OPTISWIRL 4070

Quick Start

Vortex flowmeter

KROHNE

Warnings and symbols used

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

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. They appear on the back of the invoice and 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 cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Check the packing list to check if you received completely all that you ordered.

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

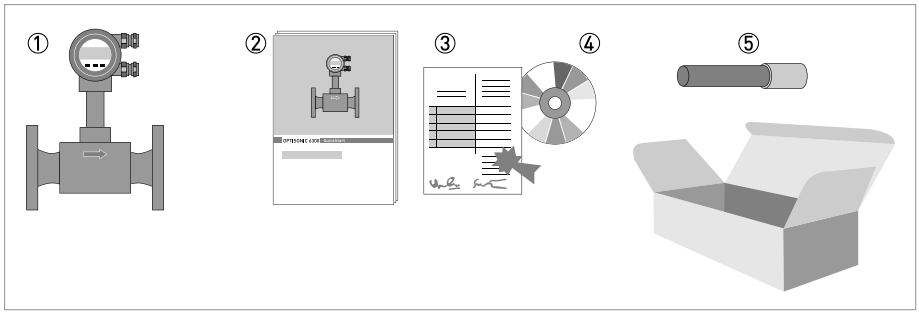


Figure 2-1: Scope of delivery

① Measuring device in ordered version
② Quick Start
③ Certificates, calibration report and parameter datasheet
④ CD with complete documentation
⑤ Bar magnet

2.2 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.

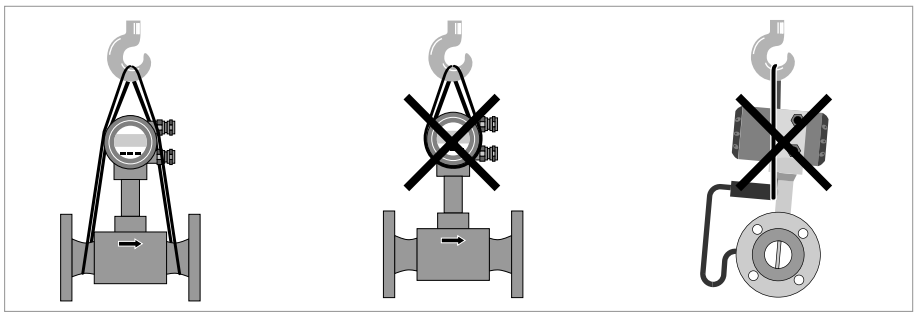


Figure 2-2: Transport instructions

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.

2.3 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.
In the event of vibrations on the piping, select the installation site so that the vibrations are at their lowest in a transverse direction to the flowmeter.

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 a centering ring.*
- *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 the danger of waterhammers can occur in steam networks appropriate condensate separators have to be installed.
Suitable measures must be taken to avoid water cavitation if it is a possible risk.

2.3.1 Measurement of liquids

Prohibited installation

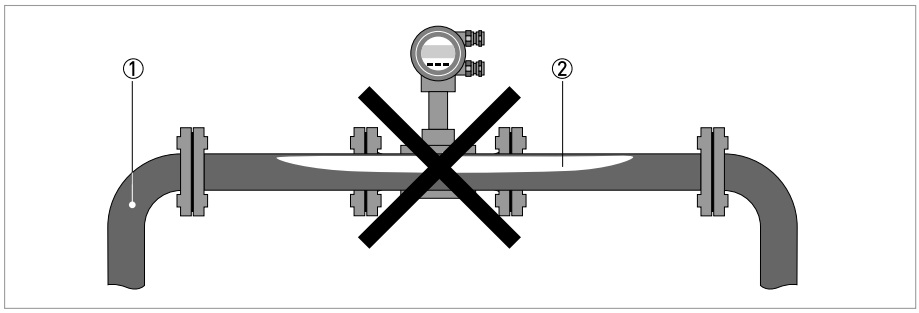


Figure 2-3: Upper pipe bend

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.

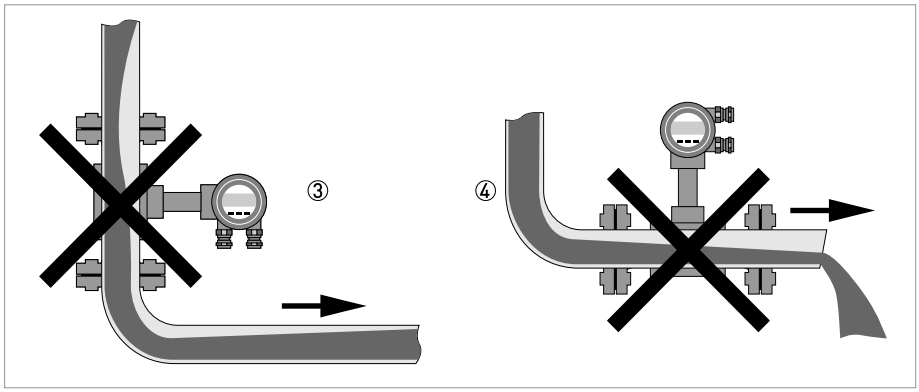
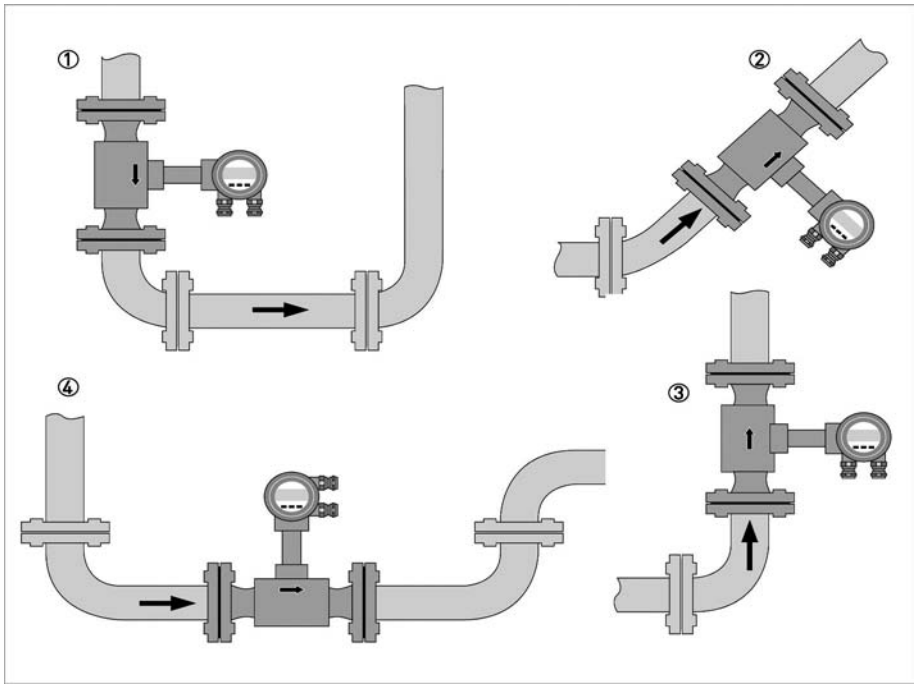


Figure 2-4: Downpipe and outlet

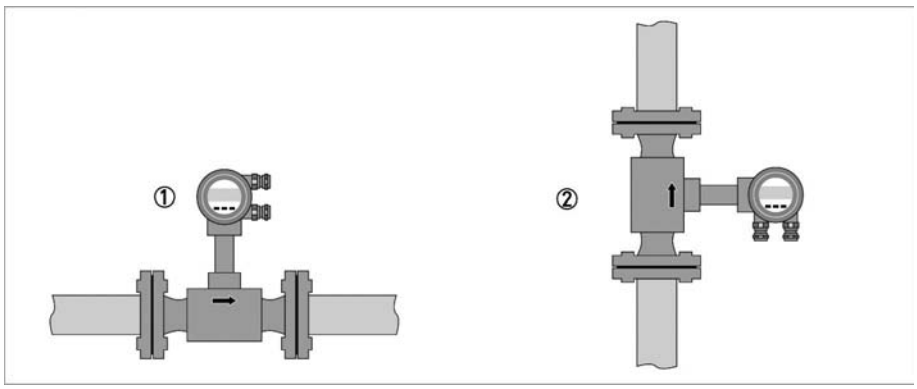
CAUTION!
Prohibited: Installing the device in a downstream pipe ③ or upstream pipe of a outlet ④. There is the risk of partially filled pipes.

Recommended installations for measurement of liquids

CAUTION!
It is absolutely necessary to comply with the required inlet and outlet runs.



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.

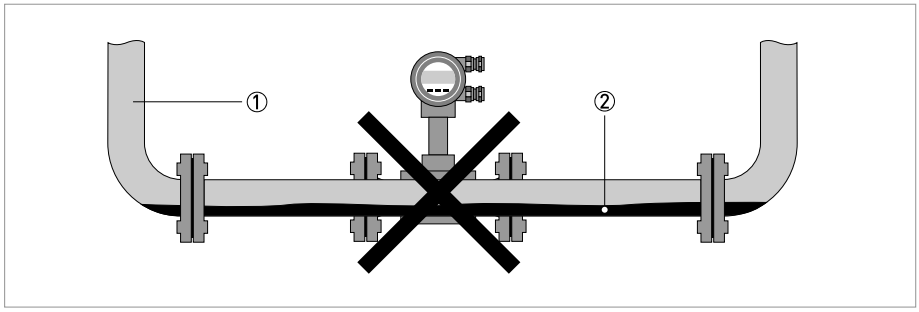


① Above a horizontal pipe
② On a vertical pipe

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

2.3.2 Measurement of vapours and gases

Prohibited installation

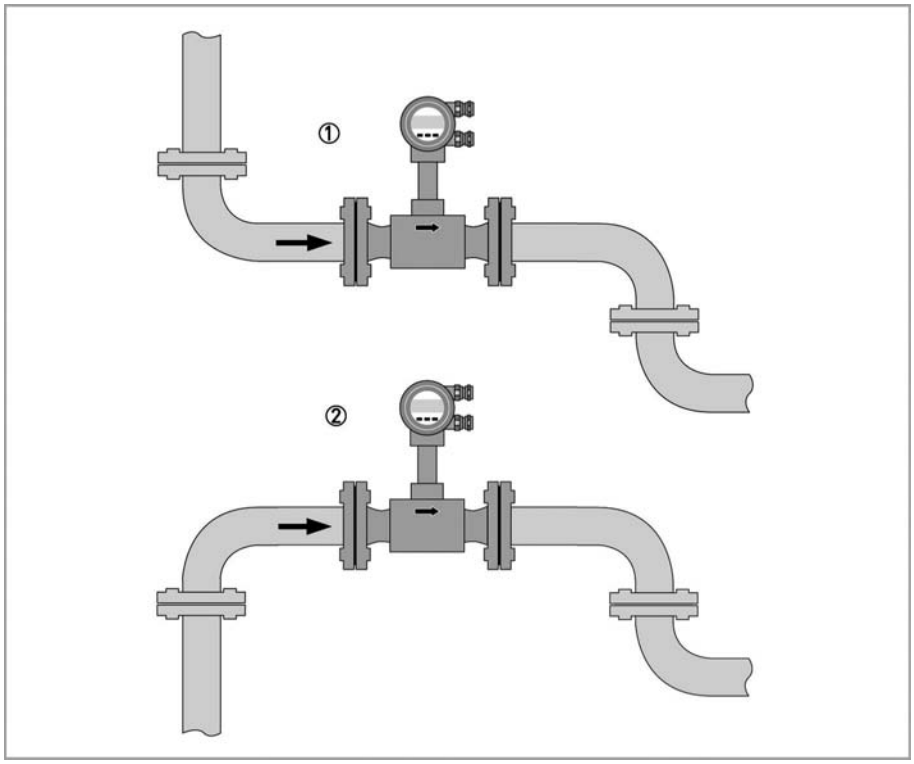


① Lower pipe bends
② Condensate

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.

Recommended installations

CAUTION!
It is absolutely necessary to maintain the required inlet and outlet runs.



① Inlet and outlet falling
② Rising inlet - falling outlet

2.3.3 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.

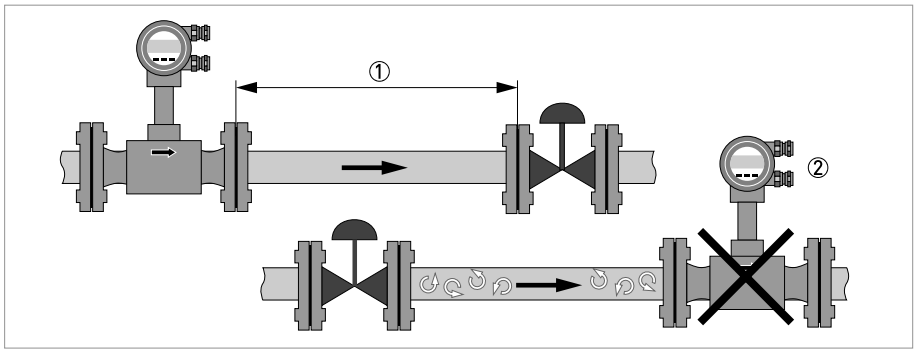
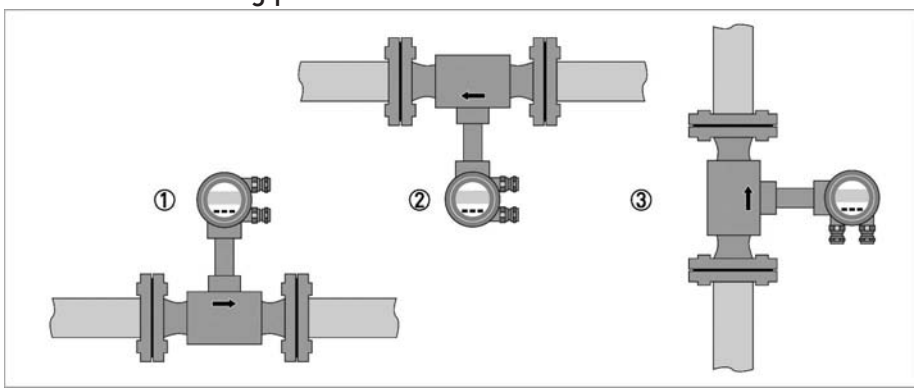


Figure 2-5: Pipeline with control valve

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.

2.3.4 Preferred mounting position

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. For further information refer to Turning the display on page 12.

2.3.5 Turning the connection housing

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

CAUTION!
Do not damage the electrical cable by overtwisting it.
Do not remove the electrical connector.

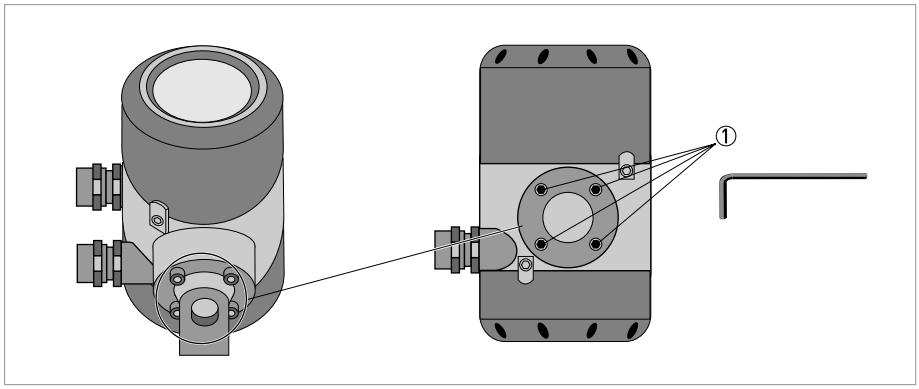


Figure 2-6: Allen screws on connection housing

- Disconnect the power supply from the measuring device.
- Loosen the four screws ① on the rear side of the connection housing.
- Lift the connection housing and turn it to the required position in 90° steps.
- Screw the connection housing back on.

2.3.6 Turning the display

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

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°.

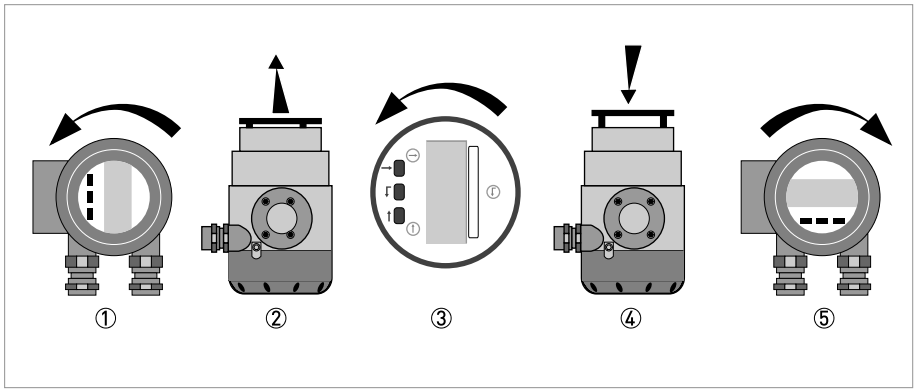


Figure 2-7: Turning the display

Turn the display as follows:

- Disconnect the power supply from the measuring device.
- Unscrew the cover in front of the display ① from the connection housing.
- Pull the display ② carefully a few centimetres out of the anchor fitting and turn it to the required 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.

2.3.7 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 up to the connecting screws of the measuring sensor.

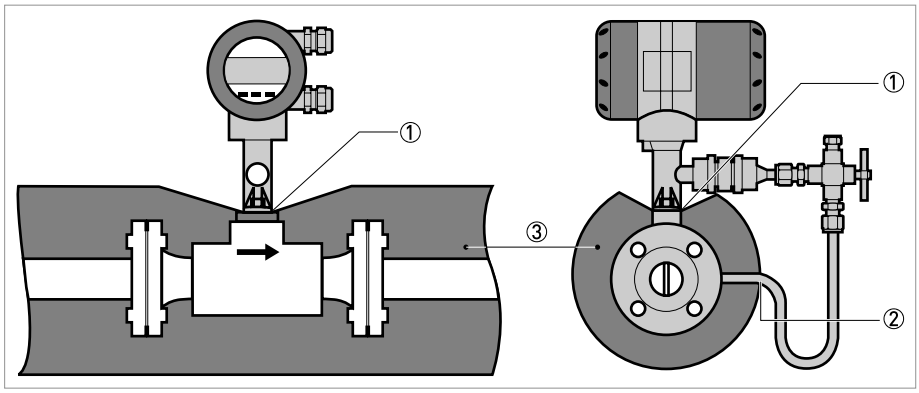


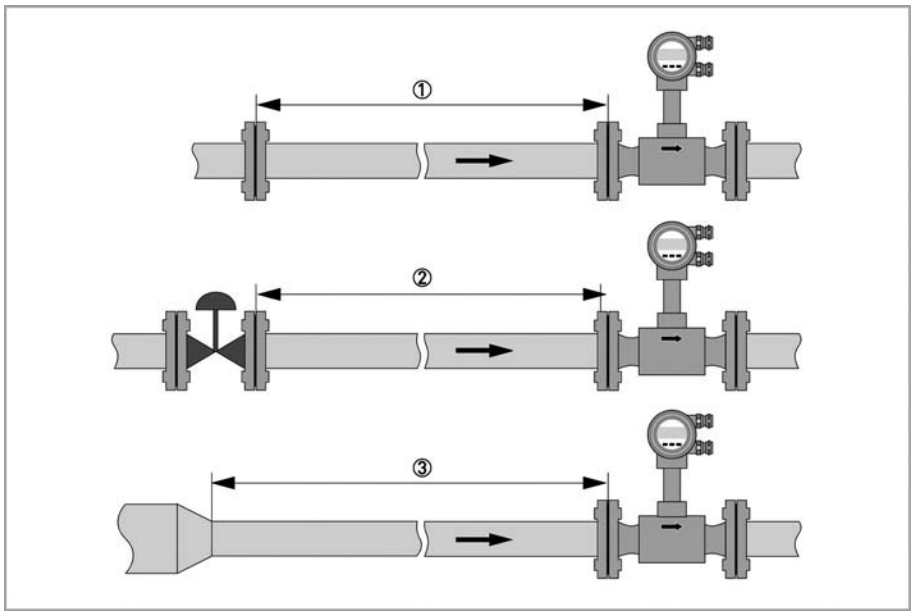
Figure 2-8: Heat insulation on connection piece and signal cable

① Max. height of insulation up to intermediate piece between measuring sensor and signal converter
② Max. thickness of the insulation up to the bend of the pressure pipe
③ Insulation

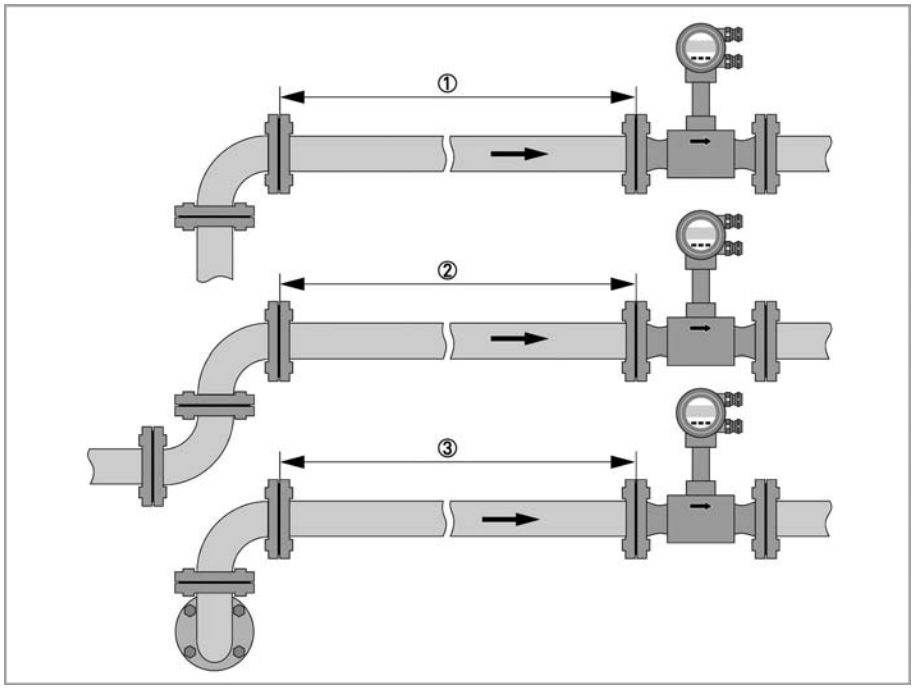
CAUTION!
The heat insulation ③ may only extend as far as the bend of the pressure sensing line ②.

2.4 Inlet and outlet runs

2.4.1 Minimum inlet runs



① General inlet run without disturbing flow ≥ 20 DN
② Behind a control valve ≥ 50 DN
③ After a pipe diameter reduction ≥ 20 DN



① After a single bend 90° ≥ 20 DN
② After a double bend 2x90° ≥ 30 DN
③ After a double three-dimensional bend 2x90° ≥ 40 DN

2.4.2 Minimum outlet runs

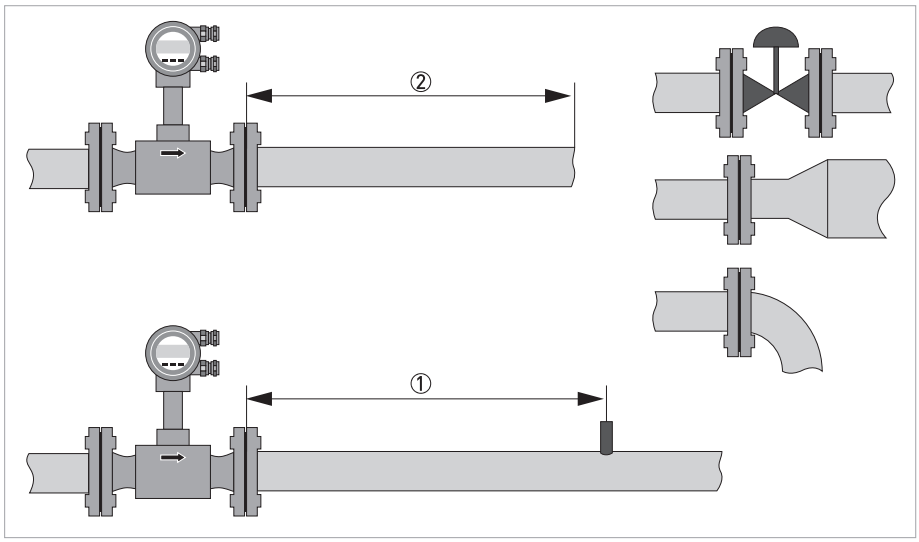


Figure 2-9: Minimum outlet runs

① Upstream of pipe expanders, pipe bends, control valves, etc. ≥ 5 DN
② Upstream of metering points ≥ 5...6 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. External temperature sensor must be located ≥ 5 DN behind the flow sensor outlet. Use sensors that are as short as possible to avoid disturbing the flow profile.

2.4.3 Flow straightener

If, due to the type of installation, the required inlet runs 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 run.

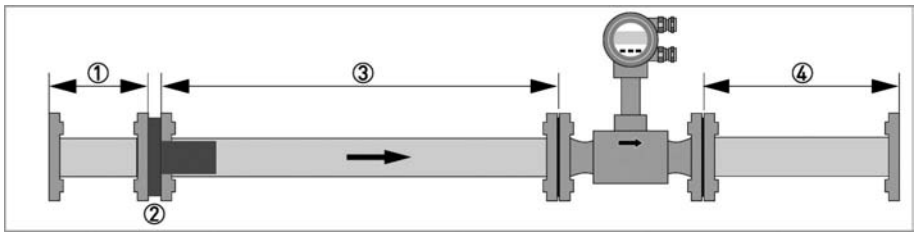


Figure 2-10: Flow straightener

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

2.5 Installation

2.5.1 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:

- Remove all transportation safety devices and protective coverings from 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 metering points with varying thermal loads, the flowmeters 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 metering point.

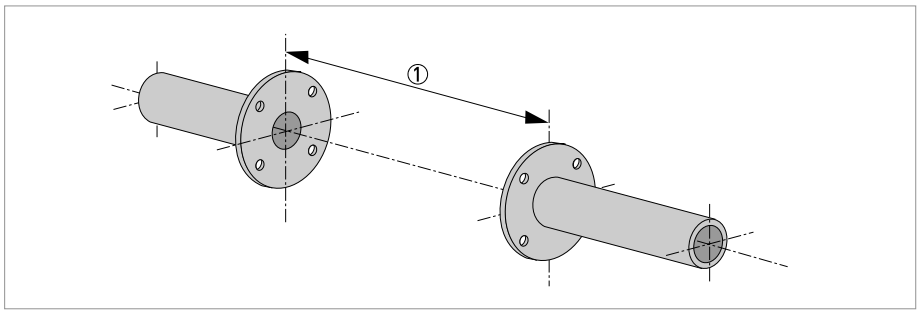


Figure 2-11: Preparing the metering point

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.

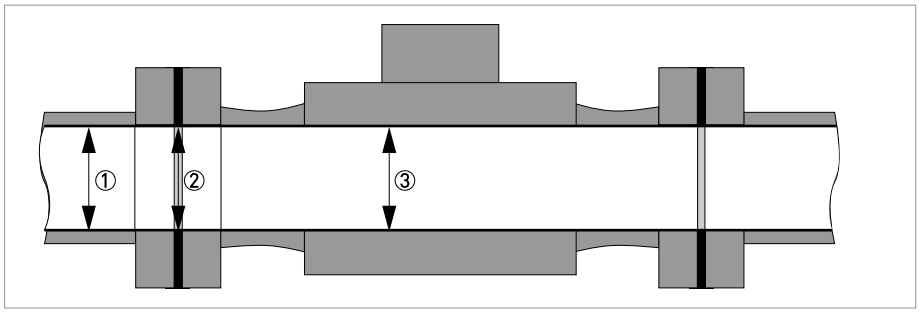


Figure 2-12: Internal diameter

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

2.5.2 Installing devices in flange design

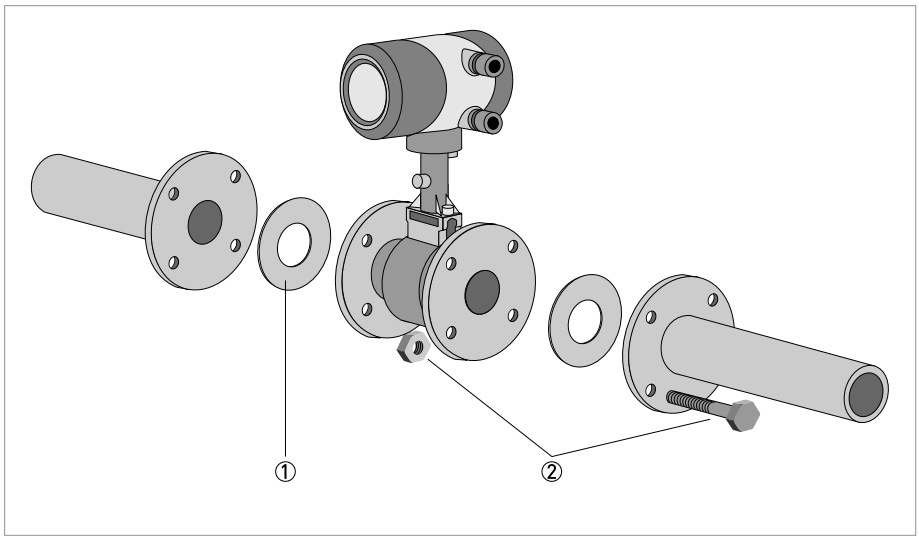


Figure 2-13: Installing devices in flange design

① Gasket
② Bolts with fixing 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.

2.5.3 Installing devices in sandwich design

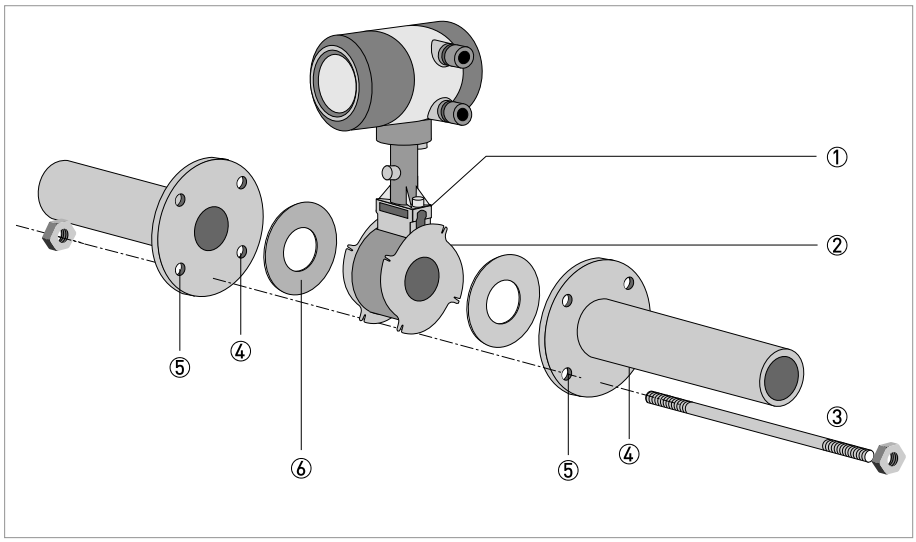


Figure 2-14: Installation using centering ring

① Measuring sensor
② Centering ring
③ Bolts with fixing nuts
④ Hole
⑤ Hole
⑥ Gasket

- Push the first bolt ③ through the hole ⑤ 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 ⑥ 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 ⑥ are concentric; they must not protrude into the pipe cross-section.
- Now tighten all nuts bit by bit alternately across the diagonal.

3.1 Safety instructions

DANGER!
Only perform work on the electrical connections in the de-energized state.
Take note of the voltage data on the nameplate!

DANGER!
Observe national installation regulations!

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

3.2 Connecting the signal converter

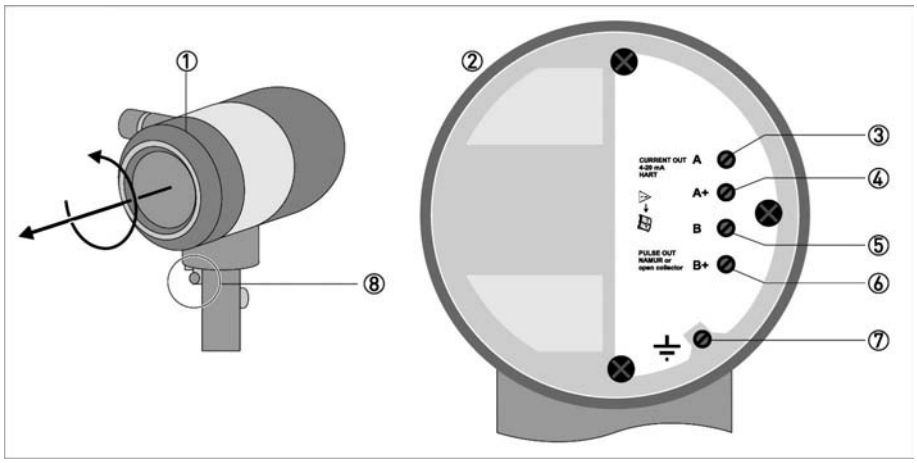


Figure 3-1: Signal converter housing with housing cover

① Housing cover of the electrical terminal compartment
② Electrical connection terminals with the housing cover open
③ Terminal A current output -
④ Terminal A+ current output +
⑤ Terminal B pulse output -
⑥ Terminal B+ Pulse output +
⑦ PE terminal in housing
⑧ PE terminal on connection piece between measuring sensor and signal converter.

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

The following procedures are to be performed:

- Unscrew the housing cover ① of the electrical terminal compartment.
- Thread the connection cable through the leadthrough in the housing.
- Connect the cable for the current output and the cable for the optional pulse output as shown in the cable terminal diagrams below. To facilitate installation the connection plug can be removed from the device. The plug is configured in such a way as to prevent reverse polarity.
- Connect the grounding to terminal ⑦ alternatively use the PE terminal on the connection piece between measuring sensor and signal converter ⑧.
- Tighten the cable glands.
- Hand-tight the housing cover with gasket.

3.3 Electrical connection of current and pulse output

- **Current output:**
  In some cases, a shielded or twisted cable may be necessary. The cable shield may only be earthed (grounded) at one place (on the power supply unit).
- **Pulse output:**
  When using the pulse output, two separate signal circuits are necessary if the pulse output is utilized together with analogue signals. Each signal circuit requires its own power supply. The total resistance must be adapted so that the total current I_{tot} does not exceed 100 mA.
- Connection current output on terminals A, A+
  Connection pulse output on terminals B, B+

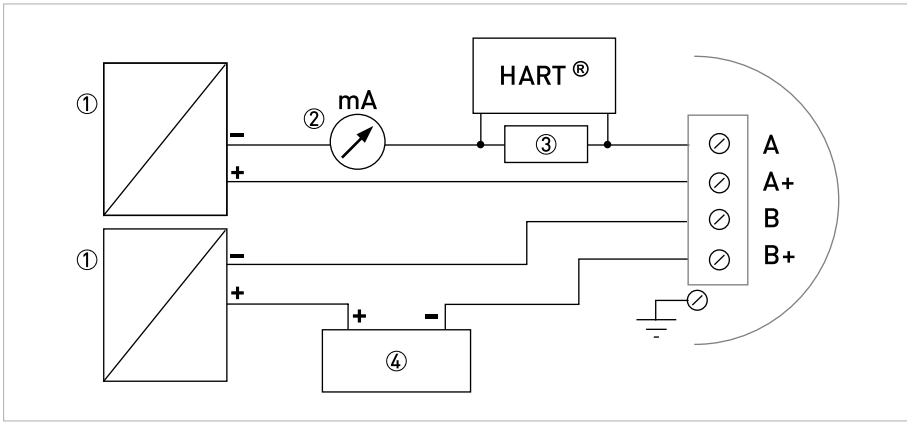


Figure 3-2: Electrical connection of current and pulse output

① Power supply per signal circuit
② Optional display unit
③ Load for HART® ≥ 250 Ω
④ e.g. counter

The maximum load resistance is calculated as follows:

$$R_L = \frac{U_{ext.} - 14\,V}{22\,mA}$$

3.4 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.

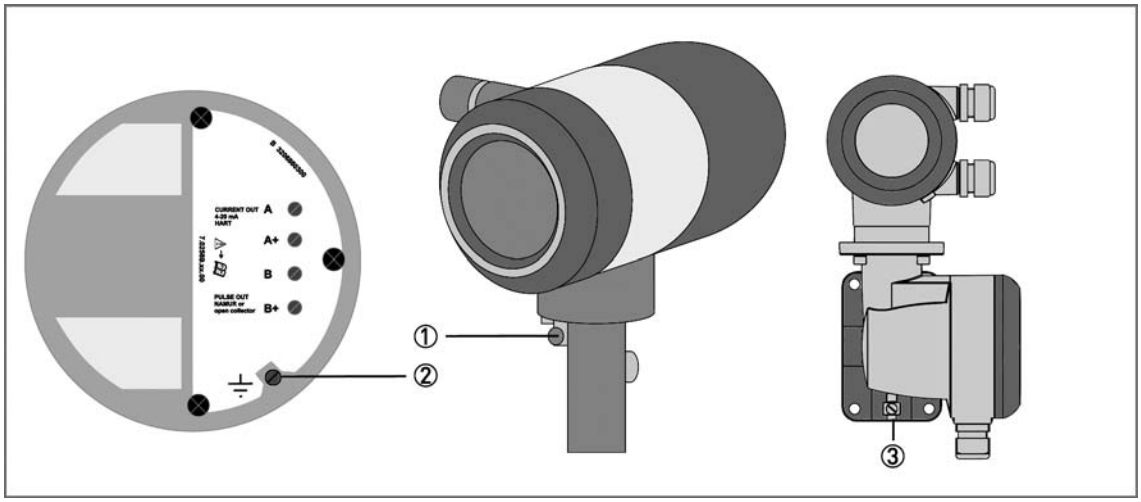


Figure 3-3: Grounding connection

① Electrical grounding connection on connection piece between measuring sensor and signal converter.
② Electrical grounding connection on housing
③ Electrical earth connection on remote version

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 wire to ground any other electrical devices.

3.5 Protection category

The measuring device meets all requirements of protection category IP66/67.

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

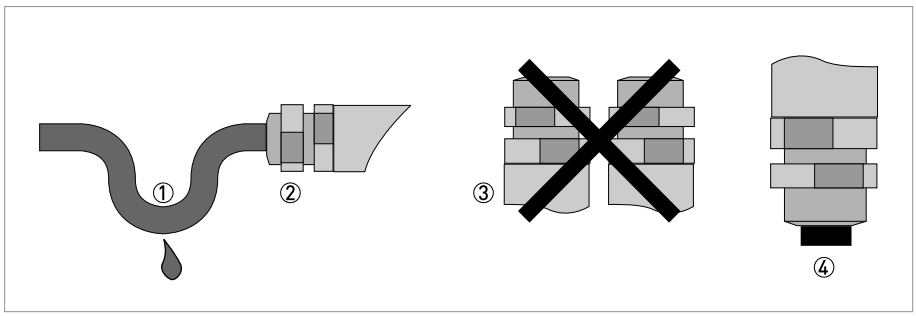


Figure 3-4: Cable feedthrough

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.
- Align the measuring device so that the cable feedthrough is never facing up ③.
- Close the unused cable feedthroughs using blind plugs ④.
- Do not remove the required cable bushing from the cable feedthrough.

4.1 Technical data

INFORMATION!

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local representative.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).*

Measuring system

Application range	Flow measurement of liquids, gases and vapours
Operating method / measuring principle	Karman vortex street
Measured value	
Primary measured value	Number of separated vortices
Secondary measured value	Operating and standard volumetric flow, mass flow
Signal converter	
Versions	Compact
	Option: Ex version
Measuring sensor	
Standard	Basic device in flange version (with integrated temperature measurement)
	Basic device in sandwich version (with integrated temperature measurement)
Optional	Basic device with additional pressure measurement
	Basic device with additional pressure measurement and shut-off valve for pressure sensor
	Dual measuring device in both flange and sandwich version (redundant measurement)
	Dual measuring device in flange version with additional pressure measurement
Display and user interface	
Local display	2 lines, 10 characters per line
Operating and display languages	German, English, French

Measuring accuracy

Reference condition	Water at 20ºC
	Air at 20°C and 1.013 bar abs.
Accuracy	Based on volume flow
Liquids	±0.75% of measured value (Re ≥ 20000)
	±2.0% of measured value (10000 < Re < 20000)
Gases and steams	±1.0% of measured value (Re ≥ 20000)
	±2.0% of measured value (10000 < Re < 20000)
	Pressure and temperature compensation: ±1.5% of measured value (Re ≥ 20000); ±2.5% of measured value (10000 < Re < 20000)
Repeatability	±0.1% of measured value
Long-term stability	±0.01% of measured value

Operating conditions

Temperature	
Product	-40...+240°C / -40...+465°F
Ambient	Non-Ex: -40...+85°C / -40...+185°F
	Ex: -40...+60°C / -40...+140°F
Storage	-50...+85°C / -58...+185°F
Pressure	
Product	Max. 100 bar / 1450 psi; Information on higher pressures on request.
Ambient	Atmosphere
Chemical properties	
Density	Taken into consideration when sizing.
Viscosity	< 10 cP
Reynold's number	10000...2300000
Recommended flow velocities	
Liquids	0.3...7 m/s / 0.98...23 ft/s (optional up to 10 m/s / 32.8 ft/s taking cavitation into account)
Gases and steams	2.0...80 m/s / 6.6...262.5 ft/s
	DN15: 3.0...45 m/s / 9.8...148 ft/s; DN25: 2.0...70 m/s / 6.6...230 ft/s
	For detailed information, see chapter "Flow tables".
Other conditions	
Protection category	IP 66/67

Installation conditions

Inlet run	≥ 20 x DN (without disturbing flow, after pipe narrowing, after a single 90° bend)
	≥ 30 x DN (after a double bend 2x90°)
	≥ 40 x DN (after a double three-dimensional bend 2x90°)
	≥ 50 x DN (after control valves)
	≥ 2 DN before flow straightener; ≥ 8 DN after flow straightener (specified values apply only to original ≥ 20 DN inlet run)
Outlet run	≥ 5 x DN
Dimensions and weights	For detailed information refer to chapter "Dimensions and weights".

Materials

Measuring sensor and process connections	Standard: 1.4404/316L
	Option: Hastelloy® C-22 on request
Converter housing	Die-cast Aluminium
Pressure sensor gasket	Standard: FPM
	Option: FFKM
Measuring tube gasket	Standard: 1.4435/316L
	Option: Hastelloy® C-276
	Selection depends on measuring sensor material/medium.

Process connections

Flange version	
DIN EN 1092-1	DN15...300 in PN16...100
ASME B16.5	½...12" in 150...600 lb
JIS B 2220	DN15...300 in JIS 10...20 K
	For detailed information on combination flange/pressure rating, refer to chapter "Dimensions and weights".
Sandwich version	
DIN	DN15...100 in PN100 (higher pressures on request)
ASME	½...4" in 600 lb (higher pressures on request)
JIS	DN15...100 in 10...20 K (higher pressures on request)

Electrical connections

Power supply	Non-Ex: 14...36 VDC
	Ex: 14...30 VDC
Current output	
Description of the used abbreviations	U_{ext} = external voltage; R_L = load + resistance
Measuring range	4...20 mA (max. 20.8 mA) + HART® protocol
Load	Minimum 0 Ω; maximum R_L = ((U_{ext} - 14 VDC) / 22 mA)
Error signal	Acc. to NAMUR NE43
	Upper value: ≥ 21.0 mA
	Lower value: ≤ 3.6 mA (not with HART® protocol)
Pulse output	
Pulse rate	Max. 0.5 pulse/s (corresponds to 1800 pulses/hour)
Power supply	Non-Ex: 24 VDC as NAMUR or open < 1 mA, maximum 36 V, closed 100 mA, U < 2 V
	Ex: 24 VDC as NAMUR or open < 1 mA, maximum 30 V, closed 100 mA, U < 2 V
HART®	
	HART® protocol via current output
Device revision	1
Physical layer	FSK
Device category	Transmitter, galvanically isolated
System requirements	Load min. 250 Ω
Multidrop operation	4 mA

Approvals and certifications

ATEX	ATEX II 2G Ex d ia [ia] IIC T6
FM	Class I, II, III Div 1/2, groups A-G

KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Measuring systems for the oil and gas industry
- Measuring systems for sea-going tankers

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