection housing.

2.2.7 Turning the connection housing

DANGER!
All work on the device electronics may only be carried out by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

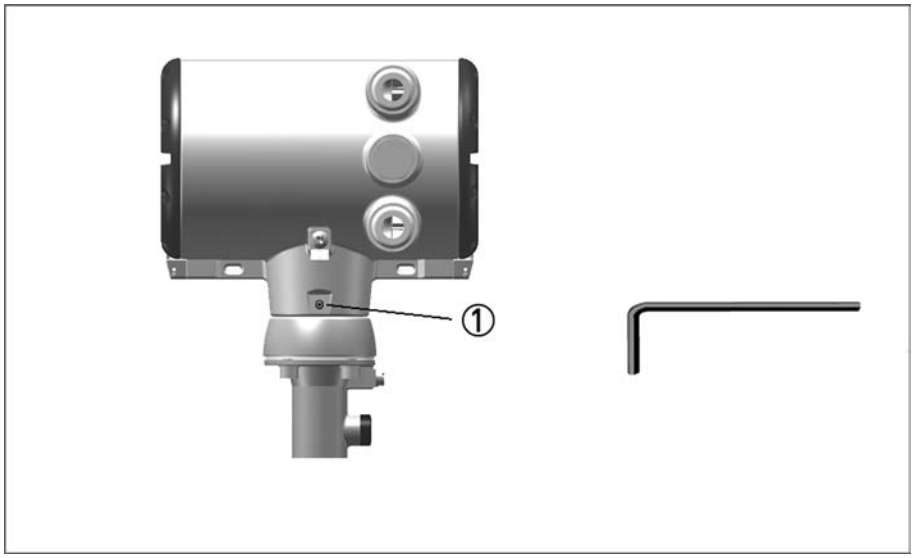


Figure 2-7: ① Allen screws M4 on connection housing

- Loosen the M4 Allen screw ① on the side of the connection housing.
- Rotate the connection housing to the desired position (0...<360°).
- Tighten the Allen screw ① again.

2.2.8 Turning the display

DANGER!
All work on the device electrics may only be carried out by appropriately trained personnel.

INFORMATION!
If the measuring device is installed in a vertical pipe, you will have to turn the display by 90°; if installed below a pipe, turn 180°.

INFORMATION!
The display can be turned in increments of 90° to four positions.

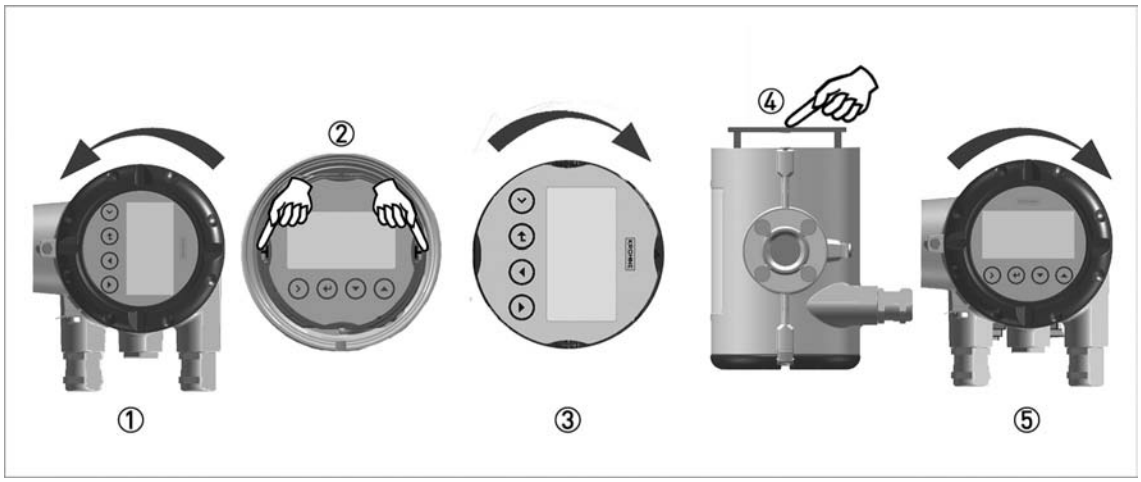


Figure 2-8: Turning the display

Turn the display as follows:

- Disconnect the power supply from the measuring device.
- Unscrew the housing cover of the display ①.
- Press the two holding brackets together and carefully remove the display ②. Turn it to the desired position ③.
- Press the display onto the spacer pins ④, until it clicks.
- Turn the cover with gasket ⑤ back onto the housing and tighten it by hand.

2.2.9 Heat insulation

CAUTION!
The area above the converter support must not be heat-insulated.
The heat insulation ③ may only extend to the maximum height ① shown below.

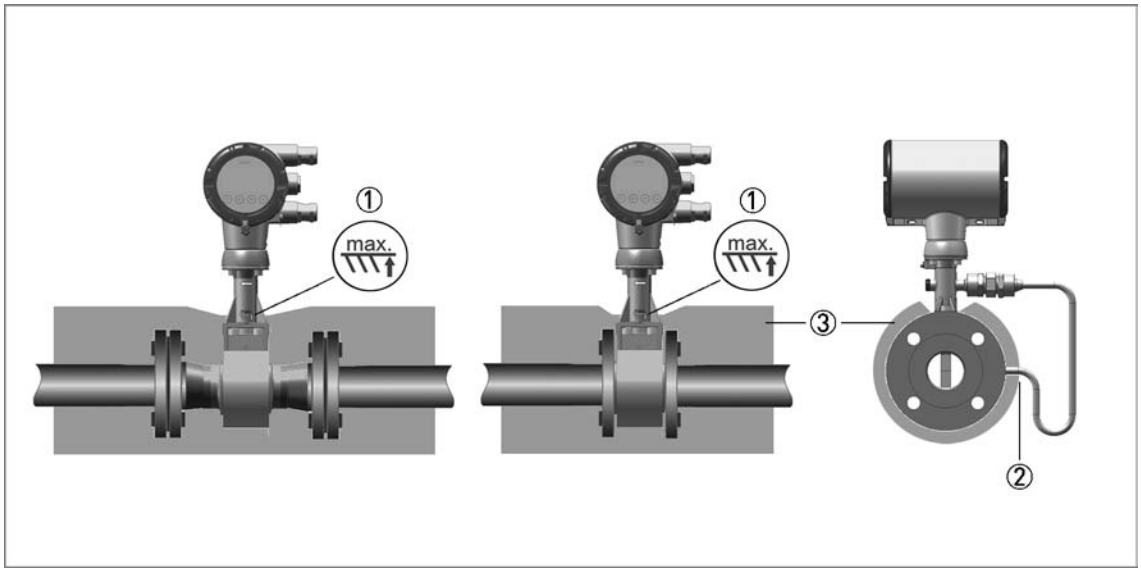


Figure 2-9: Installation heat insulation

① Max. height of the insulation up to the marking on the neck of the measuring sensor
② Max. thickness of the insulation up to the bend of the pressure pipe
③ Insulation

CAUTION!
The heat insulation ③ may only extend as far as the bend of the pressure sensing line ②.

2.3 Minimum inlet sections

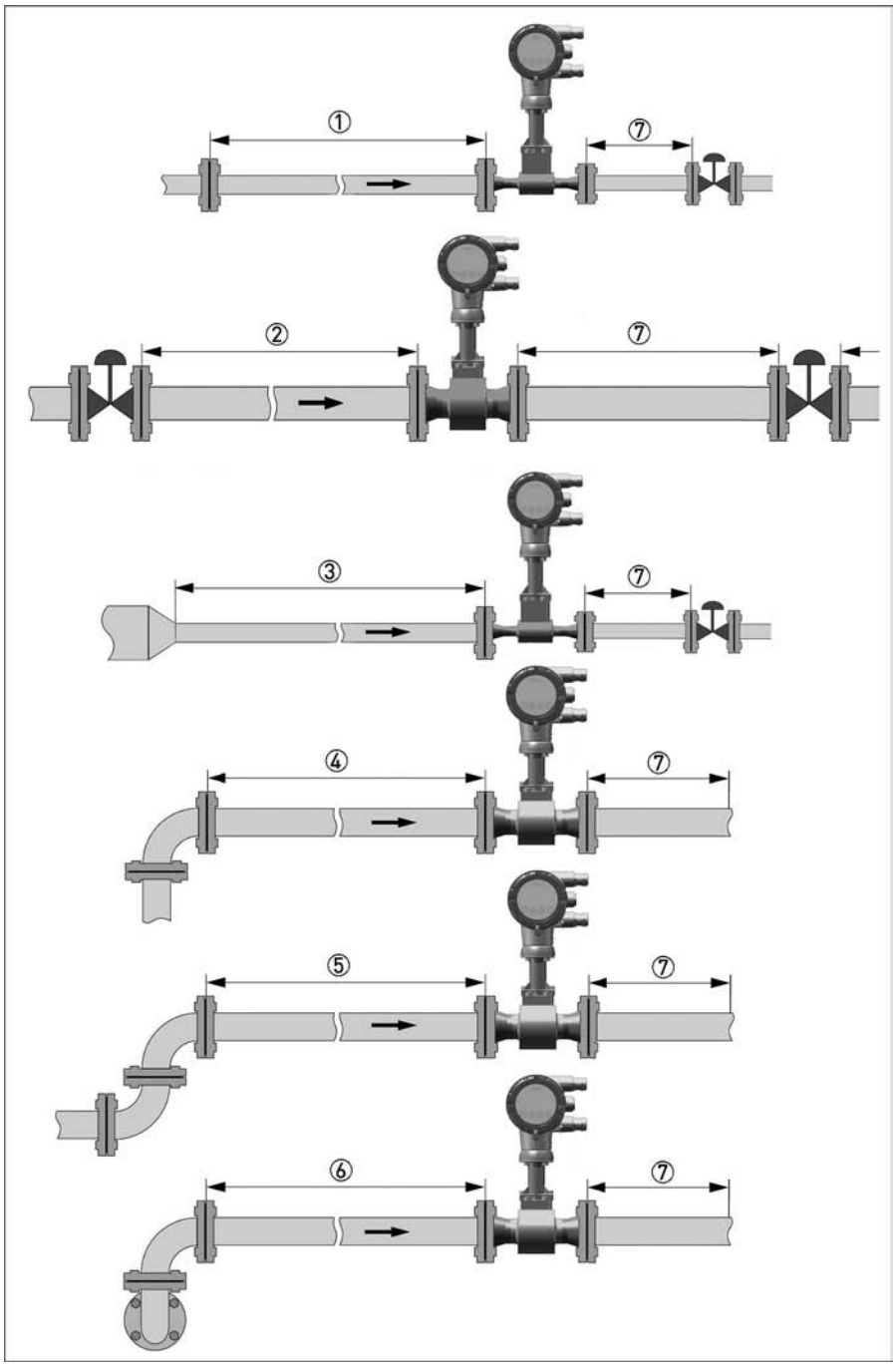


Figure 2-10: Inlet sections

① General inlet section without disturbing flow ≥ 15 DN
② Behind a control valve ≥ 50 DN
③ After a pipe diameter reduction ≥ 15 DN
④ After a single bend 90° ≥ 20 DN
⑤ After a double bend 2x90° ≥ 20 DN
⑥ After a double three-dimensional bend 2x90° ≥ 40 DN
⑦ Outlet section: >5 DN

2.4 Minimum outlet sections

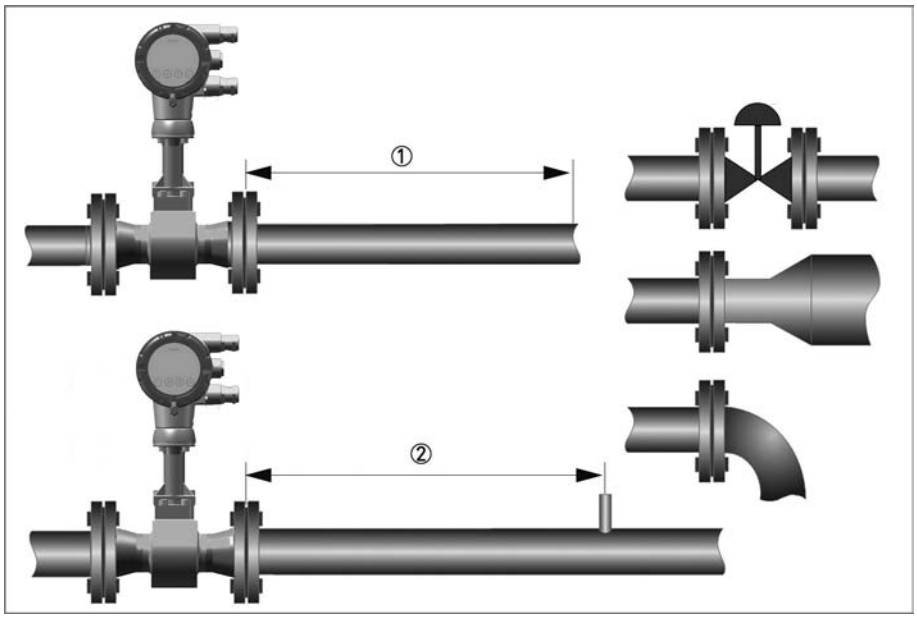


Figure 2-11: Minimum outlet sections

① Upstream of pipe expanders, pipe bends, control valves, etc. ≥ 5 DN
② Upstream of measuring points ≥ 5 DN

INFORMATION!
The interior of the pipe at the metering points must be free of burrs and other flow impediments. The measuring device has an internal temperature sensor. The distance from external temperature measuring points must be ≥ 5 DN. Use measuring sensors that are as short as possible to avoid disturbances of the flow profile.

2.5 Flow straightener

If, due to the type of installation, the required inlet sections are not available, the manufacturer recommends using flow straighteners. Flow straighteners are installed between two flanges upstream of the device and shorten the required inlet section.

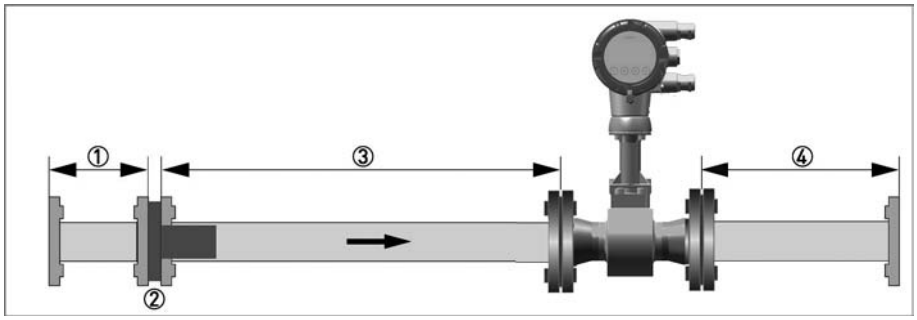


Figure 2-12: Flow straightener

① Straight inlet section upstream of straightener ≥ 2 DN
② Flow straightener
③ Straight pipe run between flow straightener and device ≥ 8 DN
④ Minimum straight outlet section ≥ 5 DN

2.6 Installation

2.6.1 General installation notes

CAUTION!
Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.

The following procedures have to be carried out before installing the device:

- Ensure that the gaskets have the same diameter as the pipelines.
- Note the correct flow direction for the device. This is indicated by an arrow on the housing of the measuring sensor.
- On measuring points with varying thermal loads, the devices have to be mounted with stress bolts (DIN 2510).
- Stress bolts or bolts and nuts are not included in the scope of delivery.
- Ensure that the measuring flange is concentrically fitted.
- Note the exact installation length of the measuring device when preparing the measuring point.

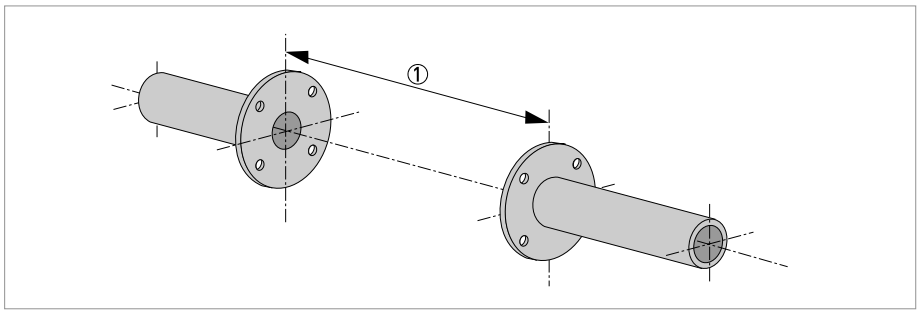


Figure 2-13: Preparing the metering point

① Installation length of measuring device + thickness of gaskets.

CAUTION!
The internal diameter of the pipelines, the measuring sensor and the gaskets must match. The gaskets may not protrude into the flow.

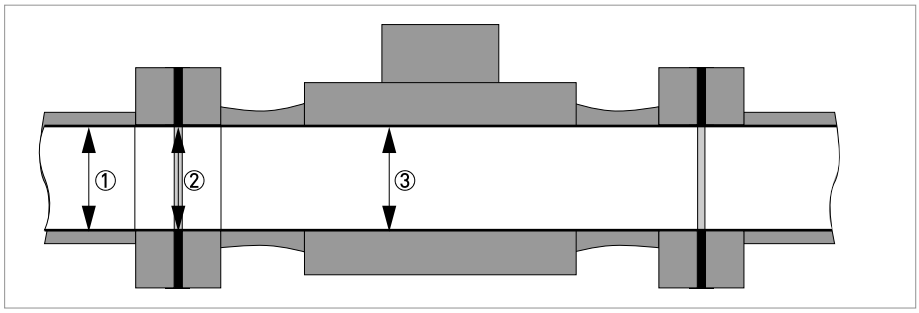


Figure 2-14: Internal diameter

① Internal diameter connection pipe
② Internal diameter flange and gasket
③ Internal diameter measuring sensor

2.6.2 Installing devices in sandwich design

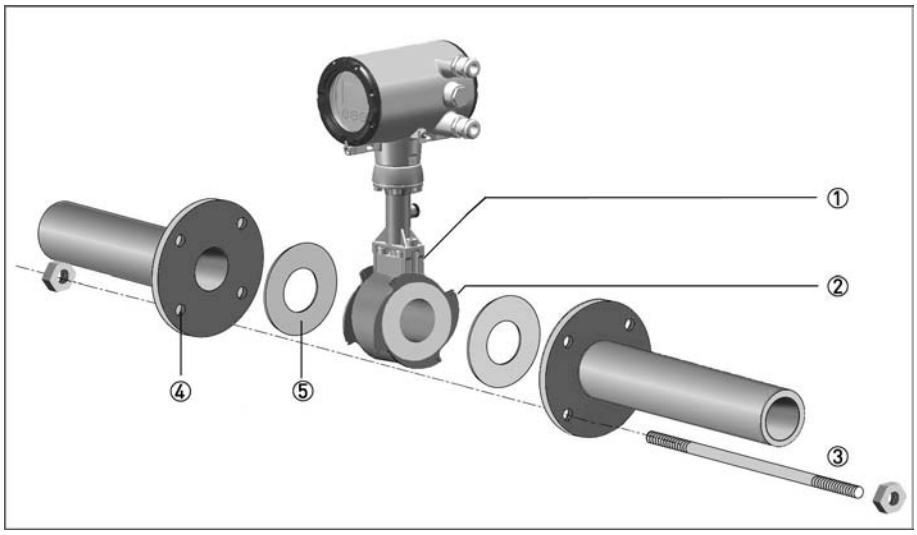


Figure 2-15: Installation using centering ring

① Measuring sensor
② Centering ring
③ Bolts with fixing nuts
④ Drill hole
⑤ Sealing

- Push the first bolt ③ through the hole ④ of both flanges.
- Screw on the nuts and washers to both ends of the bolt ③ but do not tighten them.
- Install the second bolt through the holes ④.
- Place the measuring sensor ① between the two flanges.
- Insert the gaskets ⑤ between measuring sensor ① and flanges and align them.
- Check that the flange is concentric.
- Install the remaining bolts, washers and nuts. Do not yet tighten the nuts.
- Turn the centring ring ② in a counter-clockwise direction and align the device.
- Check that the gaskets ⑤ are concentric; they must not protrude into the pipe cross-section.
- Now tighten all nuts bit by bit alternately across the diagonal.

2.6.3 Installing devices in flange design

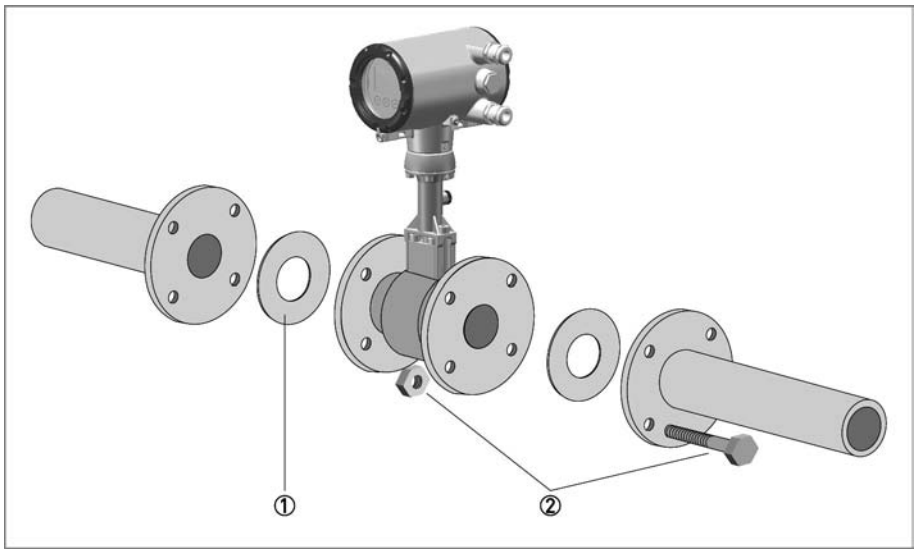


Figure 2-16: Installing devices in flange design

① Sealing
② Bolts with fastening nuts

- Use bolts and fastening nuts ② to attach the measuring device to one side of the flange.
- While doing so, insert the gaskets ① between measuring sensor and flange and align them.
- Check that the gasket is concentric and that it is not protruding into the pipe cross-section.
- Install the gasket, bolts and fastening nuts on the other side of the flange.
- Align the measuring device and the gaskets so they are concentric.
- Now tighten all nuts bit by bit alternately across the diagonal.

3.1 Safety instructions

DANGER!
All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate (see Section 2.3).

DANGER!
Observe the national regulations for electrical installations!

DANGER!
For devices used in hazardous areas, additional safety notes apply; please refer to the Ex documentation.

WARNING!
Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

INFORMATION!
Check the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Connecting the signal converter

DANGER!
All work on the electrical connections may only be carried out with the power disconnected. Take note of the voltage data on the nameplate!

INFORMATION!
When using the binary output M1...M4 as pulse output and frequencies above 100 Hz, shielded cables are to be used in order to reduce effects from electrical interferences(EMC).

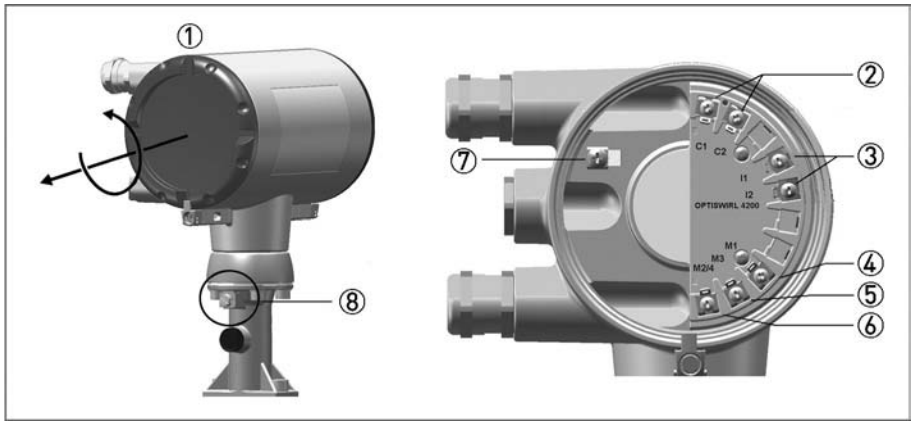


Figure 3-1: Connecting the signal converter

① Housing cover of the electrical terminal compartment
② Signal converter supply and 4...20mA Loop, terminal C1 + terminal C2 -
③ Current input 4...20mA, terminal I1 +, terminal I2 - (external transmitter, optional)
④ Terminal M1 binary or pulse output + (Hi current)
⑤ Terminal M3 binary or pulse output + (NAMUR)
⑥ Terminal M2/4 binary or pulse output, common minus connection
⑦ PE terminal in housing
⑧ PE terminal on connection piece between measuring sensor and signal converter.

INFORMATION!
Both grounding terminals ⑦ and ⑧ are equally effective from a technical point of view.

Steps for connecting the signal converter:

- Unscrew the housing cover ① of the electrical terminal compartment.
- Thread the connection cable through the leadthrough in the housing.
- Connect the cable according to the terminal diagrams below.
- Connect the grounding to the terminal ⑦. Alternatively use the PE terminal ⑧ on the connection piece between the measuring sensor and the signal converter.
- Tighten the cable glands.
- Turn the housing cover and gasket back onto the housing and tighten it by hand.

INFORMATION!
Ensure that the housing gasket is properly fitted, clean and undamaged.

3.3 Electrical connections

The signal converter is a 2-wire device with 4...20mA as output signal for the flow. All other inputs and outputs are passive and always require an additional power supply.

3.3.1 Power supply

INFORMATION!
The supply voltage has to be between 12 VDC and 36 VDC (when Ex 12...30Vdc). This is based on the total resistance of the measuring loop. To calculate this, the resistance of each component in the measuring loop (not including the device) must be added together.

The required supply voltage can be calculated using the formula below:
$U_{ext.} = R_L * 22mA + 12V$
where
$U_{ext.}$ = the minimum supply voltage and
R_L = the total measuring loop resistance.

INFORMATION!
The power supply has to be able to supply a minimum of 22 mA.

3.3.2 Current output

The signal converter is a 2-wire device with 4...20mA as output signal for the flow. All other inputs and outputs are passive and always require an additional power supply.

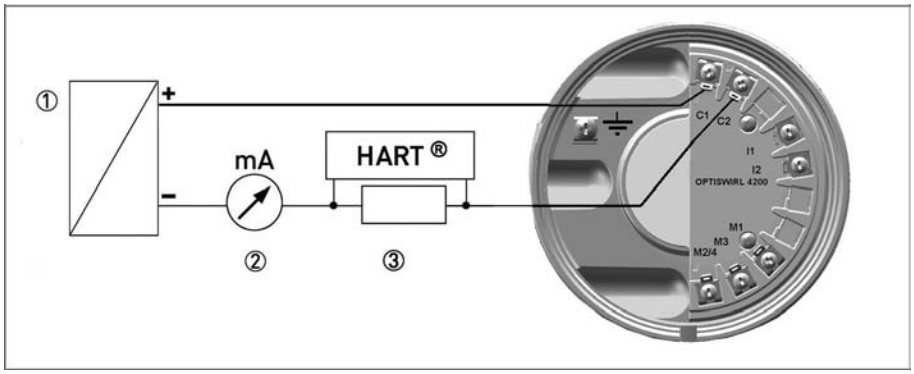


Figure 3-2: Electrical connection current output

① Power supply for current output
② Optional display unit (R_L)
③ Load for HART® ≥ 250 Ω

Connection current output Loop 4..20mA to terminals C1+, C2-
When connection cables are long, a shielded or twisted cable may be necessary. Grounding - the cable shield may only be grounded at one place (e.g. on the power supply unit).

3.3.3 Current input

An external temperature or pressure transmitter can be connected to terminals I1+ and I2-. The 4...20 mA current signal is converted to temperature or pressure in the signal converter.

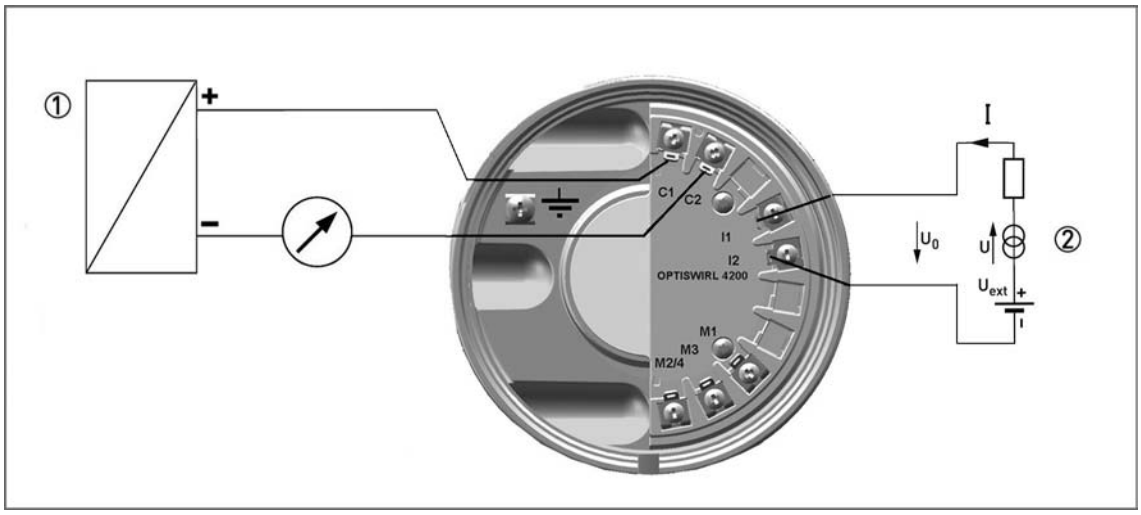


Figure 3-3: Electrical connection current input

① Power supply for the signal converter
② Current input for external temperature or pressure transmitter

3.3.4 Binary output / Status output

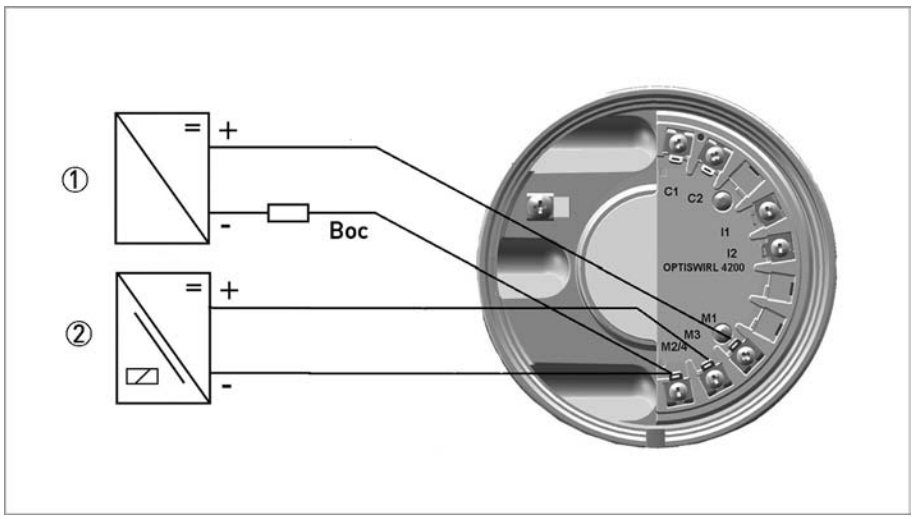


Figure 3-4: Connection binary output

① Power supply $U_{ext.}$
② Isolated switching amplifier

The binary output is electrically separated from the current output and must be separately supplied with power.

INFORMATION!
Binary output Mx can only be operated if the loop supply 4...20 mA) is applied to terminals C1+ and C2-. The binary output comes inactive by default and must thus be activated prior to first use (see Menu C2.2).

Connection binary output
In accordance with the desired signal transmission, select one of the following connection types for binary output M:

- M2/4 and M3 - NAMUR (DC interface in accordance with EN 60947-5-6)
- M2/4 and M1 - Transistor output (passive, open collector)

Terminal connection

Terminal	M1	M3	M2/4
Connection NAMUR		+ (open collector, R_i ~1 kOhm)	Common
Connection transistor output	+ (open collector, Imax<100mA)		Common

Value range NAMUR

	Normally closed	Normally open
Switching value reached	< 1mA	> 3mA
Switching value not reached	> 3mA	< 1mA

Range of values applies only when connected to a switching amplifier with the following reference values:

- Open-circuit voltage U_0 = 8.2 VDC
- Internal resistance R_i = 1 kOhm

Range of values for transistor output

Signal voltages	lower limit	upper limit	lower limit	upper limit
via load R_L	0 V	2 V	16 V	30 V

Signal currents	lower limit	upper limit	lower limit	upper limit
Category 2	0 mA	2 mA	20 mA	100 mA

To safeguard the range of values, a load R_L between 250 Ohm and 1kOhm is recommended for the passive transistor output with a nominal voltage of 24V DC. If other loads are used, caution is advised as the range of values of the signal voltages then no longer corresponds to the range of values for the inputs of process control systems and controls (DIN IEC 946).

CAUTION!
The upper limit of the signal current may not be exceeded as this may damage the transistor output.

3.3.5 Pulse output / Frequency output

The maximum frequency of the pulse output is 500 Hz and the frequency output 1000 Hz.

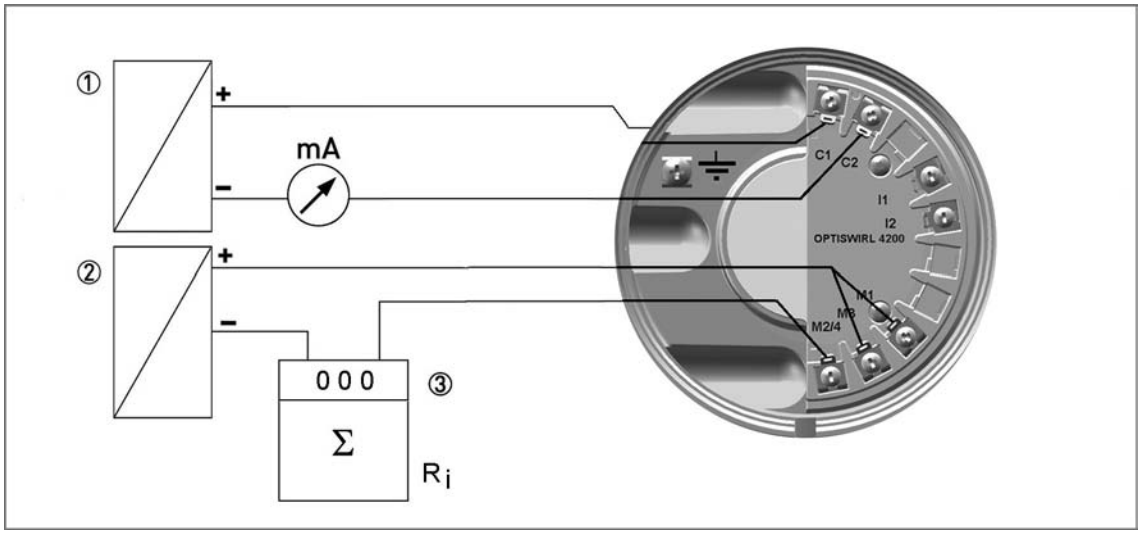


Figure 3-5: Electrical connection pulse output

① Signal converter power supply
② Pulse output power supply
③ Pulse or frequency counter

Connection is made to terminal M2/4 Common (-) and M1 for Hi Current (+) or M3 NAMUR (+).
Only one of the two connections M1 or M3 can be selected in Menu C2.2.
The output is selected as pulse, frequency or binary output in menu item C2.2
The output is a passive "open collector" output which is electrically separated from the current interface and the measuring sensor. It requires its own power supply ②.
The total resistance must be adapted so that the total current I_{tot} does not exceed 120 mA.

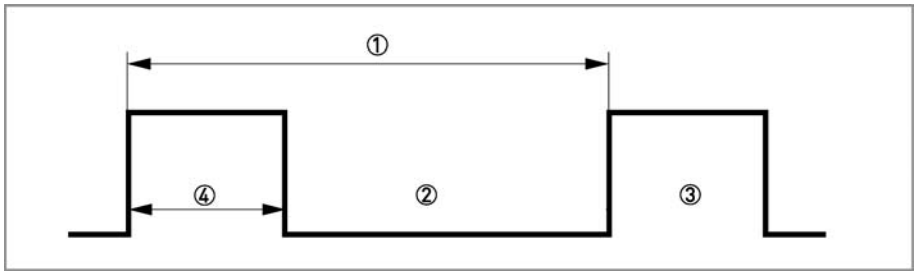


Figure 3-6: Pulse output signal definition

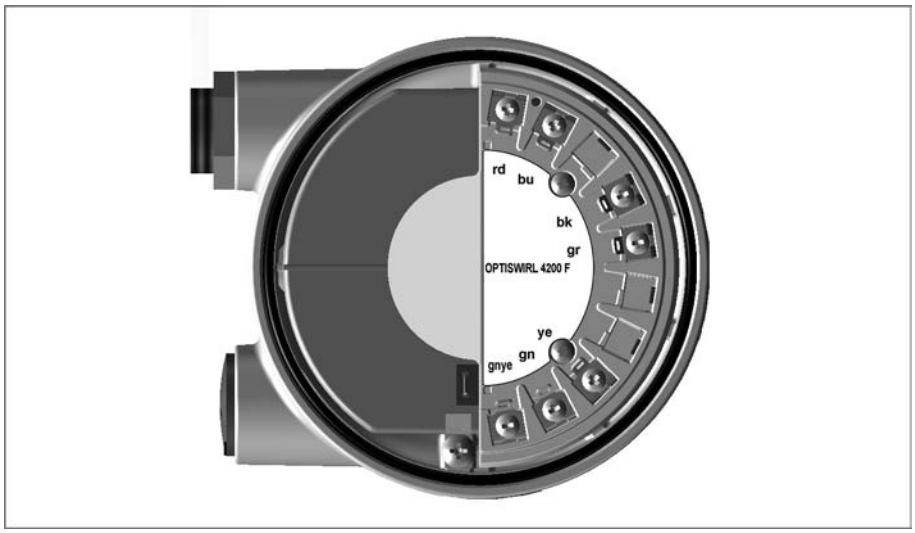
① f_{max}
② closed
③ open
④ Pulse ≥ 250 ms

The + pole of the high current output is on the M1 terminal connection. The + pole of the NAMUR output is on the M3 connection terminal. Terminal M2/4 is the common - pole of the pulse output.

High current terminal M1...M2/4		
Open:	Maximum voltage U_{max} = 36 VDC	Closed current I_R < 1 mA
Closed:	Maximum current I_{max} = 100 mA	Voltage U < 2 VDC

NAMUR terminal M3...M2/4	
R_i = 900 Ω	U_{max} = 36 VDC

3.4 Connection of remote version



The connections in the sensor and wall mount bracket connection boxes are identical in construction.

Connection cable strand colour

Terminals	Strand colour
rd	red
bu	blue
bk	black
gr	grey
ye	yellow
gn	green
gnye	Shielding

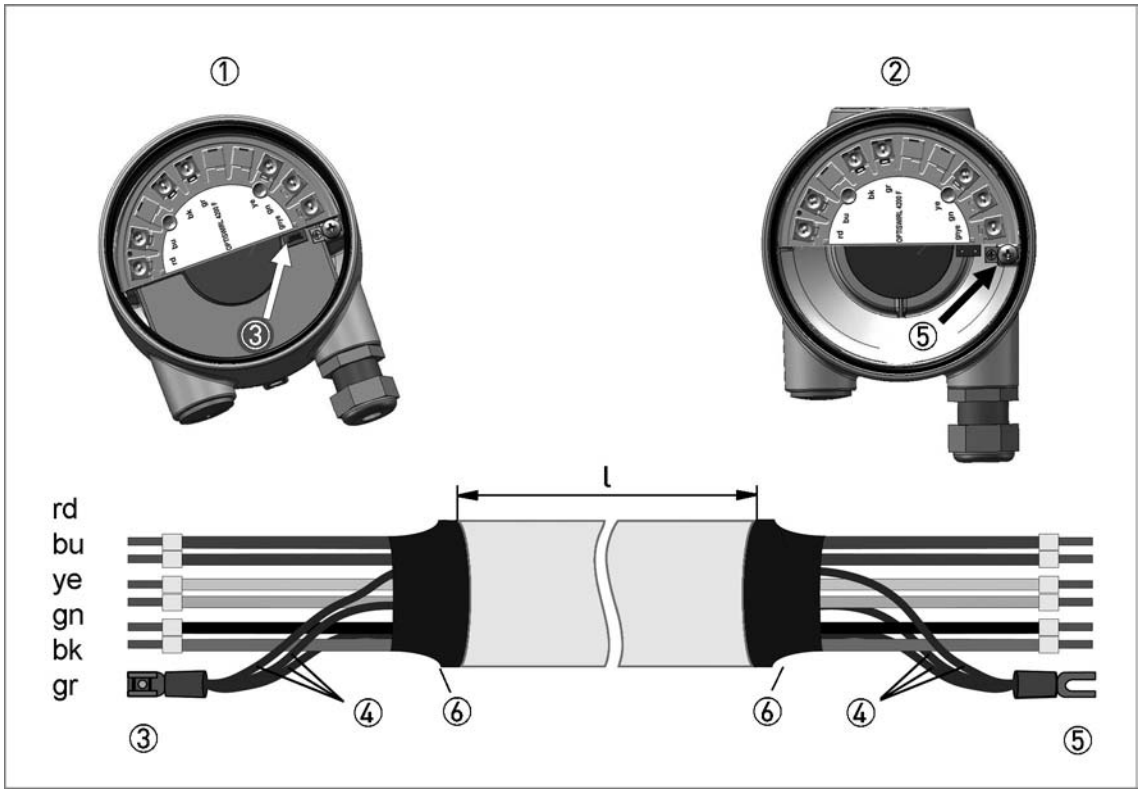


Figure 3-7: Connection of remote version

① Terminal connection measuring sensor
② Terminal connection signal converter
③ Terminal end pair shielding measuring sensor
④ Filler wire pair shielding
⑤ Fork clamp pair shielding signal converter side
⑥ Heat shrink tubing

The maximum cable length is l = 50 m.

3.5 Grounding connections

The grounding can be done either by connecting the PE terminal in the housing or the PE terminal on the connection piece between measuring sensor and signal converter. Both of these electrical connections are equally effective from a technical point of view.

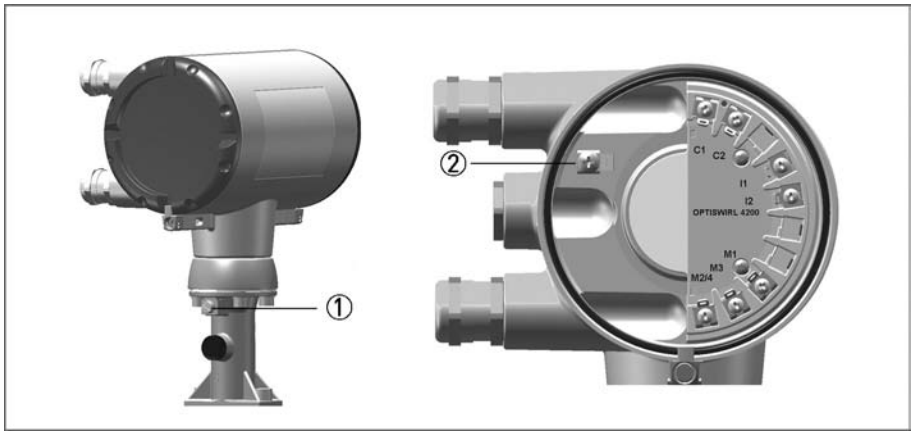


Figure 3-8: Ground connection compact version

① Electrical grounding connection on connection piece between measuring sensor and signal converter.
② Electrical grounding terminal in the housing

CAUTION!
The measuring device has to be grounded properly to achieve accurate measurement. The grounding wire may not transfer any interference voltage.
Do not use this grounding cable to ground any other electrical devices.

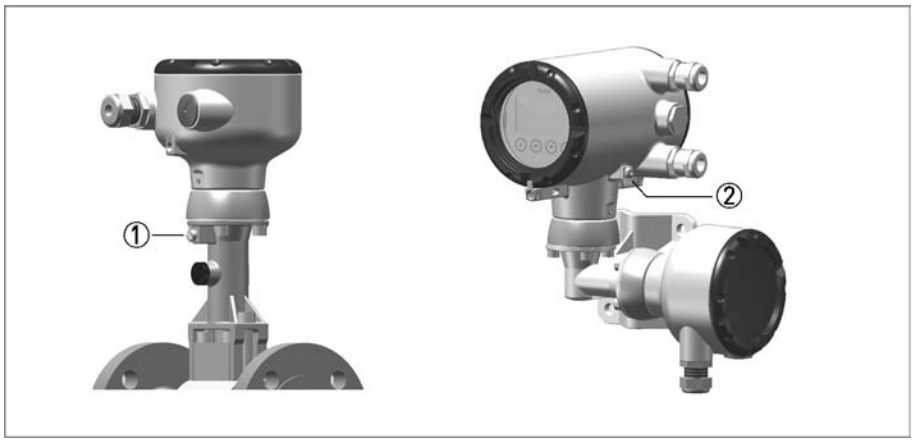


Figure 3-9: Ground connection remote version

① Electrical grounding connection on measuring sensor
② Electrical grounding connection on signal converter housing

INFORMATION!
Both the sensor and the converter must be grounded.

3.6 Ingress protection

Both the compact and remote versions of the measuring device meet all of the requirements for IP66/67.
In the remote version, the measuring device can also be optionally designed as IP66/68.

CAUTION!
After all servicing and maintenance work on the measuring device, the specified protection category must be ensured again.

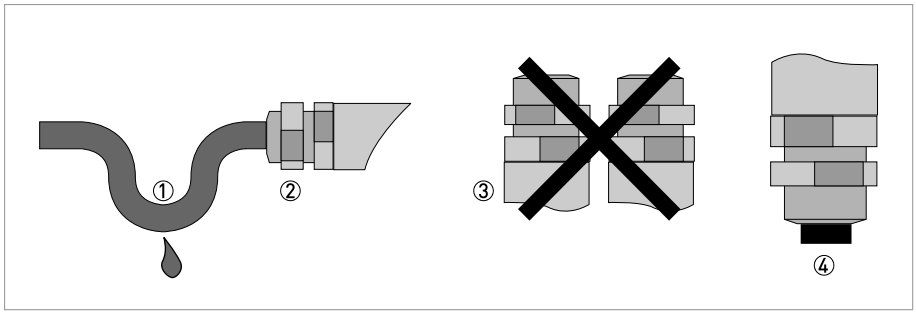


Figure 3-10: Cable feedthrough

Therefore it is essential to observe the following points:

- Use only original gaskets. They must be clean and free of any damage. Defective gaskets must be replaced.
- The electrical cables used must be undamaged and must comply with regulations.
- The cables must be laid with a loop ① upstream of the measuring device to prevent water from getting into the housing.
- The cable feedthroughs ② must be tightened. Note that the clamping range of the cable feedthrough corresponds to the outer diameter of the cable.
- Align the measuring device so that the cable feedthrough is never facing up ③.
- Close any unused cable feedthroughs using blind plugs ④ suitable for the protection category.
- Do not remove the required cable bushing from the cable feedthrough.