OPTISWIRL 5080 Handbook

Vortex flowmeter for high temperature applications

KROHNE

IMPRINT

1.1 Intended use

CAUTION!
Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

INFORMATION!
This device is a Group 1, Class A device as specified within CISPR11:2009. It is intended for use in industrial environment. There may be potential difficulties in ensuring electromagnetic compatibility in other environments, due to conducted as well as radiated disturbances.

INFORMATION!
The manufacturer is not liable for any damage resulting from improper use or use for other than the intended purpose.

The vortex flowmeters are used for flow measurement of gases, vapours and liquids.

- The flow sensors are made from stainless steel 316 or 304 or CX2MW Nickel Alloy (equivalent to Hastelloy® C).
- In your project planning, please observe the data given in the corrosion tables.
- The pressure-bearing parts have been designed and rated for stationary operation taking into account the maximum pressure and temperature.
- Observe the maximum process data indicated on the nameplate.
- External forces and moments, caused e.g. by pipe stresses, have not been taken into account.

1.2 Certifications

CE marking

The device fulfils the statutory requirements of the following EU directives:

- Pressure equipment directive
- EMC directive
- Devices for use in hazardous areas: ATEX directive

as well as

- NAMUR recommendations NE 21 and NE 43

The manufacturer certifies successful testing of the product by applying the CE marking. An EU declaration of conformity regarding the directives in question and the associated harmonised standards can be downloaded from our website.

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

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

The contents of this document have been created with great care. Nevertheless, we provide no guarantee that the contents are correct, complete or up-to-date.

The contents and works in this document are subject to copyright. Contributions from third parties are identified as such. Reproduction, processing, dissemination and any type of use beyond what is permitted under copyright requires written authorisation from the respective author and/or the manufacturer.

The manufacturer tries always to observe the copyrights of others, and to draw on works created in-house or works in the public domain.

The collection of personal data (such as names, street addresses or e-mail addresses) in the manufacturer's documents is always on a voluntary basis whenever possible. Whenever feasible, it is always possible to make use of the offerings and services without providing any personal data.

We draw your attention to the fact that data transmission over the Internet (e.g. when communicating by e-mail) may involve gaps in security. It is not possible to protect such data completely against access by third parties.

We hereby expressly prohibit the use of the contact data published as part of our duty to publish an imprint for the purpose of sending us any advertising or informational materials that we have not expressly requested.

1.3.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.3.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation or operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.3.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of icons as shown below.

1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

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

DANGER!
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

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.

LEGAL NOTICE!
This note contains information on statutory directives and standards.

- 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.

1.4 Safety instructions for the operator

WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery

INFORMATION!
Inspect the packaging carefully for damages 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!
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.

The scope of delivery is:

- Flowmeter in ordered version
- Product documentation
- Hex nut spacer (for sandwich version only)

2.2 Device versions

Available standard versions:

- Signal converter (compact or remote)
- Flow sensor as flange version (compact or remote)
- Flow sensor as sandwich version (compact or remote)

Available optional versions:

- Dual measuring device in both flange and sandwich version (redundant measurement)

2.2.1 Devices as flange version

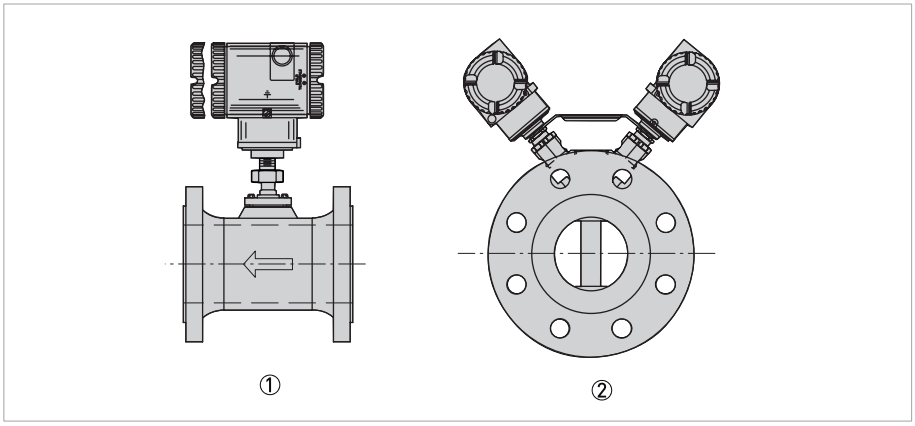


Figure 2-1: Examples of flange versions (compact)

① Single compact version (standard)
② Dual compact version (option)

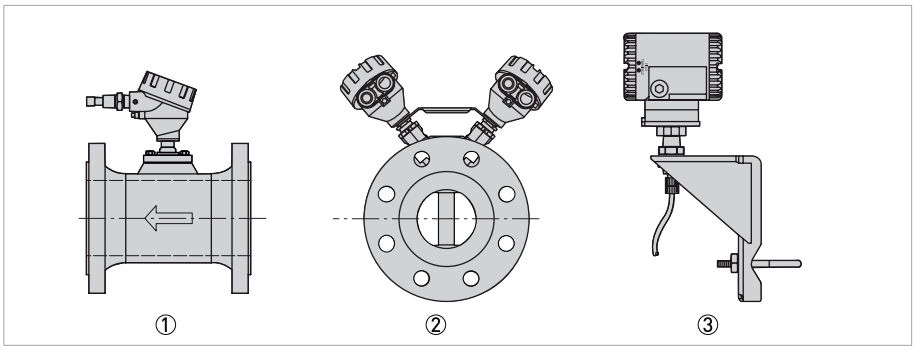


Figure 2-2: Examples of flange versions (remote)

① Single remote flow sensor (standard)
② Dual remote flow sensor (option)
③ Remote signal converter and mounting bracket

2.2.2 Devices as sandwich version

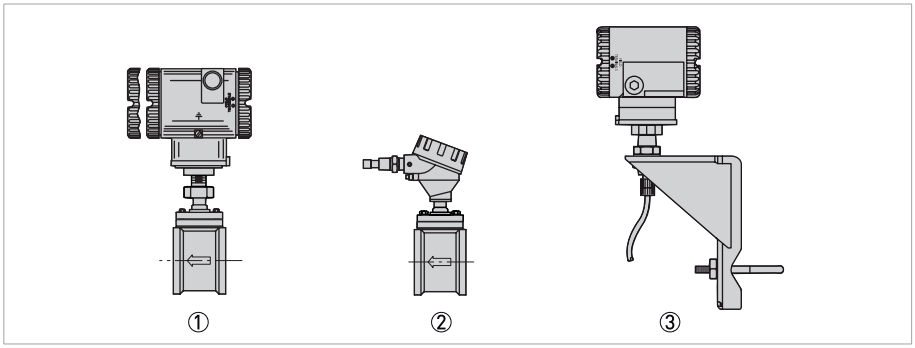


Figure 2-3: Examples of sandwich versions

① Compact sandwich version
② Remote flow sensor
③ Remote signal converter and mounting bracket

2.3 Nameplate

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.

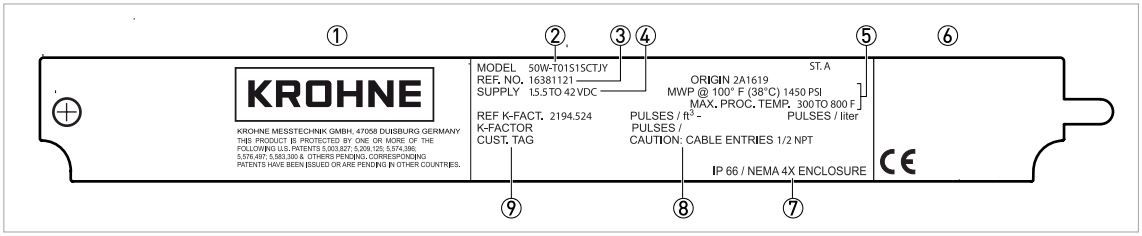


Figure 2-4: Example of a nameplate for the compact version

① Manufacturer logo and address
② Model number
③ Reference number
④ Power supply data
⑤ Max. working pressure and max. process temperature
⑥ Information from notified body, if applicable
⑦ IP rating for enclosure
⑧ Flow data and message on cable entries
⑨ Reference K-factor and customer tag

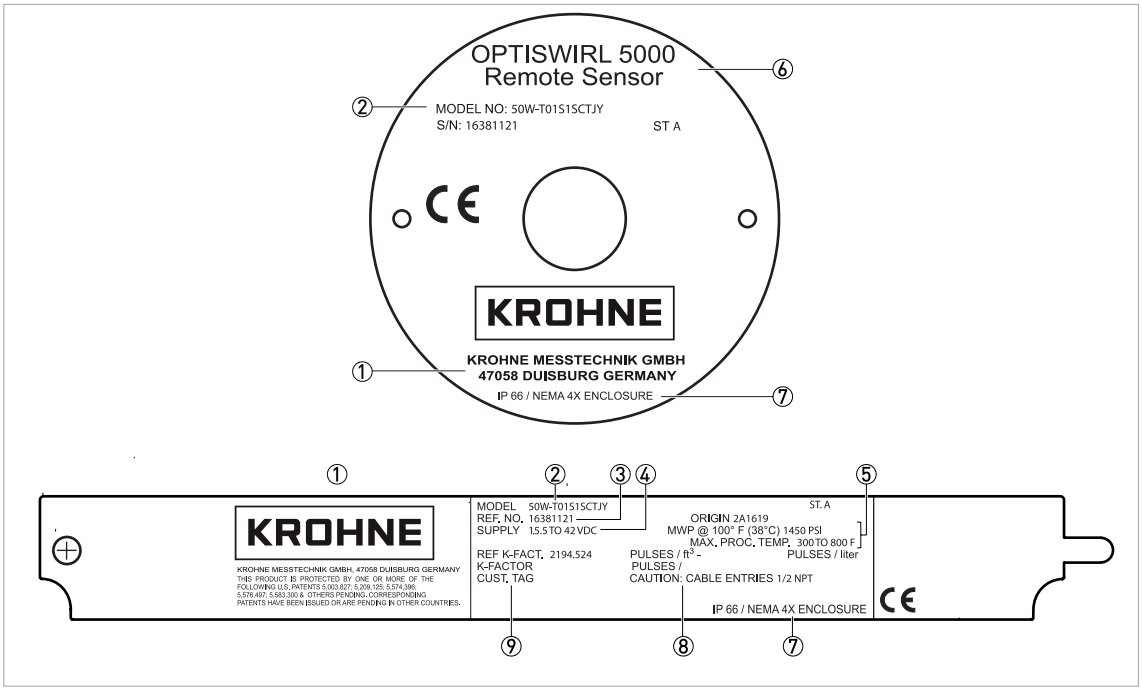


Figure 2-5: Example of a nameplate for the remote version

① Manufacturer logo and address
② Model number
③ Reference number
④ Power supply data
⑤ Max. working pressure and max. process temperature
⑥ Product designation
⑦ IP rating for enclosure
⑧ Flow data and message on cable entries
⑨ Reference K-factor and customer tag

3.1 General notes and unpacking

These flowmeters must be installed by trained personnel to meet all applicable local installation regulations, such as hazardous location requirements, electrical wiring codes and mechanical piping codes. The signal converter housing must be grounded to insure proper operation and peak performance.

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

INFORMATION!
Sandwich flowmeters may (depending on pressure rating of flanges with which they are used) have a set of centering spacers included. Do not discard these centering spacers. They must be used to install the flowmeter properly.

The flowmeter is built to be durable, but it is part of a calibrated precision system and should be handled as such.

Flowmeters with remote-mounted electronics have a cable connecting the flowmeter junction box and electronics housing. Do not allow the weight of either the flowmeter body or electronics housing to be supported by the remote cable.

Remove the flowmeter body from the shipping carton using care to avoid dropping or otherwise subjecting it to impact, particularly at the flange or sandwich faces. Never put anything through the flowmeter body for lifting purposes as damage to the shedder bar may occur.

After removing the flowmeter body from its shipping carton, inspect it for visible damage. If any damage is observed, notify the carrier immediately and request an inspection report. Obtain a signed copy of the report from the carrier. The calibration certificate and any other documentation shipped with the meter should be separated from the packing material and held for future reference. Re-install any flange covers or protective material to safeguard the flowmeter until it is installed.

Packing material should be disposed of in accordance with local regulations. All packing material is non hazardous and is generally acceptable to landfills.

3.2 Storage

- Store the device in a dry, dust-free location.
- Avoid extended direct exposure to the sun.
- Store the device in the original packaging.
- The permissible storage temperature for standard devices is -40...+85°C / -40...+185°F.

3.3 Transport

- Use lifting straps wrapped around both process connections for transport.
- Do not lift measuring devices by the signal converter housing for transport.
- Do not use lifting chains as they may damage the housing.

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.

3.4 Installation conditions

INFORMATION!
For accurate volumetric flow measurement the measuring device needs a completely filled pipe and a fully developed flow profile.

CAUTION!
Any vibration will distort the measuring result. That is why any vibrations in the pipeline must be prevented through suitable measures.

CAUTION!
Procedures to carry out before installing the device:

- *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.*
- *Never install the device directly behind piston compressors or rotary piston meters.*
- *The device must not be heated by radiated heat (e.g. exposure to the sun) to a electronics housing surface temperature above the maximum permissible ambient temperature. If it is necessary to prevent damage from heat sources, a heat protection (e.g. sun shade) has to be installed.*
- *Do not lay signal cables directly next to cables for the power supply.*
- *At product temperatures or ambient temperatures >+65° C / +149° F, a connection cable and cable glands with a minimum service temperature of +80° C / +176° F must be used.*

INFORMATION!
If there is a risk of water hammers in steam networks, appropriate condensate separators must be installed. Suitable measures must be taken to avoid water cavitation if it is a possible risk.

3.4.1 Installation when measuring liquids

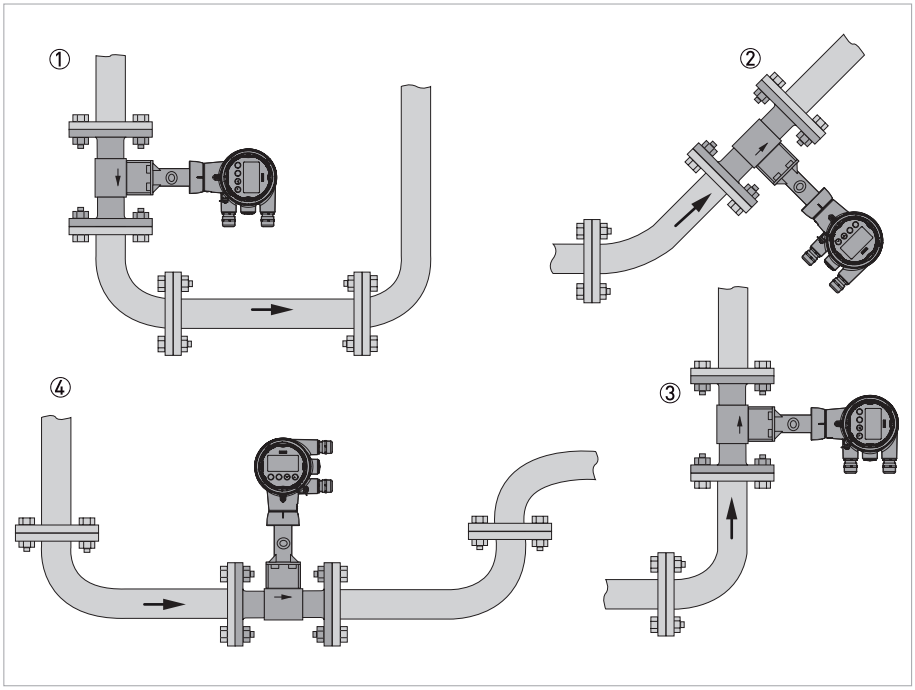


Figure 3-1: Recommended installation

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

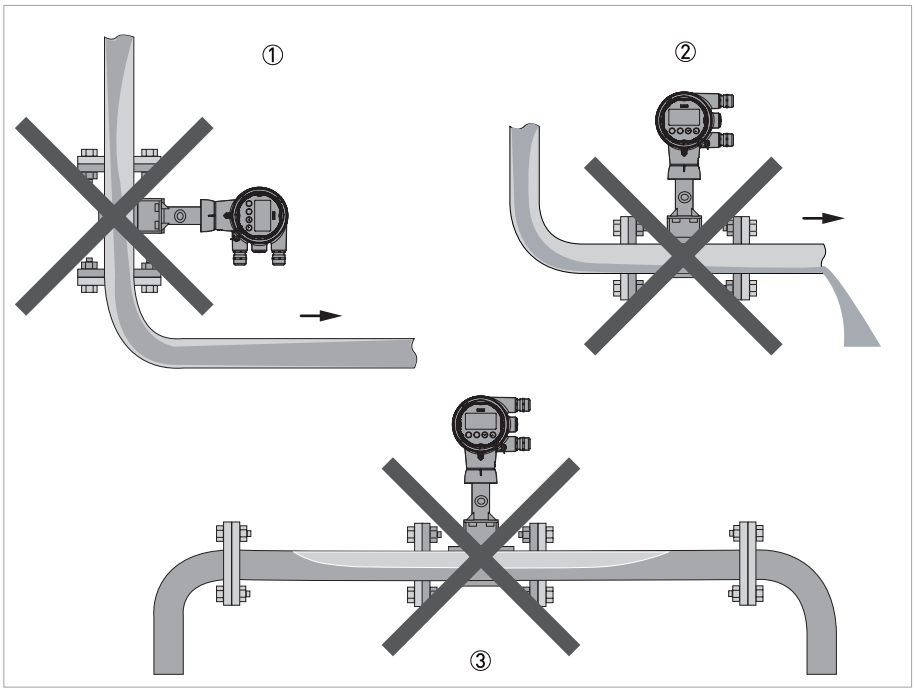


Figure 3-2: Not recommended installation

① Installing the device in a downstream pipe
② Installing the device in front of an outlet
③ Installing the device in an upper pipe bend due to risk of gas bubbles forming

CAUTION!

- *Installing the device in a downstream pipe ① or upstream pipe of an outlet ②, there is a risk of partially filled pipes leading to inaccurate measurements.*
- *Installing the device in an upper pipe bend ③, there is a risk of gas bubbles forming. Gas bubbles can lead to pressure surges and inaccurate measurement.*

3.4.2 Installation when measuring steam and gases

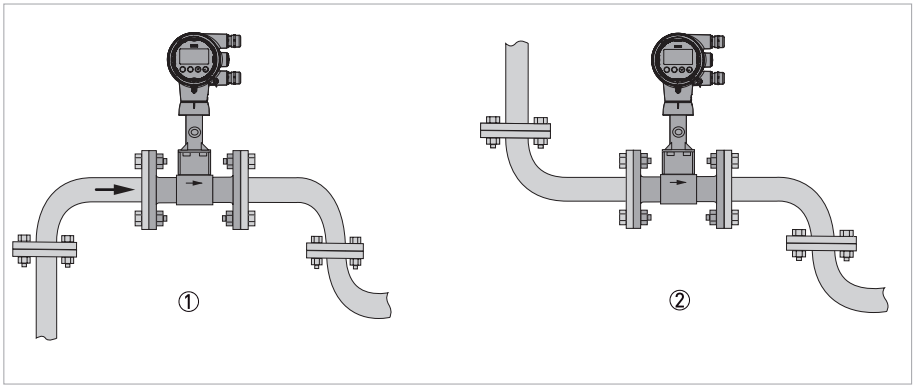


Figure 3-3: Recommended installation

① Installing the device in an upper pipe bend
② If the device is installed in a downpipe, a downpipe must be installed immediately after it

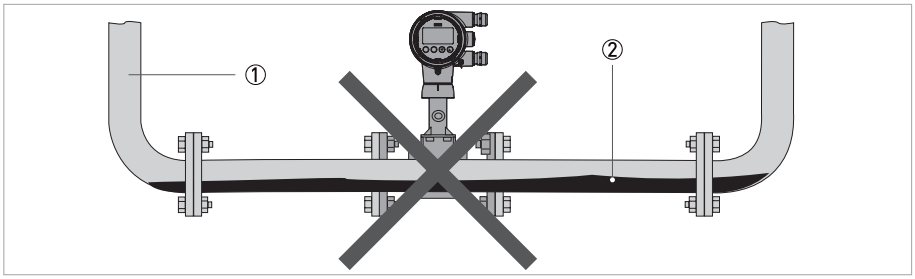


Figure 3-4: Not recommended installation

① Lower pipe bends
② Condensate

CAUTION!
Installing the device in a lower pipe bend: there is a risk of condensate forming. Condensate can lead to cavitation and inaccurate measurement. Under certain circumstances the device can be destroyed and the measured medium can leak.

3.4.3 Mounting arrangements versus medium

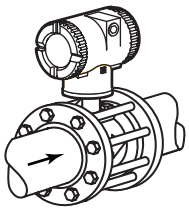
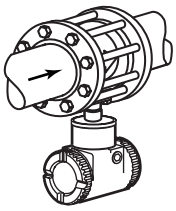
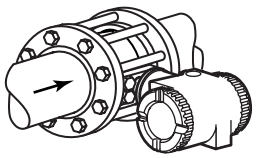
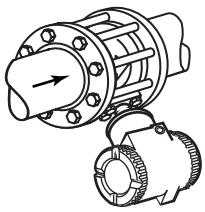
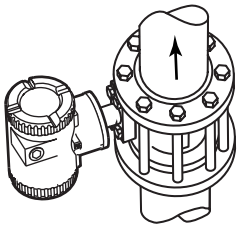
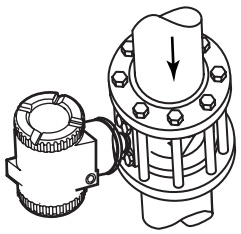
Flowmeter orientation		Liquid	Gas	Saturated steam	Superheated steam
	Housing above and Isolation valve is not used	Yes ①	Yes	No	Yes ②
	Housing above and isolation valve is used	No ⑤	Yes	No	Yes ②
	Housing below pipe	Yes ③, ④, ⑥	Yes ④	Yes	Yes ②
	Housing to side of pipe	Yes	Yes	No	Yes ②
	Housing to side and below pipe	Yes ⑥	Yes	No	Yes ②
	Vertical pipe, flow upward	Yes	Yes	No	Yes ②
	Vertical pipe, flow downward	Yes ⑦	Yes	No	Yes ②

Table 3-1: Mounting arrangements versus medium

① Possibility of temporary startup error due to trapped air.
② Requires adequate insulation.
③ Best choice when errors due to startup can not be tolerated.
④ Recommended only for clean fluids.
⑤ Not recommended for liquids with isolation valve.
⑥ Preferred for liquids with isolation valve.
⑦ Not preferred; must maintain full pipe with no voids in fluid.

3.4.4 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.

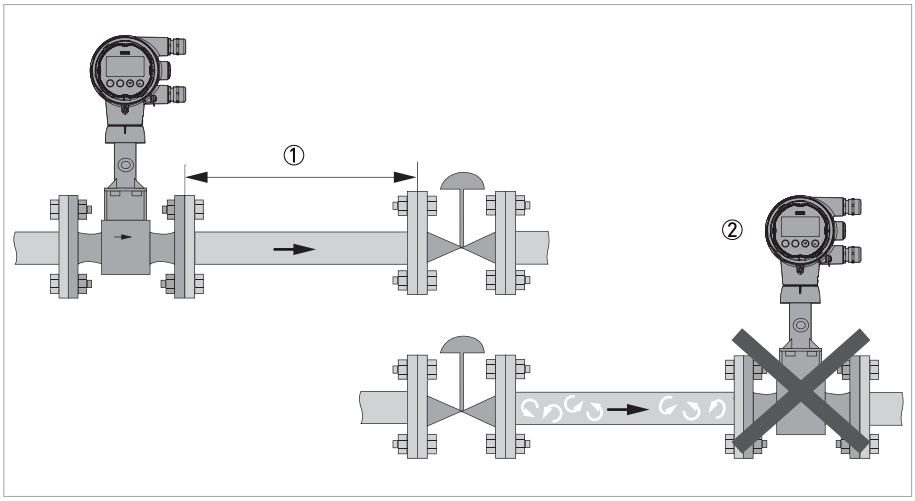


Figure 3-5: Pipelines with control valve

① Recommended: installing the device before the control valve at a distance of ≥ 5 DN
② Not recommended: installing the device directly downstream of control valves, due to vortex formation

3.5 Minimum inlet sections

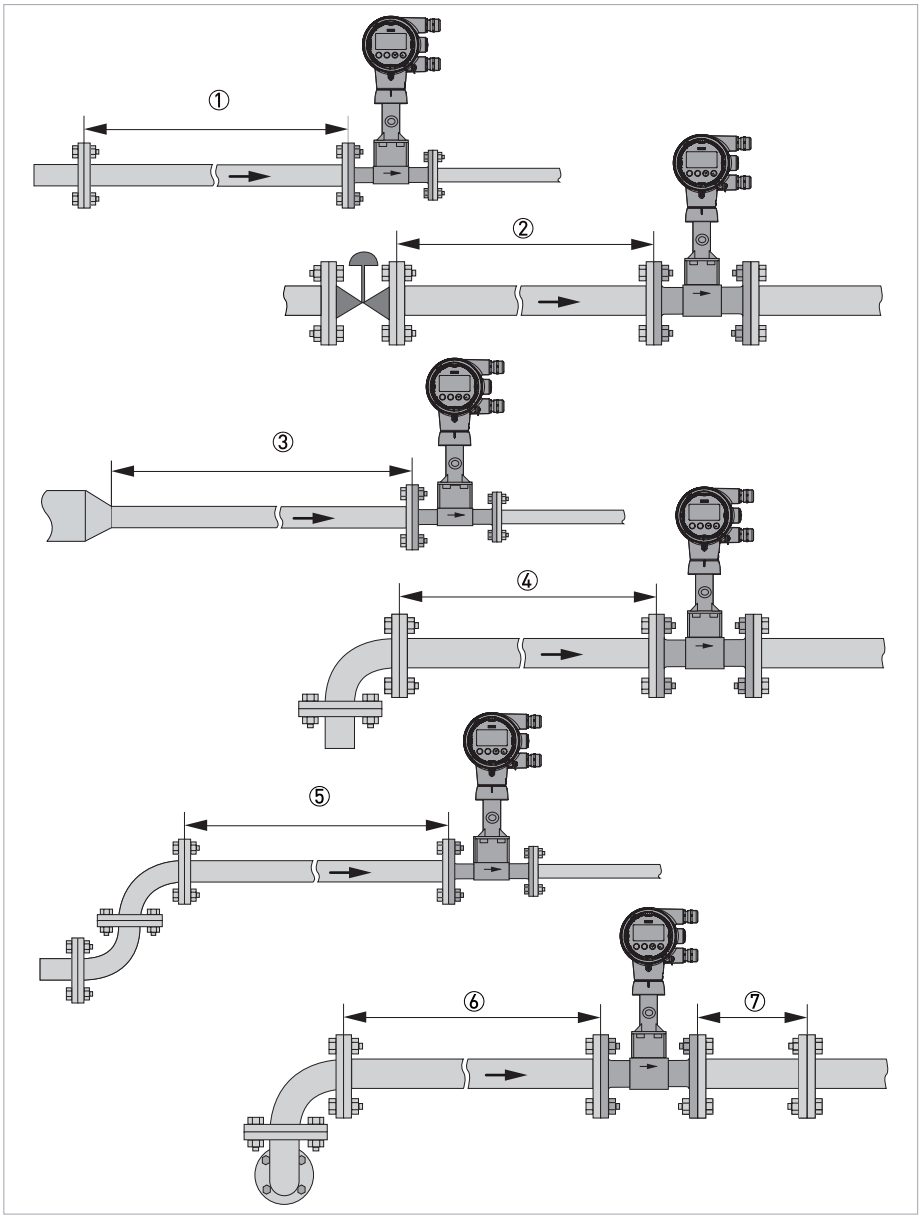


Figure 3-6: Minimum inlet sections

① General inlet section without disturbing flow ≥ 15 DN
② After a control valve ≥ 50 DN
③ After a pipe diameter reduction ≥ 20 DN
④ After a single bend 90° ≥ 20 DN
⑤ After a double bend 2x90° ≥ 30 DN
⑥ After a double three-dimensional bend 2x90° ≥ 40 DN
⑦ Outlet section > 5 DN

3.6 Minimum outlet sections

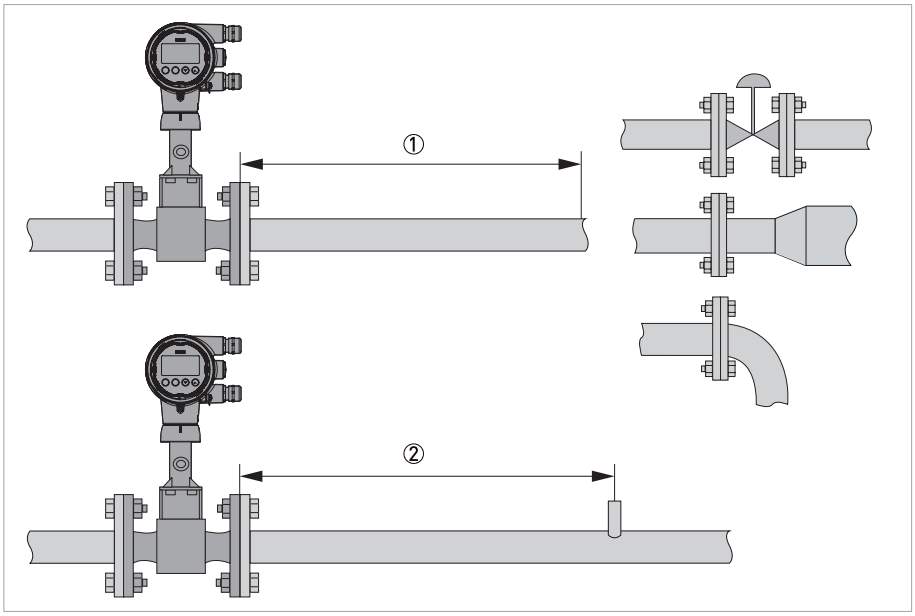


Figure 3-7: Minimum outlet sections

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 flow sensors that are as short as possible to avoid disturbances of the flow profile.

3.7 Installation

3.7.1 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 body of the flow 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.

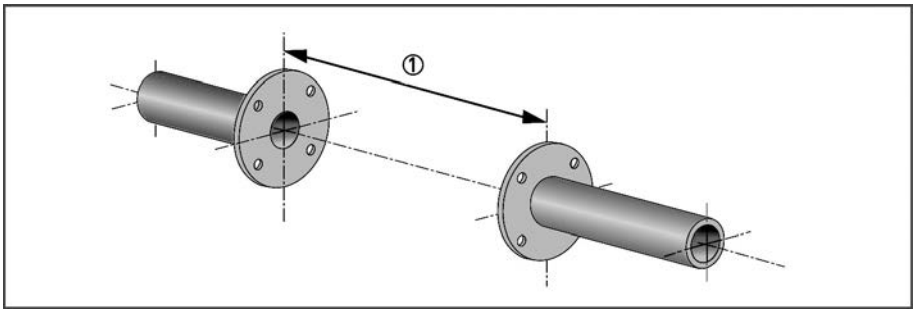


Figure 3-8: Preparing the metering point

① Installation length of measuring device + thickness of gaskets

CAUTION!

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

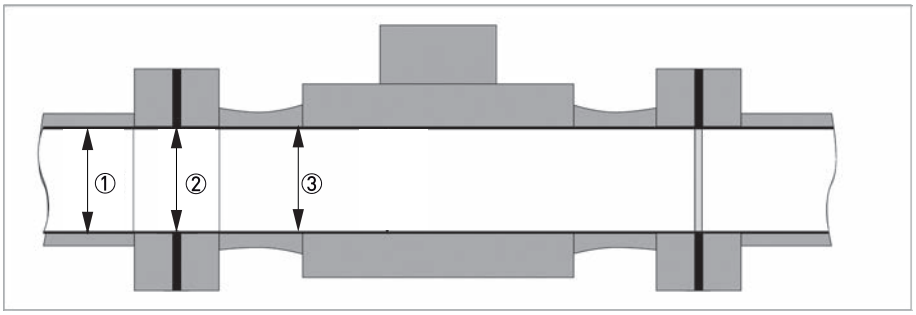


Figure 3-9: Inner diameter

① Inner diameter of connection pipe
② Inner diameter of flange and gasket
③ Inner diameter of flow sensor

3.7.2 Installing devices in sandwich design

INFORMATION!
If the electronics are mounted remotely, mount the flowmeter body so that the junction box is serviceable.

For optimal performance, the sandwich flowmeter should be centered with respect to the adjoining pipe. Normally, this requires the use of centering fixtures that are supplied with the flowmeter.

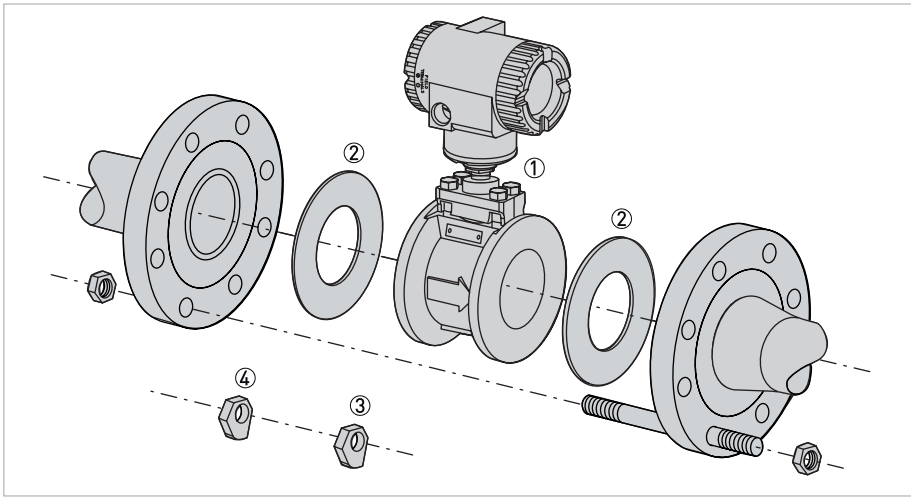


Figure 3-10: Flowmeter cerntering using spacers

① Flowmeter
② Gasket
③ Hex nut alignment device
④ 2 hex nut spacers per side

- Insert the first stud through the downstream flange at one of the lower holes, through the two hex nut spacers and then through the upstream flange. Place the nuts on both ends of the stud, but do not tighten.
- Using the remaining hex nut spacers, repeat first step at the lower hole adjacent to the first.
- Set the flowmeter between the flanges. Then, rotate spacers to the thickness that centers the flowmeter.

INFORMATION!
By rotating the hex nut spacers to the correct thickness, you can center the flowmeter to any type of flange.

- Gaskets are required and must be supplied by the user. Select a gasket material suitable for the process fluid.
- Insert gaskets between the body of the flowmeter and adjacent flanges. Position the gaskets so that the inner diameter of each gasket is centered on the inner diameter of the flowmeter and adjacent piping.

CAUTION!
Verify that the inner diameter of the gaskets is larger than that of the flow tube bore and pipe and that the gaskets do not protrude into the flowmeter entrance or exit. Protrusion into the flowstream has an adverse effect on performance.

INFORMATION!
If welding the flanges to the process piping is required, protect the flowmeter from weld splatter, which could affect flowmeter accuracy. A solid sheet of gasketing should be installed at each end of the meter during welding. Remove this sheet and install the flange gaskets after welding.

- Visually inspect for concentricity (centering and alignment) of mating flanges.
- Install the rest of the studs and nuts and tighten the nuts in accordance with conventional flange bolt tightening practice (that is, incremental and alternate tightening of bolts).

INFORMATION!
If the adjoining flanges are misaligned, align the flowmeter with the ***upstream*** *flange.*

3.7.3 Installing devices in flange design

INFORMATION!
If the electronics are mounted remotely, mount the flowmeter body so that the junction box is serviceable.

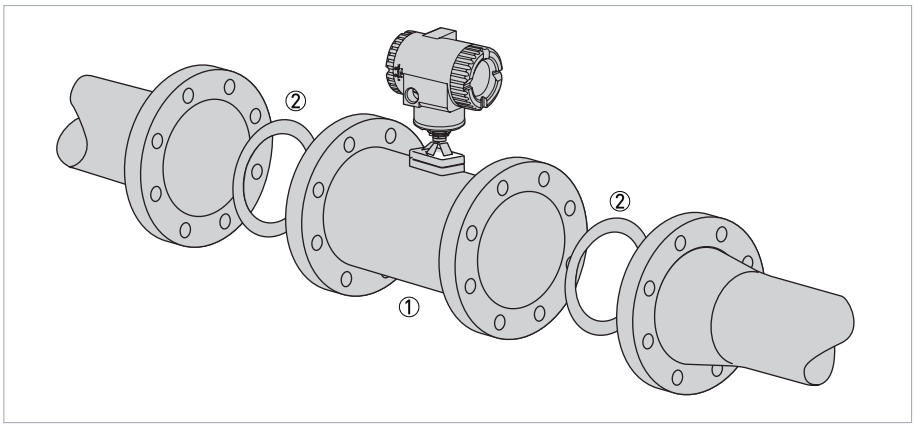


Figure 3-11: Installing devices in flange design

① Flowmeter
② Gasket

- Gaskets are required and must be supplied by the user. Select a gasket material suitable for the process.
- Insert gaskets between the body of the flowmeter and adjacent flanges. Position the gaskets so that the inner diameter of each gasket is centered on the inner diameter of the flowmeter and adjacent piping.

CAUTION!
- *Verify that the inner diameter of the gaskets is larger than that of the flow tube and pipe and that the gaskets do not protrude into the flowmeter entrance or exit. Protrusion into the flowstream has an adverse effect on performance.*
- *Gaskets do not prevent flanges from being wetted by process fluids.*

INFORMATION!
When you install new flanges in the process piping and use the meter as a gauge to set the flanges, protect the inside diameter of the flowmeter from weld splatter. Install a solid sheet of gasketing at each end of the flowmeter during welding. Remove this sheet and install the flange gaskets after welding. Remove any splatter in either the pipe or the flowmeter as it could affect flowmeter accuracy.

- Visually inspect for concentricity (centering and alignment) of mating flanges.
- Tighten bolts in accordance with conventional flange bolt tightening practice (that is, incremental and alternate tightening of bolts).

3.7.4 Mounting the remote electronics housing

The purpose of the remote electronics housing is to allow for separation of the flowmeter body and the electronics.

INFORMATION!
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

The remote electronics housing can be mounted to a vertical or horizontal DN50 or 2" pipe using the mounting bracket and U-bolt supplied. To mount the housing to a horizontal pipe, turn the U-bolt 90° from the position shown in the next figure.

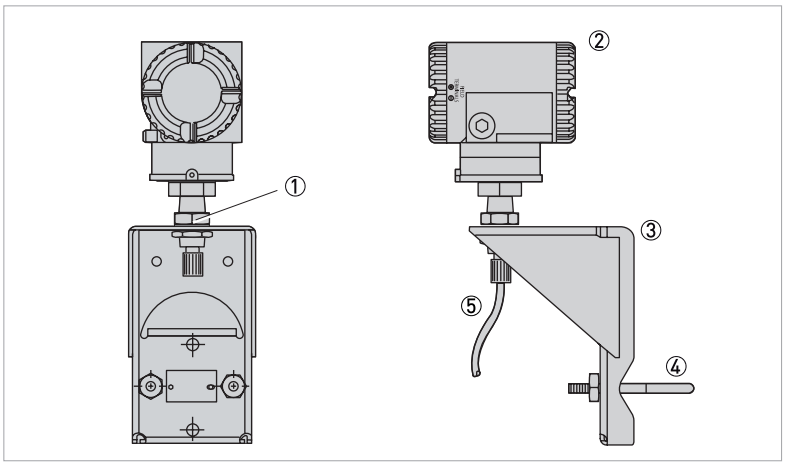


Figure 3-12: Mounting the remote electronics housing

① Jam nut
② Housing
③ Mounting bracket
④ U-bolt
⑤ Cable to junction box

The housing can be surface mounted by securing the mounting bracket to a wall using the bracket mounting holes. It may be easier to secure the mounting bracket to the wall without the housing attached. To do this, use the following procedure:

- Remove the jam nut ① under the bracket.
- Raise the housing ② until you can slide the cable through the cutout in the mounting bracket ③.
- Lay the housing aside and secure the mounting bracket ③ with the U-bolt ④ to the wall.
- Reverse steps 2 and 1.

3.8 Heat insulation

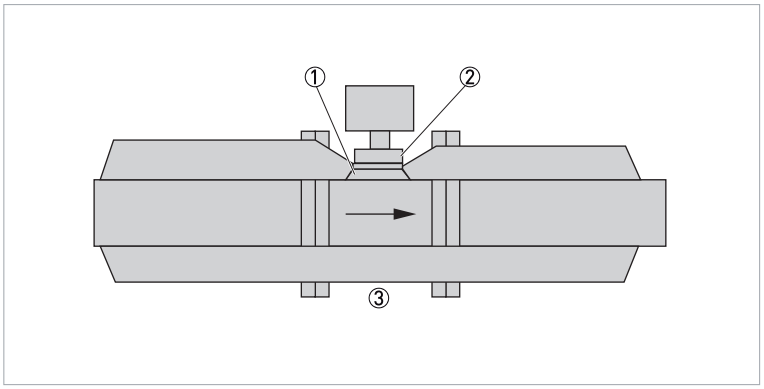


Figure 3-13: Installation heat insulation

① Bonnet pad
② Bonnet
③ Insulation

CAUTION!

- *For applications with medium temperatures above +160° C / +320° F an insulation of the pipeline in accordance to our insulation guideline is suggested.*
- *No insulation is allowed beyond the bonnet pad.*
- *Avoid higher electronic temperatures than +80° C / +176° F.*
- *The area above the signal converter support must not be heat-insulated.*

Sun cover

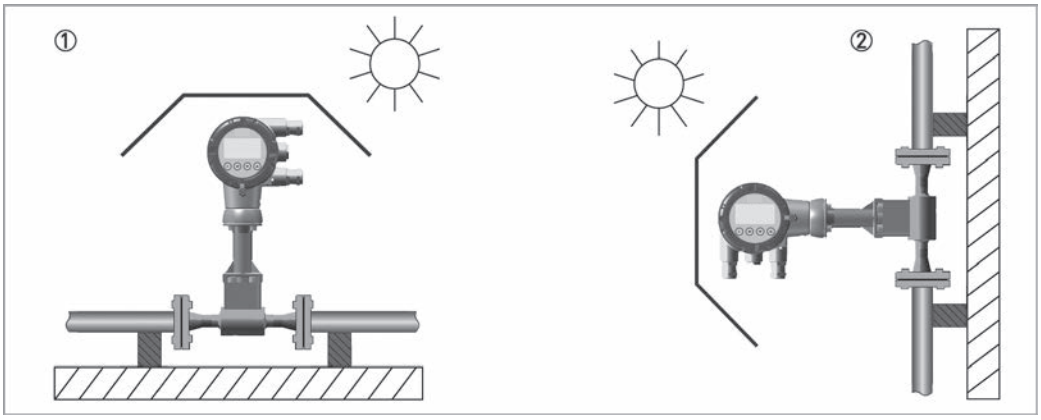


Figure 3-14: Installation recommendations

① Horizontal mounting
② Vertical mounting

The flowmeter **MUST** be protected from strong sunlight.

3.9 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.

The flowmeter housing (topworks) can be rotated up to one full turn in the counterclockwise direction when viewed from above for optimum access to adjustments, display, or conduit connections. Housings have either an anti-rotation screw or a retention clip that prevent the housing from being rotated beyond a safe depth of housing/sensor thread engagement.

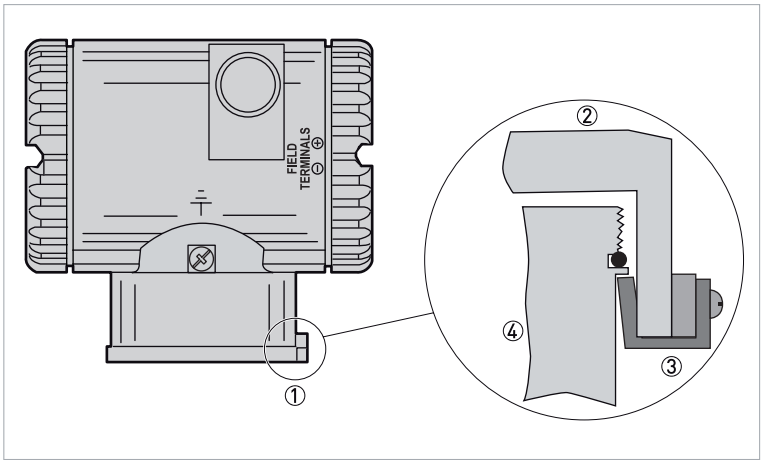


Figure 3-15: Turning the connection housing

① Anti-rotation screw or retention clip
② Housing
③ Clip
④ Cup

3.10 Turning the display

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.

The display can be rotated within the housing to any of four positions at 90° increments. To do this, loosen the two captive screws, turn the display to the desired position and retighten the screws.

CAUTION!

- *Do **NOT** turn the display more than 180° in any direction. Doing so could damage its connecting cable.*
- *Carefully fold the ribbon cable in the space between display and the electronic module so that it is not pinched. The display molding should rest firmly against the module molding before tightening the screws.*

3.11 Cover locks

Electronic housing cover locks are provided as standard with certain agency certifications.
To lock the covers, unscrew the locking pin until approximately 6 mm / 0.25" shows, lining up the hole in the pin with the hole in the housing. Insert the seal wire through the two holes, slide the seal onto the wire ends and crimp the seal.

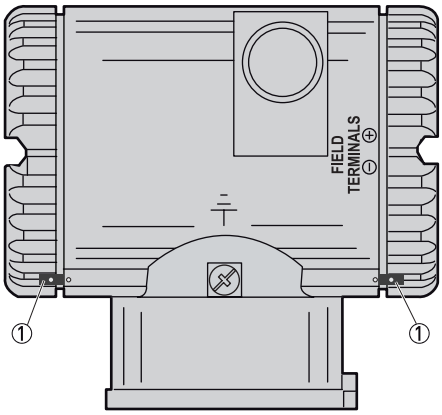


Figure 3-16: Position of the cover locks

① Cover lock

4.1 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!

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!
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.

4.2 Electrical installation of compact mounted electronics

INFORMATION!
The signal converter housing must be grounded to insure proper operation and peak performance.

A flowmeter with a compact mounted electronics requires only power and output signal wiring.

4.3 Electrical installation of remote mounted electronics

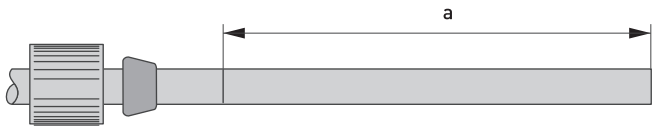
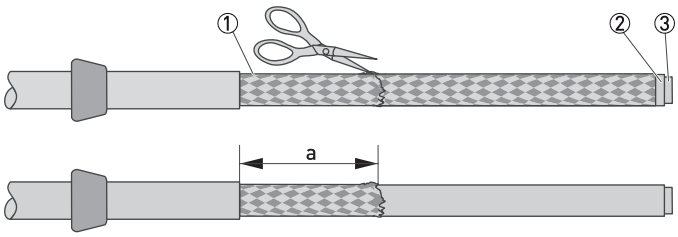
INFORMATION!
The signal converter housing must be grounded to insure proper operation and peak performance.

To use the flowmeter as shipped with the cable attached at both ends, mount the electronics housing and flowmeter body within the limits of the cable length.

If the cable must be disconnected (run the cable through conduit or for some other reason), you must disconnect the cable at the flowmeter (junction box) end. You cannot disconnect the cable at the electronics housing end because it has been epoxied into the metal connector.
It is labelled "Factory Sealed / Electronics End / Do Not Remove."

4.3.1 Preparing the remote signal cable

If the cable must be shortened or reterminated, the flowmeter (junction box) end of the cable must be prepared according to the following instructions.

1	Insert the cable into the knurled nut and rubber grommet. Then remove the outer insulation to the dimension shown. Do not damage the copper braid.	 a = 21.6 cm / 8.5±1/8"
2	Cut the copper braid 25 mm / 1" from the end of the outer insulation.	 a = 25 mm / 1" ① Copper braid ② Outer clear wrapping ③ Metalised mylar film

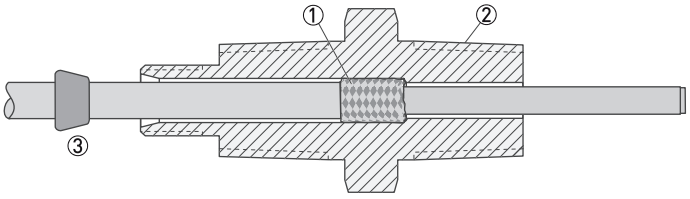
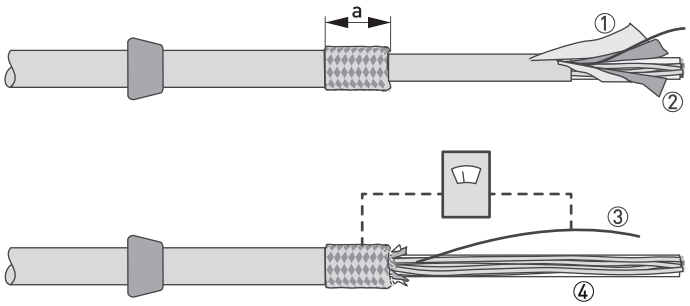
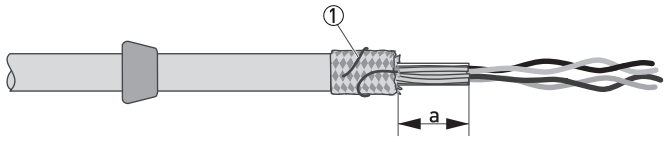
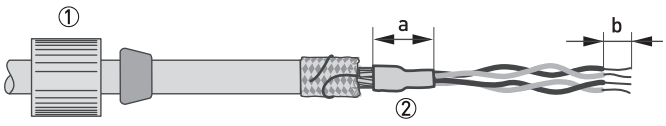
3	Insert the cable into the fitting until the cable is bottomed out inside the fitting. Rotate the fitting one or two turns to pack the braid into place. Remove the cable and examine the packed braid. If there are still strands of braid that have not packed, push them back by hand and reinsert the cable into the fitting. Remove the cable and examine the braid. It should be compressed to a length of approximately 9.5...12.7 mm / 3/8...1/2". **Note: Fitting is connected to junction box (not shown)**	 ① Compressed copper braid ② Fitting ③ Rubber grommet
4	Remove the outer clear wrapping and the metalized mylar film to the end of the packed braid. This exposes the inner drain wire. The inner clear wrapping and filler material are still in place.	 a = 9.5...12.7 mm / 3/8...1/2" ① Outer clear wrapping ② Metalised mylar film ③ Drain wire ④ Inner clear wrapping
5	Make sure that the drain wire is not in contact with the outer braid. Then use an ohm meter to verify that there is no electrical connection between the drain wire and the braid over the entire length of the cable. This step also verifies that the other end (electronics end) of the cable has been properly dressed and that there is no damage or defects in the cable.	
6	Fold the drain wire back onto the packed wire braid and wrap it around one full turn. Then cut off the remainder of the drain wire.	 a = 12.7...15.9 mm / 1/2...5/8" ① Drain wire folded back; wrapped once around and trimmed ② Twisted pair
7	Cut back the inner clear wrapping and the filler to 12.7...15.9 mm / 1/2 to 5/8" from the end of the outer insulation.	
8	Cut an 12.7 mm / 1/2" long piece of shrink wrap and position it so that half the wrap covers the inner clear wrapping/ filler and half covers the exposed pair of twisted wires. Apply heat to the shrink wrap. Note: A 12.7 mm / 1/2" wide piece of electrical tape can be used in place of the shrink wrap.	 a = 12.7 mm / 1/2" b = 6.4 mm / 1/4" ① Knurled nut ② Shrink wrap or electrical tape
9	Strip the ends of the twisted pair 6.4 mm / 1/4".	

Table 4-1: Preparing the remote signal cable

4.3.2 Connecting the remote signal cable

After the cable end has been prepared, connect the cable to the junction box.

- Insert the cable into the fitting, making sure that the cable has bottomed out in the fitting.
- Slide the rubber grommet into the fitting.
- Screw the knurled nut into place, clamping the rubber grommet against the assembly. Hand tighten with moderate force to assure a water tight connection.
- Dress the wires in the junction box as shown.

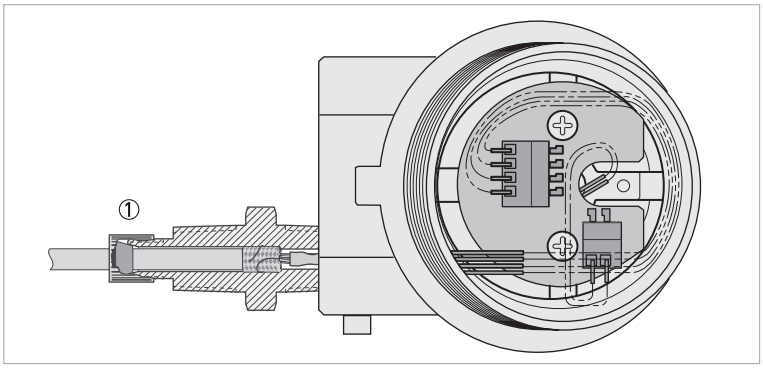


Figure 4-1: Connecting the remote signal cable

① Knurled nut and rubber grommet

4.3.3 Access to flowmeter field terminals

For access to the field terminals, remove the cover from the field terminals compartment as shown in the following figure. Note that the embossed letters **FIELD TERMINALS** identify the proper compartment ②.

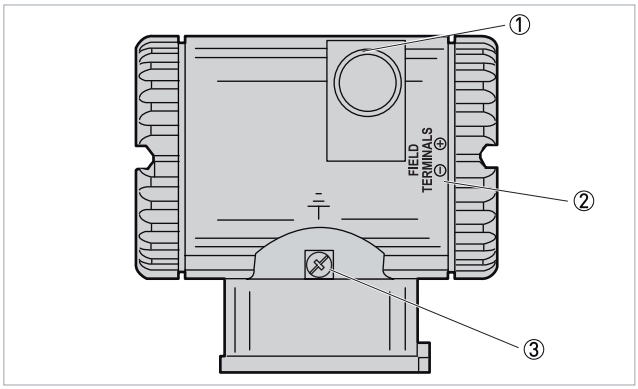


Figure 4-2: Access to flowmeter field terminals

① 1/2NPT or M20 conduit connection for customer wiring. One on opposite side also.
② Identification of proper field terminals compartment
③ External ground

INFORMATION!
Plug unused opening with the metal plug provided (or equivalent).

4.3.4 Identification on field terminals

Field wires enter through 1/2 NPT or M20 conduit threaded entrances on either side of the electronics housing. Wires terminate under screw terminals and washers on terminal block (refer to next figure) in the field terminal compartment.

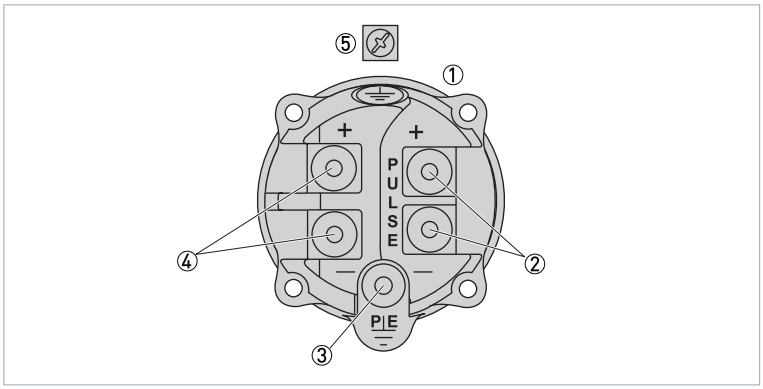


Figure 4-3: Identification on field terminals

① Terminal block (located in field terminal side of housing)
② Pulse output terminals
③ Physical earth (ground)
④ (+) and (-) power terminals
⑤ Earth (ground) screw located external to terminal block

INFORMATION!
Plug unused entrance to ensure moisture and RFI/EMI protection.

4.4 Wiring of the flowmeter

4.4.1 Wiring the flowmeter to a control loop

When wiring a flowmeter with 4...20 mA output signal, the supply voltage and loop load must be within specified limits. The supply output load versus voltage relationship is shown in the next figure.

Any combination of supply voltage and loop load resistance in the shaded area can be used. To determine the loop load resistance (flowmeter output load), add the series resistance of each component in the loop, excluding the flowmeter. The power supply must be capable of supplying 22 mA of loop current.

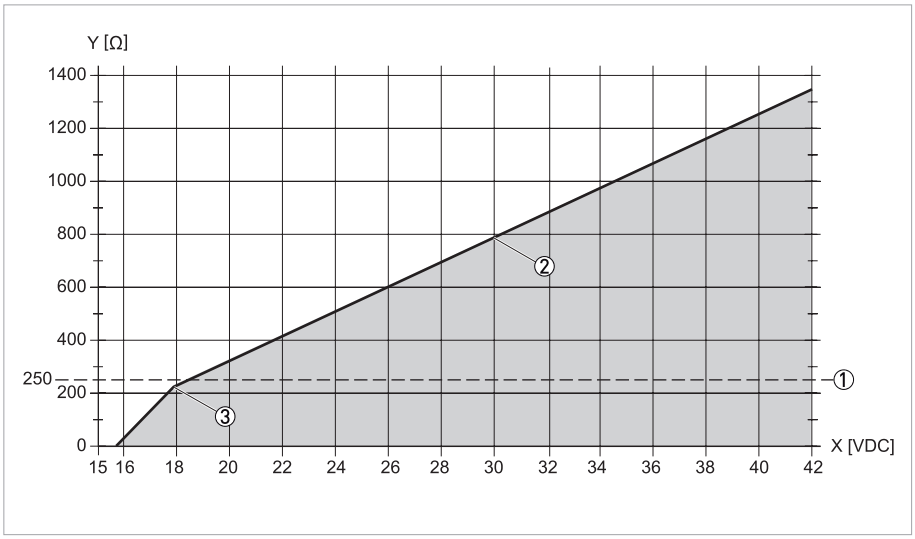


Figure 4-4: Relationship of output load versus supply voltage

X [VDC]: Supply voltage
Y [Ω]: Output load

① Minimum load with configurator or communicator
② 30 V maximum for intrinsically safe units
③ 227.5 Ω at 17.7 V

INFORMATION!
The flowmeter function with an output load less than 250 Ω provided that a PC-based configurator or HART communicator is not connected to it.
Connecting a PC-based configurator or HART communicator while operating below a 250 Ω load may cause output disturbance and/or communication problems.

Examples

- For a loop load resistance of 300 Ω, the supply voltage can be any value from 19.1 to 30 VDC.
- For a supply voltage of 24 VDC, the loop load resistance can be any value from 250 to 520 Ω (zero to 520 Ω without a HART communicator or PC-based configurator connected to the flowmeter).

To wire one or more flowmeters to a power supply, proceed with the following steps.

- Remove the cover from the field terminals compartment.
- Run signal wires (0.50 mm^2 or 20 AWG, typical) through one of the flowmeter conduit connections. Use twisted pair to protect the 4...20 mA output and/or remote communications from electrical noise. Maximum recommended length for signal wires is 1800 m / 6000 ft.

INFORMATION!

Do not run flowmeter wires in same conduit as mains (AC power) wires.

- If shielded cable is used, ground the shield at the negative terminal of the power supply. Do not ground the shield at the flowmeter.
- Plug the unused conduit opening with the 1/2 NPT or M20 metal plug provided (or equivalent). To maintain specified explosionproof and dust-ignitionproof protection, plug must be engaged a minimum of five full threads for 1/2 NPT connections; seven full threads for M20 connections.
- The flowmeter is equipped with an internal and external ground connection. Connect a ground wire to either terminal in accordance with local practice.

CAUTION!

If the loop is grounded, it is preferable to do so at the negative terminal of the DC power supply. To avoid errors resulting from earth loops or the possibility of short-circuiting groups of instruments in a loop, there should be only one earth in a loop.

- Connect the power supply and receiver loop wires to the "+" and "-" terminal connections.
- Connect receivers (such as controllers, recorders, indicators) in series with power supply and flowmeter as shown in next figure.
- Install the cover onto the flowmeter. Turn the cover to seat the O-ring into the housing and continue to hand tighten until the cover contacts the housing metal-to-metal.
- If wiring additional flowmeters to the same power supply, repeat steps 1 through 8 for each additional flowmeter.
- A HART communicator or PC-based configurator can be connected in the loop between the flowmeter and the power supply. Note that a minimum of 250 Ω must separate the power supply from the HART communicator or PC-based configurator.

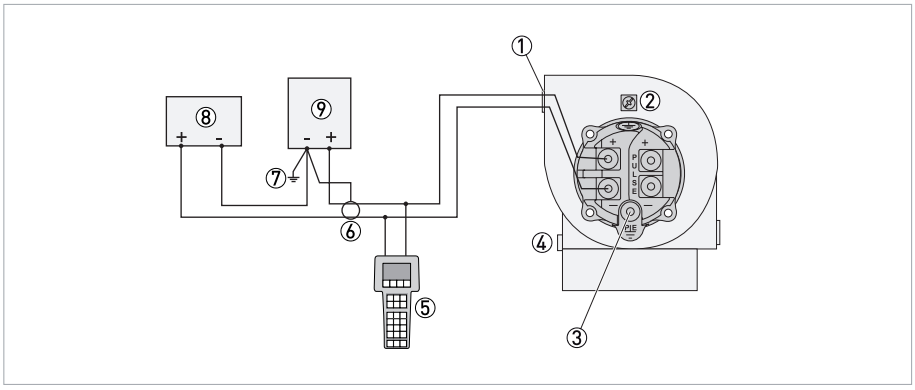


Figure 4-5: Wiring a flowmeter with a 4...20 mA output

① 1/2 NPT or M20 conduit connection (2 places)
② Internal ground terminal
③ Physical earth ground (required for explosionproof applications)
④ External ground terminal
⑤ HART communicator or PC-based configurator
⑥ Shielded wire (optional)
⑦ Ground (optional)
⑧ Receiver
⑨ Power supply

4.4.2 Wiring a flowmeter with a pulse output

Two separate loops are required when using the pulse output on a flowmeter with the 4...20 mA or digital signal. Each loop requires its own power supply. The following drawings show the connections with a transistor switch (sinking) counter input with receiver supplied power; with a transistor switch (sinking) counter input and external power supply and pull-up resistor; and with a transistor switch (sourcing) counter input and external power supply and pull-up resistor.

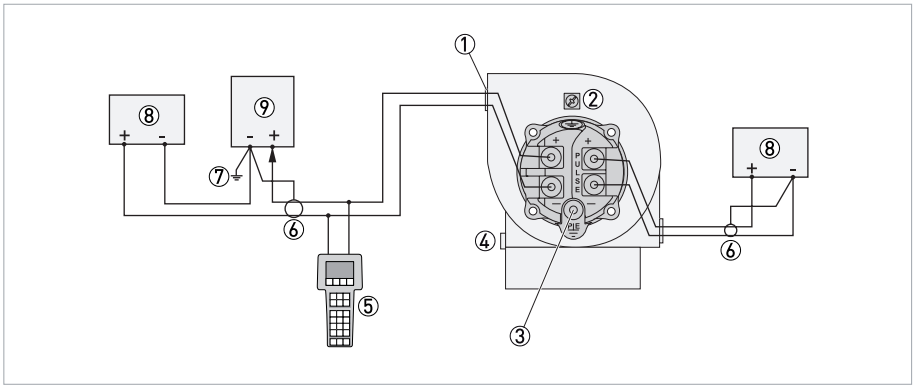


Figure 4-6: Wiring a flowmeter with a pulse output transistor switch (sinking) counter input with receiver supplied power

① 1/2 NPT or M20 conduit connection (2 places)
② Internal ground terminal (connect a ground wire in accordance with local practice)
③ PE ground (required for explosion-proof applications)
④ External ground terminal
⑤ HART Communicator or PC-based configurator (at least 250 Ω total resistance between configurator and power supply
⑥ Optional shielded wire (if used, terminate the shield at the negative terminal of the power supply)
⑦ Optional ground (grounding the loop at the negative terminal of the power supply is recommended but not required)
⑧ Receiver
⑨ Power supply

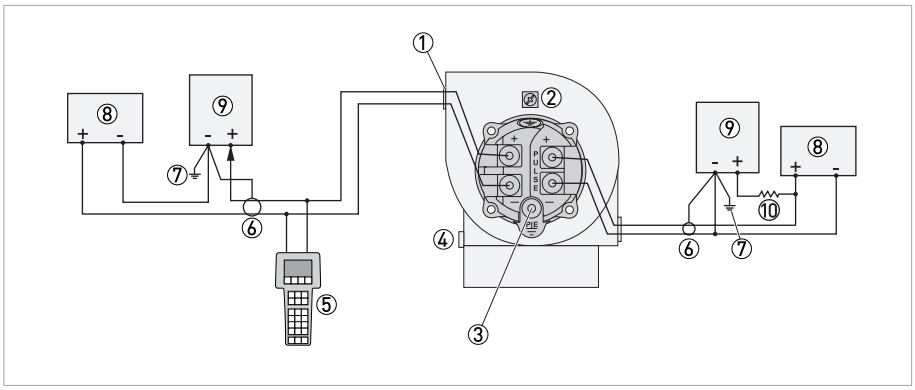


Figure 4-7: Wiring a flowmeter with a pulse output transistor switch (sinking) counter input with external power supply and pull-up resistor

① 1/2 NPT or M20 conduit connection (2 places)
② Internal ground terminal (connect a ground wire in accordance with local practice)
③ PE ground (required for explosion-proof applications)
④ External ground terminal
⑤ HART Communicator or PC-based configurator (at least 250 Ω total resistance between configurator and power supply
⑥ Optional shielded wire (if used, terminate the shield at the negative terminal of the power supply)
⑦ Optional ground (grounding the loop at the negative terminal of the power supply is recommended but not required)
⑧ Receiver
⑨ Power supply
①⓪ Load resistor (max. pulse output current is 20 mA; load resistor must be sized accordingly)

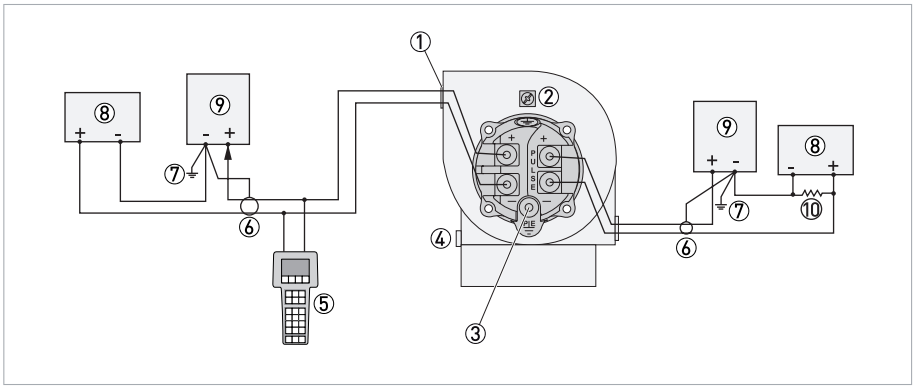


Figure 4-8: Wiring a flowmeter with a pulse output transistor switch (sinking) counter input with external power supply and pull-up resistor

① 1/2 NPT or M20 conduit connection (2 places)
② Internal ground terminal (connect a ground wire in accordance with local practice)
③ PE ground (required for explosion-proof applications)
④ External ground terminal
⑤ HART Communicator or PC-based configurator (at least 250 Ω total resistance between configurator and power supply
⑥ Optional shielded wire (if used, terminate the shield at the negative terminal of the power supply)
⑦ Optional ground (grounding the loop at the negative terminal of the power supply is recommended but not required)
⑧ Receiver
⑨ Power supply
①⓪ Load resistor (max. pulse output current is 20 mA; load resistor must be sized accordingly)

4.5 Ingress protection

The signal converter electronics housing meets the requirements for IP66 / NEMA4X in accordance with EN 60529 both for the compact and for the remote version.

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

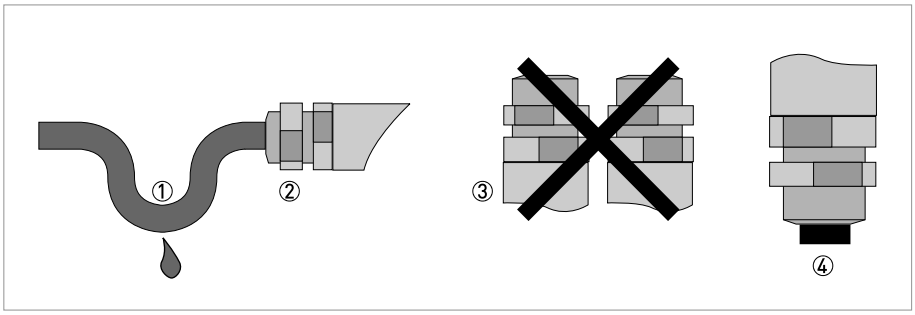


Figure 4-9: Cable feedthrough

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.

5.1 Display and operating elements

Communication with the vortex flowmeters is carried out using the HART communicator, the PC-based configurator PACTware or the optional local keypad/display.

Local keypad/display

A local display provides local indication of the measurement information, function status and reference information. The display also provides a means of performing totalizer reset and full configuration, calibration and self-test. Operation is accomplished via four multi-function keys.

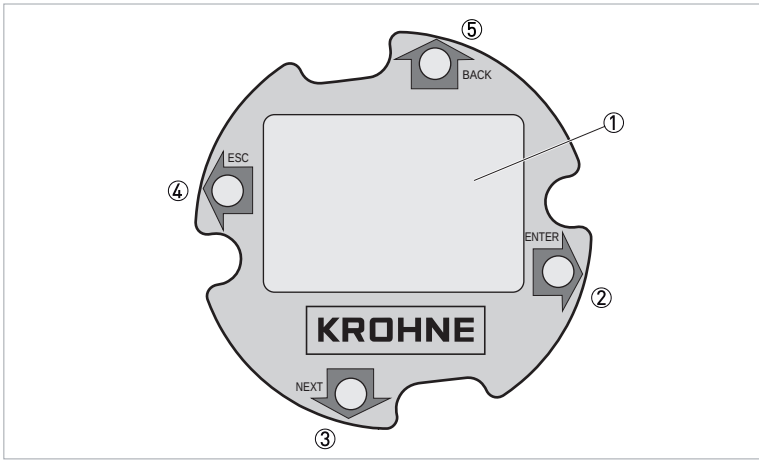


Figure 5-1: Description of local keypad/display

① Display
② Right arrow key (ENTER)
③ Down arrow key (NEXT)
④ Left arrow key (ESC)
⑤ Up arrow key (BACK)

Key	Function
Left arrow (ESC)	Moves left in the menu structure.
	Moves the cursor to the left in a data entry field.
	Escapes from changes in a picklist menu or data entry. ①
	Answers "No".
Right arrow (ENTER)	Moves right in the menu structure.
	Used to access the data entry edit mode of a parameter.
	Moves the cursor to the right in a data entry field.
	Enters and saves the changed menu picklist choices or data entry. ①
	Answers "Yes".
Up arrow (BACK)	Moves upward in the menu structure, a picklist menu or list of characters.
Down arrow (NEXT)	Moves downward in the menu structure, a picklist menu, or list of characters.

Table 5-1: Description of keys

① On data entry, repeatedly press the key until the cursor reaches the end of the display.

5.2 Basic principles of operation

5.2.1 Password

Display of information requires no password. However, the ability to access certain functions, (for purposes other than "Read Only"), such as totalizer, setup, and calibration/testing, may require a user-definable password.

The "LoPwd" allows you to reset the net totalizer and pulse totalizer. The "HiPwd" gives you access to all flowmeter functions. In addition, the write protect jumper must be in the "write" position. See “Setting the Write Protect Jumper” on page 45.

INFORMATION!
The flowmeter is shipped from the factory with a blank password. This allows access to all flowmeter functions. If password protection is required, enter a "LoPwd" and/or "HiPwd" in setup mode.

Entering the password

The totalizer, setup, and calibration/test functions may require a password (a 4-character alphanumeric string). Select the "TotPul, TotNet, TotGrd, Setup or Cal/Tst" top level menu and press enter at the password prompt. Two brackets surrounding four spaces ([- - - -]) then appear on the second line of the display. The cursor, a flashing icon, appears at the first character.

To enter the password, use the up/down arrow keys to scroll through the list of acceptable characters. After selecting the desired character, press the right arrow key to move to the next character. Continue this process until the password is complete. Pressing the right arrow key once more moves the flashing cursor to the right bracket. Pressing enter now completes the process. Prior to pressing enter, you can use the left/right arrow keys to move back and forth to modify an incorrect selection.

If you enter an incorrect password, the display indicates "Sorry" for one second, then goes to read only.

You can change a password in the "Passwd" parameter in the setup menu.

5.2.2 Editing numbers and strings

Editing any number or string in the menu system is done in the same way as entering the password. The up/down arrow keys scroll through a list of acceptable characters for the current position. The right arrow key moves the cursor to the right. It also accepts the change at the end. The left arrow key moves the cursor to the left. It also cancels the change at the beginning. There are three kinds of edit items: signed numbers, unsigned numbers and strings.

Signed numbers

Signed numbers always have a + or - sign at the beginning. The + can only be changed to - and vice versa.

Unsigned numbers

For unsigned numbers, cycle through the digits 0-9 and the decimal point, with the up/down arrow keys. When you enter a decimal point in any position and there is already a decimal point to the left of the cursor, the new decimal point overrides the old one.

Strings

Characters in strings can be changed to any valid character. You can sequence through the list of characters by pressing the up/down arrow keys. To enter the change, you must still press enter from the right side of the data field, after scrolling to the right side with the right arrow key.

5.2.3 Factory default settings

Each flowmeter is normally shipped from the factory with a customised parameter setting. If the application data are not supplied with the purchase order, the flowmeter is shipped with the following defaults. However, the flowmeter will not provide an accurate measurement if the configuration does not fit your application. Be sure to check the configuration of our flowmeter prior to start-up.

Item	Metric	Imperial
Fluid type	Liquid (water)	Liquid (water)
Type of flow	Volume	Volume
Measurement units	m^3/s	gal/min
Process temperature	20°C	68°F
Process density	998.21 kg/m^3	62.316 lb/ft^3
Absolute viscosity	1.002 cP	1.002 cP
Upper range value	Upper range limit for flowmeter size	Upper range limit for flowmeter size

Table 5-2: Default settings when application data not supplied

These defaults are **NOT** recommended for general operation. If no other process information is available, entering liquid, gas, or steam as fluid type in "Setup > Fluid > New" establishes default data bases as shown in the next tables respectively.

Item	Metric	Imperial
Fluid type	Liquid (water)	Liquid (water)
Type of flow	Same as present configuration	
Measurement units	Same as present configuration	
Process temperature	20°C	68°F
Process density	998.21 kg/m^3	62.316 lb/ft^3
Absolute viscosity	1.002 cP	1.002 cP
Upper range value	Upper range limit for flowmeter size	Upper range limit for flowmeter size

Table 5-3: Default settings for liquid

Item	Metric	Imperial
Fluid type	Steam	Steam
Type of flow	Same as present configuration	
Measurement units	Same as present configuration ①	
Process temperature	178.3°C	352.9°F
Process density	4.966 kg/m^3	0.310 lb/ft^3
Absolute viscosity	0.015 cP	0.015 cP
Upper range value	Upper range limit for flowmeter size	Upper range limit for flowmeter size

Table 5-4: Default settings for steam

① Liquid units of gallons, liters, imperial gallons or barrels per unit time are not transferable to gas.

Item	Metric	Imperial
Fluid type	Gas (air)	Gas (air)
Type of flow	Same as present configuration	
Measurement units	Same as present configuration ①	
Process temperature	20°C	68°F
Process density	9.546 kg/m^3	0.596 lb/ft^3
Absolute viscosity	0.0185 cP	0.0185 cP
Upper range value	Upper range limit for flowmeter size	Upper range limit for flowmeter size

Table 5-5: Default settings for gas

① Liquid units of gallons, liters, imperial gallons or barrels per unit time are not transferable to gas.

5.3 Using the menu tree

5.3.1 Navigation in the menu

Pressing the enter key stops the display of measurements and shows the first top level, the totalizer menu item "1 TotPul". Use the down arrow key to go to "1 TotNet" and "1 Tot Grd". At any one of these choices, press enter to edit your selection. Use the down arrow key to select "Off" (turn the totalizer off), "On" (turn the totalizer on) or "Clear" (reset the totalizer) and then press enter. Press the ESC key to return to the measure mode.

Pressing the ESC key stops the display of measurements and shows the first item in the rest of the top level menu "1 Measure". From here, the four keys allow you to move around the menu tree, as indicated by the arrows. Press the down arrow key to cycle through each of the current menu level items. Press the right arrow key to move from the current level to its submenu level. Press the left arrow key to move from the current level to the next higher level.

INFORMATION!
Each menu item has its level (1 - 5) displayed at the beginning of the top line.

5.3.2 Top level menu

The three totalizer items in the main menu were discussed immediately above. The remainder of the top level menu displays six modes – "Measure, Status, View, Setup, and Calibration/Test". You can switch from one to another in sequence by using the up/down arrow keys. To enter the second level menu from a particular top level display, press the right arrow key. To return to the top level from a second level menu item, press the left arrow key. The level of the first, second, third, fourth and fifth level menus is indicated by the digit appearing as the first character in line 1 of the display; a 1 indicates level 1 (Top level), a 2 indicates level 2 and a 3 indicates level 3 and so forth.

Top level modes and their basic functions:

Top level		Basic functions	Description
(Measurements)		Measurement values For details refer to *Measure mode* on page 47.	This is the normal operation mode. It displays configured measurements. It also indicates if diagnostic conditions exist. The selected default measurement is displayed when the signal converter is turned on
	1 TotPul	Totals reset For details refer to *Total mode* on page 47.	This mode allows resetting of each totalizer.
	1 TotNet		
	1 TotGrd		
	1 Measure	Measurement values	Pressing either the enter or ESC key moves you to the measure mode.
	1 Status	Status parameters For details refer to *Status mode* on page 48.	This mode provides the status of various parameters, write protection and any diagnostic error.
	1 View	View parameters For details refer to *View mode* on page 49.	This mode is used to display reference information such as model, calibrator and calibration dates. the transmitter software revision number can also be found here.
	1 Setup	Setup parameters For details refer to *Setup mode* on page 49.	This mode is used to customize (configure) the flowmeter to your application. This includes: "Defining, Fluid, Flow, Tuning, Total, Output, Piping, Tags, Flowtube and Password" parameters.
	1 Cal/Tst	Calibration/test parameters For details	This mode is used to perform several calibration and test functions.

Table 5-6: Top level menu

INFORMATION!
Certain parameters may be missing as you step through the menus described in this chapter depending on the configuration of your device.

5.3.3 Measure mode

In normal operation, the flowmeter displays those measurements specified in the setup mode. If configured for manual cycle, you can cycle through the measurements manually by using the up/down arrow keys. If configured for auto cycle, the display cycles through the measurements specified. If, while in auto cycle, you want to see a specific measurement momentarily, advance to that measurement with the down arrow key. Use the up arrow key to go to a specific measurement and stay there. You can then resume scanning by pressing the down arrow key.

5.3.4 Total mode

"TotPul, TotNet or TotGrd" is used to turn a totalizer on, pause the totalizer or to clear (reset) the totalizer. This is done by pressing the enter key and selecting "On, Paused or Clear" and pressing the enter key again. Before doing this you may be asked for a password.
If so, enter the "LoPwd or HiPwd" for "TotPul and TotNet". Enter the "HiPwd" for "TotGrd".

INFORMATION!
Clearing "TotGrd" also clears "TotPul and TotNet".

5.3.5 Status mode

The "MeaStat" sublevel of this mode enables you to view the units, value and status of system parameters and thus assess the performance of the loop. You can not edit them in this mode. To step through the displays of the parameters, use the up/down arrow keys. The status mode structure is shown below.

The "WrProt" sublevel of this mode shows whether write protection is enabled (Prot) or is disabled (NotProt).

The "DiagEr" sublevel of this mode shows any diagnostic errors. The display 0000 means no diagnostic errors.

INFORMATION!
A new diagnostic condition only appears after a diagnostic is detected while in measure mode.

1 Status			
	2 MeaStat		
		3 Velcty	EGU Value Status
		3 Raw Hz	
		3 KRef	
		3 KCor	
		3 KFlow	
		3 mA Out	
		3 Pulse	
		3 Reynld	
	2 WrProt		
	2 DiagEr		
	2 Reason		

Table 5-7: Status mode

5.3.6 View mode

The view mode enables you to view the identity parameters. You can not edit them in this mode. To step through the list of the following parameters, use the up and down arrow keys.

1 View		
	2 HrtTag	HART tag
	2 HartAdr	HART address
	2 HartMsg	HART message
	2 HartDes	HART designation
	2 Model	Model
	2 CalDate	Last calibration date
	2 CalName	Initials of last calibrator
	2 SW Rev	Software revision number

Table 5-8: View mode

5.3.7 Setup mode

The setup mode enables you to configure your flowmeter fluid, flow, tuning, totalizer, output, pipe, tag, flowtube and password parameters. You can also establish and change your passwords in this mode. Setup mode can be a password protected mode. So after the initial configuration, you may need to enter the "HiPwd" to make changes in this mode. For details refer to *Password* on page 43.

INFORMATION!
If you lose your password, call our local support for assistance.

If your signal converter is write protected, the display reads "Rd Only" if you try to enter the setup mode. In this case, you cannot enter the setup mode to make changes. You can, however, view but not edit the setup.

Upon attempts to enter this mode, you are asked "Loop in Manual?". After placing the loop in manual, indicate "yes" with the enter key. This is also an off-line mode. Analogue output is driven to 4 mA, pulse output to 0.

1 Setup			
	2 Fluid		
		3 New-> Edit ▽	
		3 FldTyp (Read Only)	
		3 Name	
		3 TmpEGU	
		3 FlwTmp	
		3 DenEGU*	* If EGU = Custom 4 Label
		3 FlwDen	4 Offset
		3 BasDen	4 Slope
		3 LfciEGU (Read Only)	
		3 Lfci (Read Only)	
		3 VisEGU	
		3 Visc	
	2 Flow		
		3 FlwMap	
		3 FlwEGU*	
		3 FlwURV	
		3 FlwDmp	
		3 VelEGU	
	2 Tuning		
		3 AddDrop	
		3 RdCorr	
		3 LFCI	
			4 FlwEGU
			4 Setting
	2 Total		
		3 TotNet	
			4 Map
			4 EGU *
		3 TotGrd	
			4 Map
			4 EGU *

	2 Output			
		3 Coms		
			4 PolAdr	
			4 Preambl	
		3 Pulse	4 Pulse	
			If Raw Pul=Raw	
			If Rate 4 Freq	If Tot U/P 4 P width 4 EGU 4 Factor
		3 Fail		
		3 Display		
			4 Show	
				5 FlwVol
				5 Format
				5 TotNet
				5 Format
				5 TotGRD
				5 Format
			4 Show1st	
			4 Cycle	
	2 Pipe			
		3 Piping		
			4 Config	
			4 Updist	
		3 BoreSch		
		3 Custom		
	2 Tags			
		3 HrtDes		
		3 HrtTag		
	2 NewTube			
		3 Model		
		3 Special		
			4 TubDia	
			4 TubAlp	
			4 LfUFac	
		3 K Ref		
			4 K EGU	
			4 K Ref	
	2Passwd			
		4 LoPwd		
		4 HiPwd		
	<-Cancel Save->			

Table 5-9: Setup mode

5.4 Description of setup mode

5.4.1 Setting the fluid parameter

The "2 Fluid" section of the setup mode allows you to configure parameters for fluid type, fluid name (optional), temperature unit, operating temperature, density unit, operating density, standard density, viscosity unit and viscosity.

INFORMATION!
*If you are satisfied with the existing fluid parameters, do **NOT** enter the 3 new parameter; doing so will reset all the other fluid parameters.*

- In "3 New", select the fluid as liquid, gas or steam to get the default data base for that medium. For further information refer to *Factory default settings* on page 44. Selecting "3 Edit" enables you to edit the present fluid configuration.
- "FldTyp" shows the type of fluid presently configured.
- In "3 Name", name the particular fluid (optional)
- In "3 TmpEGU", select your choice of temperature unit (°F, °C, °R, or °K).
- In "3 FlwTmp", enter the operating temperature in the temperature unit specified.
- In "3 DenEGU" select the density unit from the following picklist: kg/m3, lb/Yd3, lb/gal, oz/in3, lb/ft3, g/cm3, ST/Yd3, LT/Yd3, Custom.
  If you pick "Custom", you must define your custom unit. First, enter a label for your custom unit using up to eight alphanumeric characters. Then, enter any offset and a conversion factor (slope) from kilograms per cubic meter to the custom unit.
- In "3 FlwDen", enter the operating density in the density unit specified.
- In "3 BasDen", enter the standard density in the density unit specified.
- "LfciEGU" shows the units of the low flow cut-in.
- "Lfci" shows the Lfci presently configured.
- In "3 VisEGU", select the viscosity unit (cPoise, Poise, cStoke or PaSec).
- In "3 Visc", enter the viscosity in the viscosity unit specified.

The following table lists the engineering units (EGUs) available. The available EGU options depend on the "FlwMap" selection (VolFlow, BVolFlow, MassFlow or Velocity), and the actual EGUs are entered in the "1 Setup > 2 Flow > 3 FlwEGU" menu.

Fluid type	"FlwMap" selected	Available EGUs
Liquid	Volume (VolFlow)	m3/s, m3/m, m3/h, m3/d, gal/s, gal/m, gal/h, gal/d, Mgal/d, l/s, l/m, l/h, l/d, Ml/h, Ml/d, ft3/s, ft3/m, ft3/h, ft3/d, bbl3/s(31.5), bbl3/m, bbl3/h(31.5), bbl3/d, bbl/s, bbl/m, bbl/h , bbl/d, igal/s, igal/m, igal/h, igal/d, mcfd, mmcfd, Custom
	Standard volume (BVolFlow > StdVol)	Sm3/s, Sm3/m, Sm3/h, Sm3/d, Sft3/s, Sft3/m, Sft3/h, Sft3/d, Sgal/s, Sgal/m, Sgal/h, Sgal/d, Sbl3/s (31.5), Sbl3/m (31.5), Sbl3/h (31.5), Sbl3/d (31.5), Sbbl/s (42), Sbbl/m (42), Sbbl/h (42), Sbbl/d (42), mScfd, mmScfd, Custom
	Normal volume (BVolFlow > NormVol)	Ngal/s, Ngal/m, Ngal/h, Ngal/d, Nl/s, Nl/m, Nl/h, Nl/d, Nm3/s, Nm3/m, Nm3/h, Nm3/d, Custom
	Mass (MassFlow)	kg/s, kg/m, kg/h, kg/d, g/s, g/m, g/h, g/d, lb/s, lb/m, lb/h, lb/d, mton/h, mton/d, STon/s, STon/m, STon/h, STon/d, oz/s, oz/m, oz/h, oz/d, mton/s, mton/m, LTon/m, LTon/h, LTon/d, Custom
	Velocity	m/s, m/m, m/h, m/d, ft/s, ft/m, ft/h, ft/d
Gas	Volume (VolFlow)	ft3/s, ft3/m, ft3/h, ft3/d, m3/s, m3/m, m3/h, m3/d, mcfd, mmcfd, Custom
	Standard volume (BVolFlow > StdVol)	Sft3/s, Sft3/m, Sft3/h, Sft3/d, mScfd, mmScfd, Sm3/s, Sm3/m, Sm3/h, Sm3/d, Custom
	Normal volume (BVolFlow > NormVol)	Nm3/s, Nm3/m, Nm3/h, Nm3/d, Nl/s, Nl/m, Nl/h, Nl/d, Custom
	Mass (MassFlow)	lb/s, lb/m, lb/h, lb/d, kg/s, kg/m, kg/h, kg/d, g/s, g/m, g/h, g/d, mTon/s, mTon/m, mTon/h, mTon/d, STon/s, STon/m, STon/h, STon/d, LTon/m, LTon/h, LTon/d, oz/s, oz/m, oz/h, oz/d, Custom
	Velocity	ft/s, ft/m, ft/h, ft/d, m/s, m/m, m/h, m/d
Steam	Volume (VolFlow)	ft3/s, ft3/m, ft3/h, ft3/d, m3/s, m3/m, m3/h, m3/d, mcfd, mmcfd, Custom
	Mass (MassFlow)	lb/s, lb/m, lb/h, lb/d, kg/s, kg/m, kg/h, kg/d, g/s, g/m, g/h, g/d, mTon/s, mTon/m, mTon/h, mTon/d, STon/s, STon/m, STon/h, STon/d, LTon/m, LTon/h, LTon/d, oz/s, oz/m, oz/h, oz/d, Custom
	Velocity	ft/s, ft/m, ft/h, ft/d, m/s, m/m, m/h, m/d

Table 5-10: Available engineering units

EGU	Description	EGU	Description	EGU	Description
lb/ft3	pounds per cubic foot	LTon/d	long tons per day (2240 lbs)	Sm3/m	Standard cubic meters per minute
lb/gal	pounds per US gallon	m3/s	cubic meters per second	Sm3/h	Standard cubic meters per hour
oz/in3	Ounces per cubic in	m3/m	cubic meters per minute	Sm3/d	Standard cubic meters per day
kg/m3	kilograms per cubic meter	m3/h	cubic meter per hour	Sft3/s	Standard cubic feet per second US System
kg/l	kilograms per liter	m3/d	cubic meters per day	Sft3/m	Standard cubic feet per minute US System
g/cm3	grams per cubic centimeter	ft3/s	cubic feet per second	Sft3/h	Standard cubic feet per hour US System
lb/Yd3	pounds per cubic yard	ft3/m	cubic feet per minute	Sft3/d	Standard cubic feet per day US System
LT/Yd3	long tons per cubic yard	ft3/h	cubic feet per hour	Sgal/s	Standard US gallon per second
ST/Yd3	short tons per cubic yard	ft3/d	cubic feet per day	Sgal/m	Standard US gallon per minute
kg/s	kilograms per second	gal/s	US gallons per second	Sgal/h	Standard US gallon per hour
kg/m	kilograms per minute	gal/m	US gallons per minute	Sgal/d	Standard US gallon per day
kg/h	kilograms per hour	gal/h	US gallons per hour	Sbl3/s	Standard barrel per second (31.5 US gallons per barrel)
kg/d	kilograms per day	gal/d	US gallons per day	Sbl3/m	Standard barrel per minute (31.5 US gallons per barrel)
lb/s	pounds per second	Igal/s	imperial gallons per second	Sbl3/h	Standard barrel per hour (31.5 US gallons per barrel)
lb/m	pounds per minute	Igal/m	imperial gallons per minute	Sbl3/d	Standard barrel per day (31.5 US gallons per barrel)
lb/h	pounds per hour	Igal/h	imperial gallons per hour	Sbbl/s	Standard barrel per year (42 US gallons per barrel)
lb/d	pounds per day	Igal/d	imperial gallons per day	Sbbl/m	Standard barrel per year (42 US gallons per barrel)
g/s	grams per second	bbl3/s	Barrels per second (31.5 US gallons = barrel)	Sbbl/h	Standard barrel per year (42 US gallons per barrel)
g/m	grams per minute	bbl3/m	Barrels per minute (31.5 US gallons = barrel)	Sbbl/d	Standard barrel per year (42 US gallons per barrel)
g/h	grams per hour	bbl3/h	Barrels per hour (31.5 US gallons = barrel)	mScfd	thousand of standard cubic feet per 24 hours
g/d	grams per day	bbl3/d	Barrels per day (31.5 US gallons = barrel)	mmScfd	millions of standard cubic feet per 24 hours
oz/s	Ounces per second	bbl/s	Barrels per second (42 US gallons = barrel)	Nm3/s	Normal Cubic meter per second MKS System
oz/m	Ounces per minute	bbl/m	Barrels per minute (42 US gallons = barrel)	Nm3/m	Normal Cubic meter per minute MKS System
oz/h	Ounces per hour	bbl/h	Barrels per hour (42 US gallons = barrel)	Nm3/h	Normal Cubic meter per hour MKS System

EGU	Description	EGU	Description	EGU	Description
oz/d	Ounces per day	bbl/d	Barrels per day (42 US gallons = barrel)	Nm3/d	Normal Cubic meter per day MKS System
mTon/s	metric tons per second	l/s	liters per second	Ngal/s	Normal US gallon per second
mTon/m	metric tons per minute	l/m	liters per minute	Ngal/m	Normal US gallon per minute
mTon/h	metric tons per hour	l/h	liters per hour	Ngal/h	Normal US gallon per hour
mTon/d	metric tons per day	l/d	liters per day	Ngal/d	Normal US gallon per day
STon/s	short tons per second (2000 lbs)	Ml/h	million liters per hour	Nl/s	Normal liter per second MKS System
STon/m	short tons per minute (2000 lbs)	Ml/d	million liters per day	Nl/m	Normal liter per minute MKS System
STon/h	short tons per hour (2000 lbs)	Mgal/d	million US gallons per day	Nl/h	Normal liter per hour MKS System
STon/d	short tons per day (2000 lbs)	mcfd	thousand cubic ft per day	Nl/d	Normal liter per day MKS System
LTon/m	long tons per minute (2240 lbs)	mmcfd	million cubic ft per day	Custom	Custom VolumeNorm-Rate
LTon/h	long tons per hour (2240 lbs)	Sm3/s	Standard cubic meters per second		

Table 5-11: All flow EGU descriptions (volume, mass, base volume and velocity)

EGU	Description	EGU	Description
Viscosity		**Density**	
PaSec	Pa.s	lb/ft3	pounds per cubic foot
cPoise	centipoise	lb/gal	pounds per US gallon
K-Factor		oz/in3	ounces per cubic in
m3/p	cubic meter per pulse	kg/m3	kilograms per cubic meter
p/l	pulses per liter	kg/l	kilograms per liter
p/ft3	pulses per cubic foot	g/cm3	grams per cubic centimeter
Temperature		lb/Yd3	pounds per cubic yard
degF	degrees Fahrenheit	LT/Yd3	long tons per cubic yard
degR	degrees Rankine	ST/Yd3	short tons per cubic yard
degC	degrees Celsius	Custom	Custom density
degK	degrees Kelvin		

Table 5-12: Viscosity, K-Factor, density, and temperature EGU descriptions

5.4.2 Setting the flow parameters

The "2 Flow" section of the setup mode allows you to configure parameters for flow.

In "3 FlwMap", select "VolFlow, BVolFlow, MassFlow or Velocity".

INFORMATION!
Before changing the totalizer mappings from "VolFlow" to "BVolFlow", the totalizer must be at zero.

- *If there is flow, turn the totalizer off and clear it.*
- *If there is no flow, clear the totalizer.*

For further information refer to Total mode on page 47.

In "3 FlwEGU", select the desired unit of flow from the picklist. If you pick "Custom", you must define your custom unit. First, enter a label for your custom units using up to eight alphanumeric characters. Then, enter any offset (Offset) and a conversion factor (Slope) from kilograms per second (kg/s) for mass flow units or cubic meters per second (m3/s) for volume or base volume flow units to the custom units.

Example: The slope for a custom unit of yd^3/min would be 78.47704 because 78.47704 yd^3/min = 1 m^3/s.

In "3 FlwURV", enter the upper range value in the flow unit just specified.

In "3 FlwDmp", select the damping factor from the picklist.

In "3 VelEGU", select the desired velocity unit from the picklist.

5.4.3 Setting the tuning parameter

The "2 Tuning" section of the setup mode allows you to specify several flowmeter options.

- In "3 AddDrop", configure the pulse compensation (signal conditioning) feature as on or off.
- In "3 RdCorr", configure the Reynolds number correction feature as on or off.
- In "3 LFCI", set the low flow cut-in parameter to the level above which the flowmeter begins to measure flow. Select an output that provides no output under no flow conditions. In "4 FlwEGU", note the flow units in which the setting selections are shown. In "4 Setting", select a setting from the picklist presented.

INFORMATION!
The "LFCI" can be automatically set by the flowmeter in the calibration/test mode.

5.4.4 Setting the totals parameters

The "2 Total" section of the setup mode allows you to configure each of two totalizers. This is done in "3 TotNet" and "3 TotGrd".

INFORMATION!

Before changing the totalizer mappings from "VolFlow" to "BVolFlow", the totalizer must be at zero.

- *If there is flow, turn the totalizer off and clear it.*
- *If there is no flow, clear the totalizer.*

For further information refer to Total mode on page 47.

For each totalizer:

- In "4 Map", map the totalizer to volume, mass, or base volume.
- In "4 EGU", select the desired unit from the picklist presented. If you pick "Custom", you must define a custom unit. First, enter a Label for a custom units using up to eight alphanumeric characters. Then, enter any offset (Offset) and a conversion factor (Slope) from kilograms (for mass units) or cubic meters (for volume or base volume units) to the custom units.

Example: The slope for a custom unit of a 42 gallon barrel would be 6.2898 because 6.2898 bbl = 1 m^3.

5.4.5 Setting the output parameters

The "2 Output" section of the setup mode allows you to configure the HART communications, the mA output, the pulse output and the display parameters.

Communications

There is no need to map the measurements to be displayed in the I/A series system as they are already defined. The primary measurement is flow rate (volume, base volume or mass), the secondary measurement is net total and the tertiary measurement is grand total.

In "3 Coms", configure the communications parameters:

- In "4 PolAddr", specify the poll address from the picklist of numbers from 0 through 15.
- In "4 Preambl", set the number of preambles between 2 and 20.

mA output

In "3 Fail", configure the mA output to go fully downscale or upscale upon a failure.

Pulse output (if pulse output specified)

In "3 Pulse", go to "4 Pulse" and select the type of pulse output as "Rate, Total, Raw, or Off".

If "Rate", configure the following: In "4 Freq", select the upper frequency end point corresponding to the highest frequency generated as 10, 100 or 1000 Hz.

If "Total", configure the following:

- In "4 Pwidth", select, the pulse width as 0.5, 5 or 50 ms.
- In "4 EGU", select the units from the picklist provided.
- In "4 U/Pulse", enter the units per pulse.

If "Raw", no further action is required.

Display

In "3 Display", configure the display parameters.

In "4 Show", specify whether the reading is to be shown for each of the following measurements and, if shown, the format (decimal point placement) of the displayed value:

- In "5 FlwVol", the volume flow output display.
- In "5 TotNet", the net totalizer reading.
- In "5 TotGrd", the grand totalizer reading.

In "4 Show1st", select the first measurement to be shown as "FlwVol, Velcty, FlwBVo, FlwMas or Raw".

In "4 Cycle", specify whether the list of measurements configured to be shown are scanned automatically (Auto) or manually (Manual).

5.4.6 Setting the piping parameters

The "2 Pipe" section of the setup mode allows you to configure the parameters related to piping.

Piping

In "3 Piping", configure the parameters used by the flowmeter to correct for the effects of upstream piping and disturbances on the flowing K-Factor as follows:

- In "4 Config", select the upstream piping configuration from the following picklist:
  - Straight
  - 1 EL PAR (1 elbow with shedder parallel to elbow plane)
  - 1 EL PER (1 elbow with shedder perpendicular to elbow plane)
  - 2L0PDPAR (2 elbows with shedder parallel to plane of closest elbow and distance between elbows is zero pipe diameters)
  - 2L0PDPER (2 elbows with shedder perpendicular to plane of closest elbow and distance between elbows is zero pipe diameters)
  - 2L5PDPAR (2 elbows with shedder parallel to plane of closest elbow and distance between elbows is 5 pipe diameters)
  - 2L5PDPER (2 elbows with shedder perpendicular to plane of closest elbow and distance between elbows is 5 pipe diameters)
  - Reducer
- In "4 UpDist", enter the distance to the first upstream flow disturbance in pipe diameters.

Pipe bore

In "3 BorSch", select the pipe bore from the following picklist: "Sched 10, Sched 40, Sched 80, PN16, PN40, PN64, PN100 or Sanitary".

In "3 Custom", input a "Kref Bias" in percent (%). For example: to change Kref by 2%, enter 2.000.

5.4.7 Setting the tag parameters

The "2 Tags" section of the setup mode allows you to configure the following identification parameters:

- In "3 HrtDes", enter the device description.
- In "3 HrtTag", enter an alphanumeric description if desired.

5.4.8 Setting the flowtube parameters

The "2 NewTube" section of the setup mode allows you to configure the following flow tube parameters:

Model

In "3 Model", enter the model number of the flowtube (16 characters maximum) as found on the flowmeter tag. It is already in the database if the flowtube and electronics were shipped as a unit.

Special flowtube

If your flowtube was customized to be different from the model number entered, you can override certain descriptions in the model code in "3 Special" as follows:

- In "4 TubDia", enter the custom flowtube diameter in meters.
- In "4 TubAlp", enter the thermal coefficient of expansion (alpha) in m/m/°K.
- In "4 LfUFac" enter the low flow cut-in user factor.

Reference number

In "3 Ref No", enter the reference number (serial number) of the flowtube (16 characters maximum) as found on the flowmeter tag. It is already in the database if the flowtube and electronics were shipped as a unit.

K-Factor

In "3 K Ref", enter the K-factor as follows:

- In "4 K EGU", select p/l or p/ft3 as the unit of the K-factor.
- In "4 K Ref", enter the reference K-factor as found on the flowmeter tag.

5.4.9 Changing the password

The "2 Passwd" section of the setup mode allows you to create or change the passwords.

In "4 LoPwd", enter the new password for access to clear (reset) the net and pulse totalizers.

In "4 HiPwd", enter the new password for access to all modes.

INFORMATION!

- *Passwords contain four characters.*
- *Use four spaces to configure "No Password".*

5.5 Description of calibration/test mode

The calibration/test mode enables you to:

- Set the Low Flow Cut In (LFCI).
- Calibrate the 4 and 20 mA output.
- Self test the flowmeter.
- Use the flowmeter to test the loop.

The "Calibration/Test" mode can be a password protected mode. So after the initial configuration, you may need to enter the "HiPwd" to perform the procedures in this mode. For further information refer to *Password* on page 43.

INFORMATION!
If you lose your password, call our local cupport for assistance.

1 Cal/Tst			
	2 Calib		
		3 CalLFCI	
		3 Cal mA	
			4 Restore
			4 Cal4mA
			4 Cal20mA
			4 CalDate
			4 Initial
	2 Test		
		3 Set Dig	
		3 Set mA	
		3 Set Hz	
		SelfTst	
	<-CANCEL SAVE->		

Table 5-13: Calibration/test mode

5.5.1 Calibration

In "2 Calib", go to "3 CalLFCI" to have the flowmeter automatically set the "Low Flow Cut-In". In doing this, the flowmeter chooses the lowest level at which no signal is detected over a 20 seconds time interval. It is important that the flow be zero during this procedure.

INFORMATION!
This procedure may confirm your choice of LFCI setting in the chapter "Setting the tuning parameters". However, if it picks a different selection, it overwrites your selection.

In "2 Calib", go to "3 Cal mA" to calibrate the 4 and 20 mA output.

- The "4 Restore" parameter restores the factory calibration.
- The "4 Cal4mA" and "4 Cal20mA" parameters allow the 4 to 20 mA output of the flowmeter to be calibrated or matched to the calibration of the receiving device to an accuracy of 0.005 mA.

INFORMATION!
The flowmeter has been accurately calibrated at the factory. Recalibration of the output is normally not required, unless it is being adjusted to match the calibration of the receiving device.

- In "4 CalDate", enter the date of the last calibration if desired.
- In "4 Initial", enter the initials of the last calibrator if desired.

5.5.2 Test

In "2 Test", you can self test the flowmeter and use the flowmeter to test the loop.

Testing the loop

The flowmeter can be used as a signal source to check and/or calibrate other instruments in the control loop, such as indicators, controllers, and recorders. To do this, set the mA output (3 Set mA), rate pulse output (3 Set Hz), or digital output (3 SetDig) signals to any value within the range limits of the meter.

Testing the flowmeter

The self test parameter (3 SelfTst) checks the flowmeter operation by injecting, near the front end of the electronics, an internally generated periodic signal of known frequency. The frequency of this signal is in turn measured and checked against the injected signal.

INFORMATION!
It is recommended that you clear the totalizer after a self test. For further information refer to Total mode on page 47.

5.6 Error messages

This section defines error messages that may be displayed and actions that can be taken to correct the error. Some messages appear periodically while seeing a valid flow measurement. This typically occurs when "soft limits" have been exceeded and the flowmeter is warning that a hard limit is approaching.

Message	Explanation	Corrective action
Override	The flowmeter is being overridden by an external host such as another configurator or control system.	None - This is an awareness message that the flowmeter is being overridden.
W: Input xxxxxxxx	Warning: An input to a specific measurement or calculation has exceeded the normal limit and is in the "soft limit" region. The measurement or calculation is defined on the second line of the message.	1. Check inputted temperature flowing temperature to make sure it is within the temperature limits of the sensor. 2. Check the raw frequency to determine if it is out of limits for the flowmeter size.
B: Input xxxxxxxx	Bad input: Same as above except the inputs have now exceeded the "soft limit". This adversely affects all measurements.	
W: Input Total	Warning: The total (pulse, net or grand) may not be correct due to a momentary loss of power.	Clear the total. Pulse and net total can be cleared independently. Clearing the grand total clears pulse and net totals also.
FcErr E:0xxxx	An internal function did not execute successfully.	If this occurs at startup, an invalid configuration exists. Re-check the configuration. If this does not resolve the problem, re-enter the model.

Table 5-14: Operational error messages

Message	Explanation	Corrective action
WrProtct	The write protect jumper is in the "protect" position or is missing. The configuration cannot be changed unless the jumper is in the "write" position.	Install or move the write protect jumper to the "write" position. For further information refer to *Cover locks* on page 31.
Cfg Err MsCode	An incorrect model code has been entered.	Enter the correct model code.
No Pulse Hardware	An incorrect model code has been entered. The model code entered was for a flowmeter with a pulse output. The electronics module does not have a pulse output PWB.	
Bad URV URV=URL	The entered URV has exceeded the URL (meter capacity) of the flowmeter.	Press "Enter" to change the URV to the value of the URL. Make sure that the entered value for "Flowing Density" is correct.
Bad URV URV=Min	The entered URV is less than the minimum value allowed for the URV.	Press "Enter" to change the URV to the value of the URL. Make sure that the entered value for "Flowing Density" is correct. ①
FcErr E:0xxxxx	An internal function did not execute successfully.	Review the inputs associated with the last menu function. If this does not resolve the problem, re-enter the model.

Table 5-15: Configuration error messages

① The minimum URV value is three times (3x) the LFCI flow rate. For applications where the URV is very low relative to the flowmeter capacity, this error message may appear when this constraint is violated. This could be the result of lowering the URV, increasing the LFCI setting, or decreasing the flowing density (increasing the corresponding LFCI flow rate values).

5.7 Setting the write protect jumper

Your signal converter has write protection capability which meets the security requirements of ISAS84.01- 1986 for use in safety shutdown systems. This means that the local display and remote electronics can be prevented from writing to the electronics. Write protection is set by moving a jumper that is located in the electronics compartment behind the display. To activate write protection, remove the display and remove the jumper or place it in the "protect" position. In the "write" position, writing to certain functions can be limited by password protection. For further information refer to *Password* on page 43.

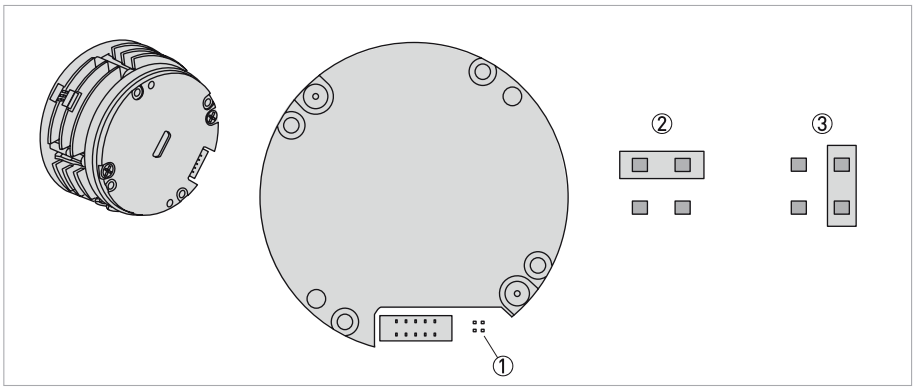


Figure 5-2: Position of the write protect jumper

① Write protection pins
② Jumper in protect position
③ Jumper in write position

5.8 Operation via HART Communicator

5.8.1 Explanation of parameters

Cross reference	Parameter	Explanation
Menu level 1		
1 Status	Detail Status	Path to viewing the status of various device parameters.
1 Setup	Detailed Setup	Path to detailed setup parameters.
	Device Setup	Path to all other parameters.
1TotGrd	Grand Operations	Procedure to start, pause or clear the grand total.
1 Measure	Grand Total Value	Shows the grand total value.
	Net Total Value	Shows the net total value.
1 View	Review	Path to viewing flowmeter values and settings.
	Revisions	Path to configuring the various revision levels.
Menu level 2		
2 Calib	Calibration	Path to performing a D/A trim or scaled D/A trim.
2 CalDate / 4 Cal Date	Calibration Date	In "1 View", shows the last calibration date. In "1 Cal/Tst", enter the date of the last calibration.
2 CalName / 4 Initial	Calibrator Name	In "1 View", shows the initials of the last calibrator. In "1 Cal/Tst", enter the date of the initials of the last calibrator.
2 Tags	Device Info	Path to configuring the device description parameters.
2 Reason	Error Reason	Shows the error reason code.
2 New Tube	Flowtube Configuration	Path to configuring the flowtube parameters.
2 HartAdr / 4 PolAdr	HART Adress	In "1 View", shows the poll address. In "1 Setup", configure the poll address to a number from 0 through 15. A non zero number applies to multidrop applications.
2 HartDes / 3 HrtDes	HART Description	In "1 View" shows the descriptor. In "1 Setup", enter the descriptor (16 characters maximum).
2 HartMsg	HART Message	In "1 View" shows the message.
2 Flow	HART PV	Map the PV to Flow to Mass / Volume Flow.
2 HRTTag / 3 HRTTag	HART Tag	In "1 View", shows the tag. In "1 Setup", enter the tag (8 characters maximum).
2 Test	Loop Test	Procedure to use the flowmeter as a calibration source to check other instruments in the loop.
2 MeaStat	Measurement Status	Path to viewing the status of various measurement parameters.
2 Pipe	Measuring Elements	Path to configuring the measuring element parameters.
2 Model / 3 Model	Model Code	In "1 View", shows the model code. In "1 Setup", enter the model code.
2 Total	Net Operations	Procedure to start, pause or clear the net total.
2 Output	Output Configuration	Path to configuring the output parameters.
2 Passwd	Password	Enter the password to enter advanced menu.
2 SW Rev	Software Rev	Shows the software revision level.
	Software Sub-Revision	Shows the software sub-revision level.
2 HrtTag / 3HrtTag	Tag	In "1 View", shows the tag. In "1 Setup", enter the tag (8 characters maximum).

Cross reference	Parameter	Explanation
2 Total	Total Units	Path to configuring the totals parameters.
	Totals Operations	Path to viewing, starting, stopping, or clearing the totalizers.
2 Tuning	Tuning	Path to configuring the tuning parameters.

Menu level 3

3 VisEGU	Abs Viscosity Unit	Select the viscosity unit from the picklist provided.
3 mA Out -> Status	AO Status	Shows the AO status
3 mA Out ->Value	AO Value	Shows the AO value
3 FlwMap	AO/PV Map	Shows whether the PV is mapped to "Volume Flow", "Mass Flow", "BVolFlow" or "Velocity".
3 FlwURV	AO/PV URV	Shows the AO/PV URV
3 SetLFCI	Auto LFCI	Procedure for the flowmeter to automatically set the LFCI.
3 Bas Den	Base Density	In "1 Setup", enter the base density in the density unit specified. This is only used to calculate the base volumes.
3 Custom	Custom K Bias	In "1 Setup", enter the custom K-factor (with sign in percent). In "1 Status", shows the custom K-Factor.
3 Label	Custom PV Label	Enter the label for your custom PV unit.
3 Offset	Custom PV Offset	Enter any offset.
3 Cal mA	D/A Trim	Procedure to trim the 4 and 20 mA output values of the flowmeter to match the output of a plant standard measurement device.
3 DenEGU	Density Units	In "Detailed Setup", select the density unit from the picklist provided. In "Review", shows the density units.
3 SetDig	Digital Output	Path to configuring the digital output.
3 Velcty	Flow Velocity	Shows the flow velocity value.
3 Name	Fluid Name	In "1 Setup", enter the name of the fluid. In "Review", shows the fluid name.
3 FldTyp (Read Only)	Fluid Type	In "1 Setup" the fluid type will be shown.
3TotGrd	Grand Total	In "Process Variables", shows the grand total. In "1 Setup", path to configuring the grand total mapping and units.
3 Coms	HART Output	Path to configuring the HART output.
3 KCor	K Corrected	In "1 Status" shows the K corrected value.
3 K Ref / 4 K Ref	K Factor	In "1 Status", shows the K-Factor value. In "1 Setup", enter the K-Factor.
3 Lfci (Read Only) / 3 CalLFCI	LFCI	In the "1 Setup", shows the low flow cut-in value. In "1 Cal/Tst", the LFCI can be automatically calibrated.
3 Display	Local Display	Path to configuring the local display.
3 BoreSch	Mating Pipe	In "1 Setup", select the type of mating pipe from the picklist provided.
3 TotNet	Net Total	In "Process Variables", shows the net total. In "Detailed Setup", path to configuring the net total mapping and units.
3 Fail	O/P Alarm Code	In "1 Setup", configure the output to go fully upscale or downscale if a failure occurs.
3 Pipe	Piping	Path to configuring the piping parameters.
3 FlwMap	PO/PV Map	Shows whether the PV is mapped to "Volume Flow", "Mass Flow", "BVolFlow" or "Velocity".
3 FlwURV	PO/PV URV	Shows the PO/PV URV.

Cross reference	Parameter	Explanation
3 FlwDen	Process Density	In "1 Setup", enter the flow density in the density unit specified.
3 Flw Tmp	Process Temperature	In "Detailed Setup", enter the flow temperature in the temperature unit specified. In "Review", shows the process temperature.
3 Visc	Process Viscosity	In "1 Setup", enter the base viscosity in the viscosity unit specified.
3 Add Drop	Pulse Add Drop	In "1 Setup", configure the pulse compensation (signal conditioning) feature "On" or "Off".
3 Pulse	Pulse Operations	Procedure to start, pause or clear the pulse total.
	Pulse Output	Path to configuring the pulse output.
3 Pulse (2 MeaStat)	Pulse Out	Shows the pulse value.
	Pulse Status	Shows the pulse status.
3 mA Out	PV AO	Shows the analogue output of the process variable.
3 FlwDmp	PV Damping	Enter the damping time if different than the one shown.
3 FlwMap	PV Map	Map the PV to "Volume Flow", "Mass Flow", "BVolFlow" or Velocity.
3 FlwEGU	PV Units	In "1 Setup", select the PV units from the picklist. In "Detailed Setup", select the PV units from the picklist.
3 FlwURV	PV URV	In the "1 Setup", shows the process variable upper range value which can be configured.
3 RdCorr	Reynolds Correction	Shows the Reynolds correction status (on/off).
	Reynolds Number	Configure the Reynolds number correction feature "On" or "Off".
3 SelfTst	Self Test	Procedure to self test the device.
3 Set mA	Set Analog Out	Procedure to set the analogue output to 4 mA, 20 mA or another value.
3 Set DIG	Set Digital Out	Procedure to set the digital output to override the PV, net total, grand total, or vortex frequency.
3 New	Set Fluid Defaults	Path to setting the default parameters for the type of fluid selected (liquid, gas, or steam).
3 Set Hz	Set Pulse Out	Procedure to set the pulse output to 0 Hz, the maximum frequency, or another value.
3 Special	Special	Path to configuring special flowtube parameters.
3 TmpRGU	Temperature Units	In "Detailed Setup", select the temperature unit from the picklist provided. In "Review", shows the temperature units.
3 Custom	Tube Diameter	Enter the custom flowtube diameters in meters.
3 VelEGU	Velocity Unit	In "1 Setup", select the unit from the picklist.

Menu level 4

4 HiPwd	Admin Password	Set Admin password.
4 If EGU (Customer Label)	Custom Dens Label	Enter the label for your custom density unit.
4 Offset	Custom Dens Offset	Enter any offset.
4 Slope	Custom PV Slope	Enter a conversion factor for the custom PV unit.
4 Cycle	Display Cycle	Specify whether the list of measurements configured to be displayed are scanned automatically or manually.
4 Show	Display Setup	Set the parameters to be shown on the display.
4 Map	Grand Total Map	Map the "Grand Total" to "Volume", "Mass" or "BVolume".

Cross reference	Parameter	Explanation
4 EGU	Grand Total Units	In "Detailed Setup", select the grand total units from the picklist provided. In "Review", shows the grand total units.
4 K EGU	K Factor Units	In "1 Setup", path to selecting the K-Factor unit.
4 Setting	LFCI Index	Shows the low flow cut-in picklist number.
4 LfUFac	Low Flow Cut Factory	Set to factory value of LFC.
4 Map	Net Total Map	Map the "Net Total" to "Volume", "Mass" or "BVolume".
4 EGU	Net Total Units	In "Detailed Setup", select the net total units from the picklist provided. In "Review", shows the net total units.
4 Preambl	Num Req Preams	In "1 Setup", configure the number of preambles to be sent in a response message from the flowmeter to the host.
4 Config	Piping Config	In "Detailed Setup", select the type of piping configuration from the picklist provided. In "Review" shows the type of piping configuration.
4 Show1st	Primary Display	Select the first measurement to be displayed.
4 Frequ	Pulse Max Freq	In "1 Setup", set the upper frequency end point corresponding to the highest frequency as 10, 100 or 1000 Hz.
4 Pulse	Pulse Mode	In "1 Setup", select the type of pulse output as "Rate", "Total", "Raw" or "Off". In "1 View", shows the type of pulse output.
4 Factor	Pulse Resolution	Enter the units per pulse.
4 EGU	Pulse Total EGU	Select the unit from the picklist provided.
4 Pwidth	Pulse Width	Select the pulse width as 0.5, 5 or 50 ms.
4 TubAlp	Tube Alpha	Enter the thermal coefficient of expansion (alpha) in m/m/°K.
4 Tub Dia	Tube Diameter	Enter the custom flowtube diameters in meters.
4 Updist	Upstream Distance	In "1 Setup", enter the distance to the first upstream disturbance in pipe diameters.
4 LoPwd	User Password	User Password

Menu level 5

5 FlwVol	Show	Map the PV to "Volume Flow".
5 Format	Display Format	Set the display format (to decide how many decimal points to be used for displaying a particular value).
5 TotGRD	Totalizer Grand	Grand Totalizer
5TotNet	Totalizer Net	Net Totalizer
p/CuFt	p/CuFt	Sets the K-Factor unit to pulses per cubic foot.
p/l	p/l	Sets the K-Factor unit to pulses per liter.

Table 5-16: Parameters

Communicator parameters

Parameter	Explanation
Analog Output	Path to configuring the analogue output.
AO/PV LRV	Shows the AO/PV LRV.
Basic Setup	Path to basic setup parameters.
Dev ID	Shows the device identification number.
Device Err Status	Shows the device error status.
Device Warn Status	Shows the device warning status.
Diag/Service	Path to status, test, and calibration parameters.
Fld Dev Rev	Shows the software version of the vortex flowmeter.
Hardware Rev	Shows the vortex flowmeter hardware revision level.
LFCI Adjust Factor	Enter the low flow cut-in user factor.
Manufacturer	Shows the manufacturer.
PO/PV LRV	Shows the PO/PV LRV.
Process Parameters	Path to configuring the process parameters.
Process Variables	Path to viewing the process variable values.
Pulse Map	Shows whether the pulse is mapped to "Volume Flow", "Mass Flow", "BVolFlow," or "Velocity".
PV	Shows the value of the process variable.
PV % Rnge	Shows the process variable in percent of range.
PV Configuration	Path to configuring the PV parameters.
PV Damp	Shows the damping time.
PV Min Span	Shows the minimum span.
PV USL	In the "Basic Menu", shows the upper sensor limit. In "Review", shows the upper sensor limit.
Scaled D/A Trim	Procedure to trim the low and high mA output values of the flowmeter to match the output of a plant standard measurement device.
Serial Number	In "Detailed Setup", enter the serial number. In "Review", shows the serial number.
Universal Rev	Shows the universal command set revision level.
Variable Map	Map the output as the primary, secondary, tertiary, or fourth output.
Velocity Status	Shows the Velocity status.
Vortex Freq	Shows the vortex frequency.

Table 5-17: Communicator parameters

5.8.2 Online menu

1. Device Setup			
	1. Process Variables		
		1. PV	
		2. PV % Rnge	
		3. PV AO	
		4. Net Total (SV)	
		5. Grand Total (TV)	
		6. Vortex Freq (QV)	
	2. Diag/Service		
		1. Totals Operations	A
		2. Auto LFCI	
		3. Self Test	
		4. Loop Test	B
		5. Calibration	C
		6. Measurement Status	D
		7. Detail Status	E
	3. Basic Setup		
		1. Model Code	
		2. Set Fluid Defaults	F
		3. K Factor Units	G
		4. K Factor	
		5. PV Map	
		6. PV Units If PV Units = Custom, specify Custom PV Label Custom PV Offset Custom PV Slope	
		7. PV URV	
		8. PV Damping	
		9. Tag	

	4. Detailed Setup		
		1. Measuring Elements	H
		2. Flowtube Config	J
		3. Tuning	K
		4. Output Config	L
		5. Device Info	M
2. PV			
3. PV AO			
4. PV URV			
5. LFCI			
6. LFCI Index			
7. PV USL			

A	1. Pulse Operations		H	1. Process Variables	
	2. Net Total Value				1. PV
	3. Net Operations				2. PV % Rnge
	4. Grand Total Value				3. PV AO
	5. Grand Operations				4. Net Total
B	1. Set Digital Out				5. Grand Total
	2. Set Analog Out				6. Vortex Freq
	3. Set Pulse Out			2. PV Configuration	N
C	1. D/A Trim			3. Total Units	P
	2. Scaled D/A Trim			4. Process Parameters	Q
	3. Date			5. Piping	R
D	1. Flow Velocity		J	1. Model Code	
	2. Velocity Status			2. K Factor Units	
	3. K Factor			3. K Factor	
	4. K Corrected			4. Serial Number	
	5. K Corrected Status			5. Special	
	6. AO Status				1. Tube Diameter
	7. AO Value				2. Tube Alpha
	8. Pulse Out				3. LFCI Adjust Factor
	9. Pulse Status		K	1. Reynolds Correction	
	Process Viscosity			2. Pulse Add/Drop	
	Viscosity Status			3. LFCI	
E	1. Error Reason		M	1. Manufacturer	
	2. Device Err Status			2. Tag	
	3. Device Warn Status			3. Descriptor	
F	1. Liquid			4. Message	
	2. Gas			5. Date	
	3. Steam			6. Revisions	
G	1. p/l				
	2. p/CuFt				

L	1. Digital Output			R	1. Mating Pipe
	1. Variable Map				This menu branch is not available for special orders or with Schedule 160.
	2. Set Digital Out				Schedule 10
	2. Analog Output	S			Schedule 40
	3. Pulse Output	T			Schedule 80
	4. HART Output				PN16
	1. Poll Addr				PN40
	2. Num Req Preams				PN64
	5. O/P Alarm Code				PN100
	6. Local Display				Sanitary
	1. Show				2. Piping Config
	2. Primary Display				Straight
	3. Display Cycle				1 L paral to shed
N	1. PV Map				1 L perp to shed
	2. PV Unit If PV Units = Custom, specify Custom PV Label Custom PV Offset Custom PV Slope				2 L cls paral shed
	3. PV URV				2 L cls perp shed
	4. PV Damping				2 L 5 dia paral
	5. Velocity Units				2 L 5 dia perp
P	1. Net Total				Reducer
	1. Net Total Map			S	1. AO/PV Map
	2. Net Total Units				2. AO/PV URV
	2. Grand Total				3. AO/PV LRV
	1. Grand Total Map				4. Set Analog Out
	2. Grand Total Units				5. Calibration C
Q	1. Set Fluid Defaults			T	**If Pulse Mode is "Off"**
	2. Fluid Name				1. Pulse Mode[1]
	3. Temperature Units				**If Pulse Mode "Raw"**
	4. Process Temp				1. Pulse Mode[1]
	5. Density Units If Density Units = Custom, specify Custom Dens Label Custom Dens Offset Custom Dens Slope				[1] 1. Off 2. Raw 3. Rate 4. Total
	6. Process Density				
	7. Base Density				
	8. Abs Viscosity Unit				
	9. Process Viscosity				

T	**If Pulse Mode is "Rate"**		U	O/P Alarm Code
	1. Pulse Mode[1]			PV Damp
	2. PO/PV Map			Pulse Add/Drop
	3. PO/PV URV			Fluid Name
	4. PO/PV LRV			Fluid Type
	5. Pulse Max Freq			Temperature Units
	6. Set Pulse Out			Process Temperature
	If Pulse Mode is "Total"			Density Units
	1. Pulse Mode			Process Density
	2. Pulse Map			Base Density
	3. Pulse Width			Abs Viscosity Units
	4. Pulse Total EGU			Process Viscosity
	5. Pulse Resolution			Mating Pipe
	6. Set Pulse Out			Piping Config
U	Model Code			Upstream Distance
	Serial Number			Custom K Bias
	K Factor			Manufacturer
	PV USL			Dev ID
	PV Min Span			Tag
	LFCI			Descriptor
	LFCI Index			Message
	PV Units			Date
	Net Total Units			Universal Rev
	Grand Total Units			Fld Dev Rev
	AO/PV Map			Software Rev
	AO/PV URV			Software Sub-Revision
	AO/PV LRV			Hardware Rev
	Pulse Mode			Poll Addr
	PO/PV Map*			Num Req Preams
	PO/PV URV*			
	PO/PV LRV*			
	Pulse Max Freq*			
	Pulse Map**			
	Pulse Width**			
	Pulse Total EGU**			
	Pulse Resolution**			

* If Pulse mode = Rate
** If Pulse Mode = Total

6.1 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

6.2 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

INFORMATION!
For more precise information, please contact your local sales office.

6.3 Returning the device to the manufacturer

6.3.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

WARNING!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of the personnel, the manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

WARNING!
If the device has been operated with toxic, caustic, radioactive, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralising, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that it is safe to handle and stating the product used.*

6.3.2 Form (for copying) to accompany a returned device

CAUTION!
To avoid any risk for our service personnel, this form has to be accessible from outside of the packaging with the returned device.

Company:		Address:
Department:		Name:
Telephone number: Fax number:		Email address:
Manufacturer order number or serial number:		
The device has been operated with the following medium:		
This medium is:		radioactive
		water-hazardous
		toxic
		caustic
		flammable
		We checked that all cavities in the device are free from such substances.
		We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment caused by any residual media contained in this device when it is returned.		
Date:		Signature:
Stamp:		

6.4 Disposal

LEGAL NOTICE!
Disposal must be carried out in accordance with legislation applicable in your country.

Separate collection of WEEE (Waste Electrical and Electronic Equipment) in the European Union:

According to the directive 2012/19/EU, the monitoring and control instruments marked with the WEEE symbol and reaching their end-of-life **must not be disposed of with other waste**.
The user must dispose of the WEEE to a designated collection point for the recycling of WEEE or send them back to our local organisation or authorised representative.

7.1 Functional principle

Vortex flowmeters are used to measure the flow of gases, vapours and liquids at completely filled pipes.

The measuring principle is based on the Karman vortex street. The measuring tube contains a bluff body at which vortex shedding occurs and which is detected by a sensor unit located behind. The frequency **f** of the vortex shedding is proportional to the flow velocity **v**. The non-dimensional Stouhal number S describes the relationship between vortex frequency **f**, width **b** of the bluff body and the average flow velocity **v**:

$$f = \frac{S \cdot v}{b}$$

The vortex frequency is recorded at the flow sensor and evaluated at the signal converter.

7.2 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 sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Measuring system

Application range	Flow measurement of conductive and non-conductive liquids, gases and steam
Function / Measuring principle	Karman vortex street

Measurement

Primary measured value	Number of separated vortices
Secondary measured value	Operating and standard volume flow and mass flow

Signal converter

Versions	Compact version (the signal converter is mounted directly on the flow sensor)
	Remote version (electrical connection to the flow sensor via signal cable) Cable length: ≤ 15 m / 50 ft

Flow sensor

Standard	Flange version
	Sandwich version
Option	Dual measuring device in flange version (redundant measurement)

Display and user interface

Local display	16-character digital indicator and configurator
	Indication: Flow rate, totaliser value or alternating between both
Interface and display languages	English
Communication format	Digital communications is provided in both the analogue (4...20 mA) and digital modes based upon the FSK (Frequency Shift Keying) technique.
Diagnostics	**Online diagnostics:** Flowmeter uses internal diagnostic functions including hardware checks and internal code and database validation. Error checking and diagnostic codes are also embedded in the communications protocol. These diagnostics are performed at start-up and as continuous background checks.
	Offline diagnostics (self test): The configurators allow self-tests to be initiated to validate the signal converter electronics. This test uses an internally generated frequency signal.
Security	**Write protect jumper:** A write protect jumper provides additional security by allowing the user to prevent the local indicator (configurator) and remote configurator from writing to the electronics. This write protection capability meets the security requirements of ISA-584.01-1986.
	Password protection: This is provided in the local display/configurator mode to assure operating security. A second level of protection is provided for configuration security.

Measuring accuracy

Reference conditions

Factory calibration conditions	Medium: Clear water
	Process & ambient temperature: +20...+30°C / +68...+86°F
	Relative humidity: 50...90%
	Supply voltage at mA output: 24 ± 0.5 VDC

Accuracy

Liquids	±0.5% of measured value (Re ≥ 30000)
	±1.0% of measured value (20000 < Re < 30000)
	±2.0% of measured value (10000 < Re < 20000)
Gases and steam	±1.0% of measured value (Re ≥ 20000)
	±2.0% of measured value (10000 < Re < 20000)
Process temperature effect on K-factor	There is an effect on the reference K-factor due to a diameter change of the flow tube bore with temperature. The effect is -0.3% of flow rate per +55°C / +100°F increase in temperature. The flowmeter will automatically recompute a flowing K-factor when process temperature is entered in the database fluid definition.

Operating conditions

Temperature

Process temperature	+150…+430°C / +302…+806°F
Ambient temperature	**Non-Ex:** -20…+80°C / -4…+176°F
	Ex: depending on type of protection and temperature class ATEX intrinsically safe: T_a = -40...+80°C ATEX flameproof: T_a = -20...+80°C FM intrinsically safe: T_a = 80°C FM explosion-proof: T_a = -40...+85°C IECEx intrinsically safe: T_a = -40...+80°C IECEx flameproof: T_a = -20...+80°C
	Note: When operating at ambient temperatures below -29°C / -20°F, it is important to maintain a minimum loop voltage of 15.75 VDC to maintain remote configurator communications capability.

Pressure

Medium pressure	Designed to withstand pressure within ANSI/ASME B16.5 Class 150, 300, 600, 900 or 1500 flange ratings and metric EN 1092-1, PN16, PN40, PN63, PN100 or PN160 flange ratings.
Maximum static pressure	103.4 barg / 1500 psig / 10340 kPa or that imposed by flange rating.

Media properties

Density	Taken into consideration when sizing.
Viscosity	< 10 cP
Reynold's number	> 10000

Nominal flow velocity limits

Lower range limit	6.0/ $\sqrt{\rho_f}$ m/s or 5.0/ $\sqrt{\rho_f}$ ft/s
Upper range limit	300/ $\sqrt{\rho_f}$ m/s or 250/ $\sqrt{\rho_f}$ ft/s
ρ_f is the fluid density at flowing conditions	

Environmental protection

Ingress protection	Electronics housing: IP66 / NEMA4X

Installation conditions

Inlet section	≥ 15 x DN without disturbing flow; ≥ 20 x DN 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 a flow straightener; ≥ 8 DN after a flow straightener
Outlet section	≥ 5 x DN

Materials

Flowmeter body & shedding bar	**OPTISWIRL 5080 flange version:** DN15...DN100: body and flanges in 316 stainless steel DN150...DN200: body in 316 stainless steel; flanges in 304 stainless steel DN250...DN300: body and flanges in 304 stainless steel
	OPTISWIRL 5080 sandwich version: 316 stainless steel for all sizes or CX2MW Nickel Alloy (equivalent to Hastelloy® C) up to DN100
Electronics housing & housing covers	Low copper, die-cast aluminum alloy with epoxy finish
Seals	Flow sensor seals for high temperature sensor: 316 stainless steel gasket; 316 SS/grafoil flow dam
	Seal of housing covers, housing neck and terminal block: Buna-N O-ring seals
Dual measurement manifold	CF8M stainless steel

Process connections

DIN EN 1092-1	DN15...300
ASME B16.5	3/4...12"
For detailed information on combination flange/pressure rating, refer to section "Dimensions and weights".	

Electrical connections

Supply voltage	15.5...42 VDC; depending on electrical safety approvals and certifications
	Intrinsically safe: max. 30 VDC With intrinsically safe certifications with a 24 VDC supply, an active barrier is required.
Cable entries	1/2 NPT or M20

Outputs

Output damping	Damping smooths the flow rate output and optimises the flowmeter's response time to the control system. Damping is an exponential filter with a selectable time constant; it can be set between 0 and 32 seconds. An eight second damping factor will pass 64% of the step change in this time period. Damping applies to all outputs except the raw pulse output where no damping is applied to the direct vortex shedding frequency.

Analogue output

General	Flow rate available as a 4...20 mA signal with the 20 mA value being set by the configured full range flow rate.
Type	4...20 mA HART®
Supply current	22 mA DC maximum
Supply voltage effect	Less than 0.005% per Volt
Ambient temperature effect (amplifier only)	For +28°C / +50°F change in ambient temperature within operative limits. Zero (4 mA): ±0.02% of span maximum Span (16 mA): ±0.1% of span maximum
Response time (without damping)	0.5 seconds or the vortex shedding period for frequencies less than 2 Hz.

HART®

	HART analogue or digital multidrop mode
Remote configurator / Communicator	HART communicator or PC-Based configurator
Communication rate	1200 baud
Communication distance (rated)	1800 m / 6000 ft
Flow/Total measurement update	5 times/s
Raw pulse measurement update	Vortex shedding frequency

Digital output

General	Digital information is superimposed on a 4...20 mA signal at 1200 baud
Supply current	10 mA DC maximum
Supply voltage effect	No effect on accuracy
Ambient temperature effect (amplifier only)	±0.01% of reading from -40...+80°C / -40...+176°F
Response time (without damping)	0.5 seconds or the vortex shedding period for frequencies less than 2 Hz.

Pulse output

General	The pulse output is an externally powered 2-wire transistor switch type output. This output can be configured using any applicable configuration device to select any one of three types of pulse outputs: raw pulse, rate pulse and total pulse.
	Raw pulse: This is the vortex shedding frequency directly passed through providing an instantaneous, non dampened frequency output
	Rate pulse: The frequency of this output is a 50% duty cycle pulse output with a frequency range of 0...10, 0...100 or 0...1000 Hz, proportional to zero flow to the full range flow rate/upper range value (URV).
	Total pulse: The frequency of this output is also a 50% duty cycle pulse output that is configured to provide a pulse when a determined volumetric/totalized unit has flowed through the meter.
Specifications	Isolated 2-wire transistor switch
	Applied voltage: 5...30 VDC
	Maximum "ON" state voltage drop: 1.0 VDC
	Maximum "ON" state current: 20 mA
	Reverse polarity protected
	Short circuit protected
	Connectable to pull up or pull down counters
Supply current	20 mA DC maximum
Supply voltage effect	No effect on accuracy
Ambient temperature effect (amplifier only)	±0.01% of reading from -40...+80°C / -40...+176°F
Response time (without damping)	Raw pulse: Vortex shedding frequency
	Rate or total pulse: 0.25 seconds or the vortex shedding period for frequencies less than 2 Hz.

Approvals and certificates

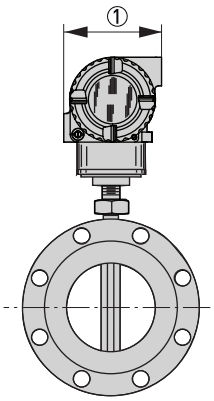
CE	This device fulfils the statutory requirements of the relevant EU directives. The manufacturer certifies successful testing of the product by applying the CE mark.
	For full information of the EU directives & standards and the approved certifications, please refer to the CE declaration or the manufacturer website.
Non-Ex	Standard
Hazardous areas	
ATEX	**Intrinsically safe:** II 1G II 2D Ex ia IIC T4 Ga Ex tb IIIC T103°C Db Compact and remote versions (electronics and junction box)
	Flameproof: II 2/1 (1) G II 2D Ex db [ia Ga] ia IIC T4 Gb Ex tb IIIC T85°C Db Compact versions (electronics) and remote versions (electronics housing)
IECEx	**Intrinsically safe:** Ex ia IIC T4 Ga Ex tb IIIC T103°C Db
	Flameproof: Ex d [ia Ga] ia IIC T4 Gb Ex tb IIIC T85°C Db Compact versions (electronics) and remote versions (electronics housing)
FM (in preparation)	**Intrinsically safe** for Class I, II, III, Div. 1, Groups A, B, C, D, E, F, G; Also Zone approved AEx ia IIC
	Explosionproof with IS sensor connection for Class I, Div. 1, Groups B, C, and D; **Dust-ignitionproof** for Class II, Div. 1, Groups E, F, and G; Class III, Div. 1
Other standards and approvals	
Vibration resistance	Flowmeter was tested with up to 3g of acceleration with no physical damage, no shift in calibration after the test and no loss of communications throughout the test.
EMI and RFI	Flowmeters meet the requirements of EN 61326-1.

7.3 Dimensions and weights

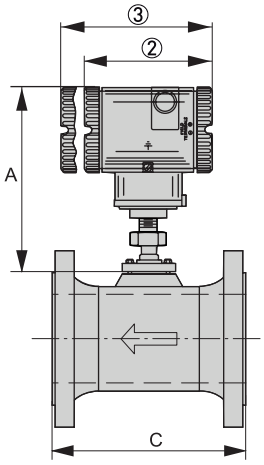
7.3.1 Dimensions for flange versions

Compact versions - single measurement

Standard version (front and side view)



① = 96 mm / 3.77"



A = 297 mm / 11.7"

② = 124 mm / 4.9"
③ = 154 mm / 6.1"
Extended cover this side when digital display available

Nominal size	Flange rating	O.D. (outer Ø)	I.D. (inner Ø)	C
		[mm]		
DN15	PN40 ①	95	18.8	138
	PN100	105	18.8	152
DN25	PN40 ①	115	24.3	142
	PN100	140	24.3	178
	PN160	140	24.3	178
DN40	PN40 ①	150	38.1	152
	PN100	170	38.1	186
	PN160	170	38.1	190
DN50	PN40 ①	165	49.2	166
	PN63	180	49.2	194
	PN100	195	49.2	206
	PN160	195	49.2	220
DN80	PN40 ①	200	72.9	202
	PN63	215	72.9	230
	PN100	230	72.9	242
	PN160	230	72.9	258

Nominal size	Flange rating	O.D. (outer Ø)	I.D. (inner Ø)	C
		[mm]		
DN100	PN40 ①	235	97.2	222
	PN63	250	97.2	248
	PN100	265	97.2	272
	PN160	265	97.2	292
DN150	PN16	285	146.3	237
	PN40 ①	300	146.3	277
	PN63	345	146.3	317
	PN100	355	146.3	357
	PN160	355	146.3	383
DN200	PN16	340	193.7	302
	PN25	360	193.7	338
	PN40	375	193.7	354
	PN63	415	193.7	398
	PN100	430	193.7	438
	PN160	430	193.7	458
DN250	PN16	405	242.9	318
	PN25	425	242.9	354
	PN40	450	242.9	388
	PN63	470	242.9	428
	PN100	505	242.9	492
DN300	PN16	460	288.9	359
	PN25	485	288.9	387
	PN40	515	288.9	433
	PN63	530	288.9	483
	PN100	585	288.9	543

Table 7-1: Dimensions for DIN flanges

① May be used with PN25 mating flange.

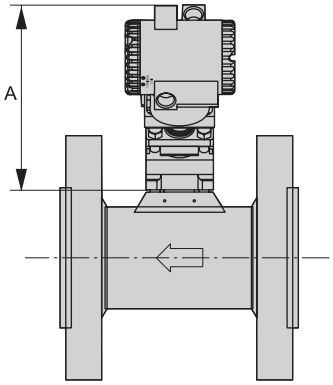
Nominal size	Flange rating	O.D. (outer Ø)	I.D. (inner Ø)	C (RF)	C (RTJ)
		[inch]			
3/4"	Class 150	3.88	0.74	6.56	-
	Class 300	4.62	0.74	6.94	7.32
	Class 600	4.62	0.74	7.44	7.44
	Class 900	5.12	0.74	8.44	8.44
	Class 1500	5.12	0.74	8.44	8.44
1"	Class 150	4.25	0.96	6.80	7.18
	Class 300	4.88	0.96	7.32	7.70
	Class 600	4.88	0.96	7.82	7.82
	Class 900	5.88	0.96	8.70	8.70
	Class 1500	5.88	0.96	8.70	8.70

Nominal size	Flange rating	O.D. (outer Ø)	I.D. (inner Ø)	C (RF)	C (RTJ)
		[inch]			
1 1/2"	Class 150	4.62	1.50	7.32	7.70
	Class 300	6.12	1.50	7.82	8.20
	Class 600	6.12	1.50	8.44	8.44
	Class 900	7.00	1.50	9.44	9.44
	Class 1500	7.00	1.50	9.44	9.44
2"	Class 150	6.00	1.94	7.75	8.13
	Class 300	6.50	1.94	8.25	8.75
	Class 600	6.50	1.94	9.01	9.13
	Class 900	8.50	1.94	11.25	11.37
	Class 1500	8.50	1.69	11.25	11.37
3"	Class 150	7.50	2.87	8.88	9.26
	Class 300	8.25	2.87	9.62	10.12
	Class 600	8.25	2.87	10.38	10.50
	Class 900	9.50	2.87	11.88	12.00
	Class 1500	10.50	2.63	13.12	13.25
4"	Class 150	9.00	3.83	9.62	10.00
	Class 300	10.00	3.83	10.38	10.88
	Class 600	10.75	3.83	12.12	12.24
	Class 900	11.50	3.83	13.12	13.24
	Class 1500	12.25	3.44	13.88	14.00
6"	Class 150	11.00	5.76	12.00	12.38
	Class 300	12.50	5.76	12.76	13.26
	Class 600	14.00	5.76	14.74	14.86
	Class 900	15.00	5.19	16.50	16.62
	Class 1500	15.50	5.19	19.00	19.25
8"	Class 150	13.50	7.63	15.00	15.38
	Class 300	15.00	7.63	15.75	16.26
	Class 600	16.50	7.63	18.00	18.12
	Class 900	18.50	6.81	20.26	20.38
	Class 1500	19.00	6.81	24.26	24.64
10"	Class 150	16.00	9.56	15.00	15.38
	Class 300	17.50	9.56	16.24	16.74
	Class 600	20.00	9.56	19.50	19.62
12"	Class 150	19.00	11.37	17.00	17.38
	Class 300	20.50	11.37	18.24	18.74
	Class 600	22.00	11.37	20.74	20.76

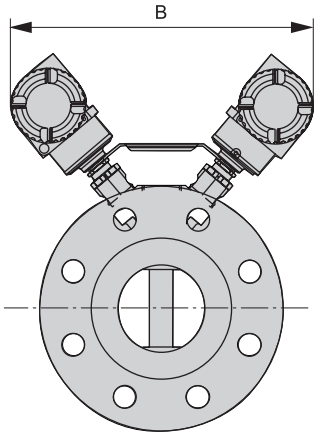
Table 7-2: Dimensions for ANSI flanges

Compact versions - dual measurement

Side view



Front view

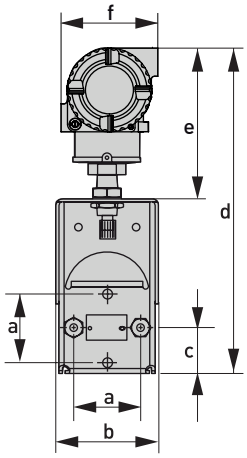


Dimension	[mm / inch]
A	305 / 12.0
B	508 / 20.0

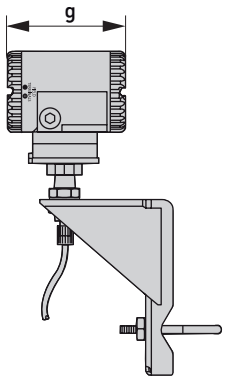
Table 7-3: Dimensions in mm and inch

Remote versions - signal converter and mounting bracket

Front view



Side view

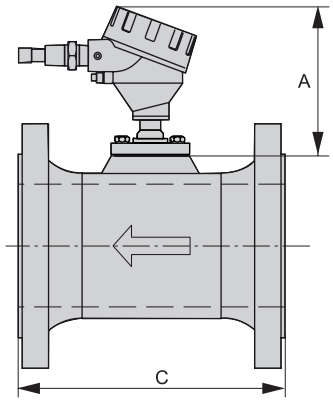


	a	b	c	d	e	f	g
mm	69.9	99	46	318	140	96	154
inch	2.75	3.9	1.8	12.5	5.5	3.8	6.1

Table 7-4: Dimensions in mm and inch

Remote versions - flow sensor

Standard version



A = 297 mm / 11.7"

Nominal size	Flange rating	O.D. (outer Ø)	I.D. (inner Ø)	C
		[mm]		
DN15	PN40 ①	95	18.8	138
	PN100	105	18.8	152
DN25	PN40 ①	115	24.3	142
	PN100	140	24.3	178
	PN160	140	24.3	178
DN40	PN40 ①	150	38.1	152
	PN100	170	38.1	186
	PN160	170	38.1	190
DN50	PN40 ①	165	49.2	166
	PN63	180	49.2	194
	PN100	195	49.2	206
	PN160	195	49.2	220
DN80	PN40 ①	200	72.9	202
	PN63	215	72.9	230
	PN100	230	72.9	242
	PN160	230	72.9	258
DN100	PN40 ①	235	97.2	222
	PN63	250	97.2	248
	PN100	265	97.2	272
	PN160	265	97.2	292

Nominal size	Flange rating	O.D. (outer Ø)	I.D. (inner Ø)	C
		[mm]		
DN150	PN16	285	146.3	237
	PN40 ①	300	146.3	277
	PN63	345	146.3	317
	PN100	355	146.3	357
	PN160	355	146.3	383
DN200	PN16	340	193.7	302
	PN25	360	193.7	338
	PN40	375	193.7	354
	PN63	415	193.7	398
	PN100	430	193.7	438
	PN160	430	193.7	458
DN250	PN16	405	242.9	318
	PN25	425	242.9	354
	PN40	450	242.9	388
	PN63	470	242.9	428
	PN100	505	242.9	492
DN300	PN16	460	288.9	359
	PN25	485	288.9	387
	PN40	515	288.9	433
	PN63	530	288.9	483
	PN100	585	288.9	543

Table 7-5: Dimensions for DIN flanges

① May be used with PN25 mating flange.

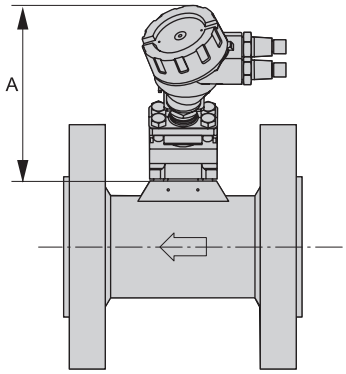
Nominal size	Flange rating	O.D. (outer Ø)	I.D. (inner Ø)	C (RF)	C (RTJ)
		[inch]			
3/4"	Class 150	3.88	0.74	6.56	-
	Class 300	4.62	0.74	6.94	
	Class 600	4.62	0.74	7.44	7.44
	Class 900	5.12	0.74	8.44	8.44
	Class 1500	5.12	0.74	8.44	8.44
1"	Class 150	4.25	0.96	6.80	7.18
	Class 300	4.88	0.96	7.32	7.70
	Class 600	4.88	0.96	7.82	7.82
	Class 900	5.88	0.96	8.70	8.70
	Class 1500	5.88	0.96	8.70	8.70

Nominal size	Flange rating	O.D. (outer Ø)	I.D. (inner Ø)	C (RF)	C (RTJ)
		[inch]			
1 1/2"	Class 150	4.62	1.50	7.32	7.70
	Class 300	6.12	1.50	7.82	8.20
	Class 600	6.12	1.50	8.44	8.44
	Class 900	7.00	1.50	9.44	9.44
	Class 1500	7.00	1.50	9.44	9.44
2"	Class 150	6.00	1.94	7.75	8.13
	Class 300	6.50	1.94	8.25	8.75
	Class 600	6.50	1.94	9.01	9.13
	Class 900	8.50	1.94	11.25	11.37
	Class 1500	8.50	1.69	11.25	11.37
3"	Class 150	7.50	2.87	8.88	9.26
	Class 300	8.25	2.87	9.62	10.12
	Class 600	8.25	2.87	10.38	10.50
	Class 900	9.50	2.87	11.88	12.00
	Class 1500	10.50	2.63	13.12	13.25
4"	Class 150	9.00	3.83	9.62	10.00
	Class 300	10.00	3.83	10.38	10.88
	Class 600	10.75	3.83	12.12	12.24
	Class 900	11.50	3.83	13.12	13.24
	Class 1500	12.25	3.44	13.88	14.00
6"	Class 150	11.00	5.76	12.00	12.38
	Class 300	12.50	5.76	12.76	13.26
	Class 600	14.00	5.76	14.74	14.86
	Class 900	15.00	5.19	16.50	16.62
	Class 1500	15.50	5.19	19.00	19.25
8"	Class 150	13.50	7.63	15.00	15.38
	Class 300	15.00	7.63	15.75	16.26
	Class 600	16.50	7.63	18.00	18.12
	Class 900	18.50	6.81	20.26	20.38
	Class 1500	19.00	6.81	24.26	24.64
10"	Class 150	16.00	9.56	15.00	15.38
	Class 300	17.50	9.56	16.24	16.74
	Class 600	20.00	9.56	19.50	19.62
12"	Class 150	19.00	11.37	17.00	17.38
	Class 300	20.50	11.37	18.24	18.74
	Class 600	22.00	11.37	20.74	20.76

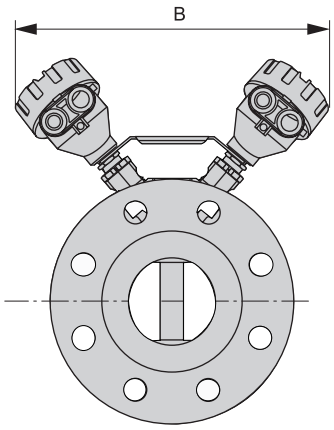
Table 7-6: Dimensions for ANSI flanges

Remote versions - dual measurement

Side view



Front view



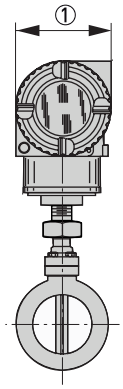
Dimension	[mm / inch]
A	290 / 11.4
B	508 / 20.0

Table 7-7: Dimensions in mm and inch

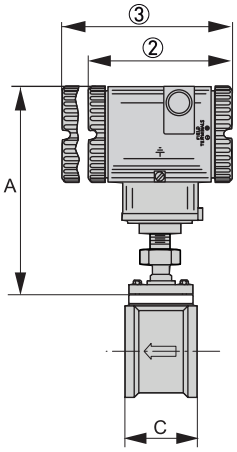
7.3.2 Dimensions for sandwich versions

Compact versions

Standard version (front and side view)



① = 96 mm / 3.8"



② = 124 mm / 4.9"
③ = 154 mm / 6.1"

Extended cover this side when digital display available

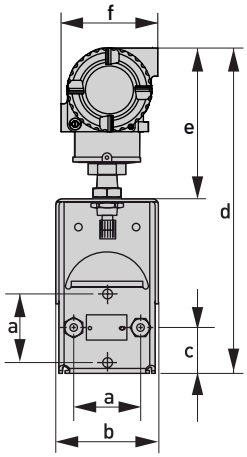
Nominal size	O.D. (outer Ø)	I.D. (inner Ø)	C
[mm / inch]			
15 / 3/4	57.2 / 2.25	18.8 / 0.74	79.5 / 3.13
25 / 1	66.8 / 2.63	24.3 / 0.96	79.5 / 3.13
40 / 1 1/2	85.9 / 3.38	38.1 / 1.50	79.5 / 3.13
50 / 2	104.6 / 4.12	49.2 / 1.94	79.5 / 3.13
80 / 3	136.7 / 5.38	72.9 / 2.87	95.3 / 3.75
100 / 4	174.5 / 6.87	96.7 / 3.81	120.7 / 4.75
150 / 6	222.3 / 8.75	147.3 / 5.80	177.8 / 7.00
200 / 8	279.4 / 11.00	193.0 / 7.60	228.6 / 9.00

Table 7-8: Dimensions in mm and inch

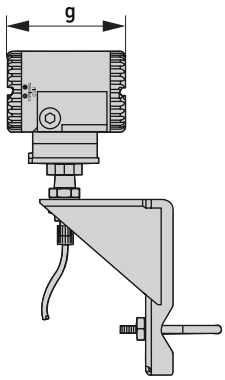
INFORMATION!
Flowmeter body fits between ANSI Class 150, 300, or 600 raised face flanges and PN16, 40, 63, and 100 flanges.

Remote versions - signal converter and mounting bracket

Front view



Side view

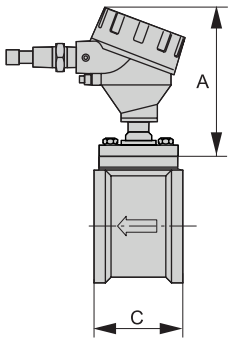


	a	b	c	d	e	f	g
mm	69.9	99	46	318	140	96	154
inch	2.75	3.9	1.8	12.5	5.5	3.8	6.1

Table 7-9: Dimensions in mm and inch

Remote versions - flow sensor

Standard version



Nominal size	O.D. (outer Ø)	I.D. (inner Ø)	C
[mm / inch]			
15 / 3/4	57.2 / 2.25	18.8 / 0.74	79.5 / 3.13
25 / 1	66.8 / 2.63	24.3 / 0.96	79.5 / 3.13
40 / 1 1/2	85.9 / 3.38	38.1 / 1.50	79.5 / 3.13
50 / 2	104.6 / 4.12	49.2 / 1.94	79.5 / 3.13
80 / 3	136.7 / 5.38	72.9 / 2.87	95.3 / 3.75
100 / 4	174.5 / 6.87	96.7 / 3.81	120.7 / 4.75
150 / 6	222.3 / 8.75	147.3 / 5.80	177.8 / 7.00
200 / 8	279.4 / 11.00	193.0 / 7.60	228.6 / 9.00

Table 7-10: Dimensions in mm and inch

7.3.3 Weight

Nominal size		Approx. weights	
[mm]	[inch]	[kg]	[lb]
DN15	3/4	2.8	6
DN25	1	3.2	7
DN40	1 1/2	3.7	8
DN50	2	5.0	11
DN80	3	8.5	19
DN100	4	12.0	26
DN150	6	16.5	36
DN200	8	27.5	61

Table 7-11: Weight for sandwich versions in kg and lb

The electronics housing itself weighs about 2 kg / 4 lbs and varies slightly depending on whether indicator/configurator, and/or extended housing covers are used.

DIN flanges				ANSI flanges			
Nominal size	Flange rating	Weight [kg]	Weight [lb]	Nominal size	Flange rating	Weight [kg]	Weight [lb]
DN15	PN40	6.08	13.3	3/4"	Class 150	5.21	11.4
DN15	PN100	7.85	17.2	3/4"	Class 1500	9.25	20.3
DN25	PN40	6.58	14.4	1"	Class 150	6.03	13.2
DN25	PN160	9.26	20.1	1"	Class 1500	11.52	25.3
DN40	PN40	8.62	18.9	1 1/2"	Class 150	8.07	17.7
DN40	PN160	13.29	29.2	1 1/2"	Class 1500	16.15	35.5
DN50	PN40	10.34	22.7	2"	Class 150	9.98	21.9
DN50	PN160	17.92	39.4	2"	Class 1500	25.08	55.2
DN80	PN40	15.60	34.3	3"	Class 150	20.00	44.0
DN80	PN160	27.08	59.6	3"	Class 1500	50.26	110.7
DN100	PN40	20.64	45.4	4"	Class 150	21.55	47.4
DN100	PN160	37.33	82.2	4"	Class 1500	71.22	156.9
DN150	PN16	28.39	62.5	6"	Class 150	35.7	78.6
DN150	PN160	89.32	196.8	6"	Class 1500	162.43	358.0
DN200	PN16	43.5	95.8	8"	Class 150	58.24	128.3
DN200	PN160	162.29	357.7	8"	Class 600	131.76	290.4
DN250	PN16	65.63	144.6	8"	Class 1500	298.6	658.3
DN250	PN100	191.73	422.6	10"	Class 150	73.07	161.0
DN300	PN16	93.21	205.4	10"	Class 600	216.5	477.2
DN300	PN100	280.82	619.0	12"	Class 150	114.98	253.4
				12"	Class 600	245.62	241.4

Table 7-12: Weight for flange versions in kg and lb

7.4 Pressure & temperature ratings for flanges

ANSI flange rating acc. to ASME B16.5 for group 2.2 materials

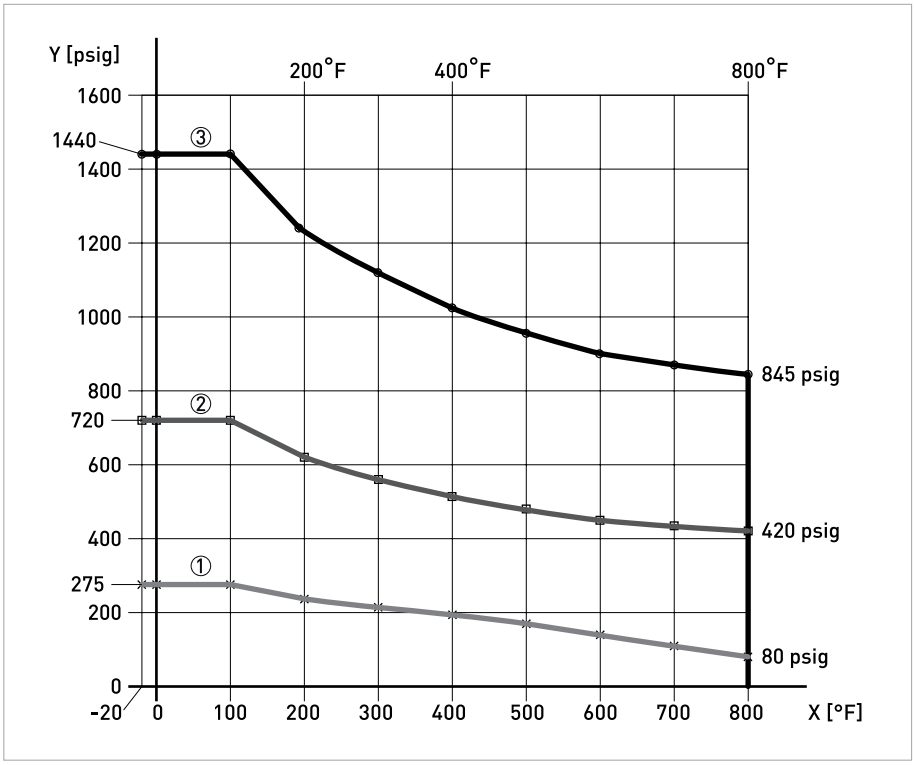


Figure 7-1: ANSI flange rating acc. to ASME B16.5 for group 2.2 materials

X: Process temperature in °F
Y: Process pressure in psig

① Class 150
② Class 300
③ Class 600

ANSI flange rating acc. to ASME B16.5 for group 2.1 materials

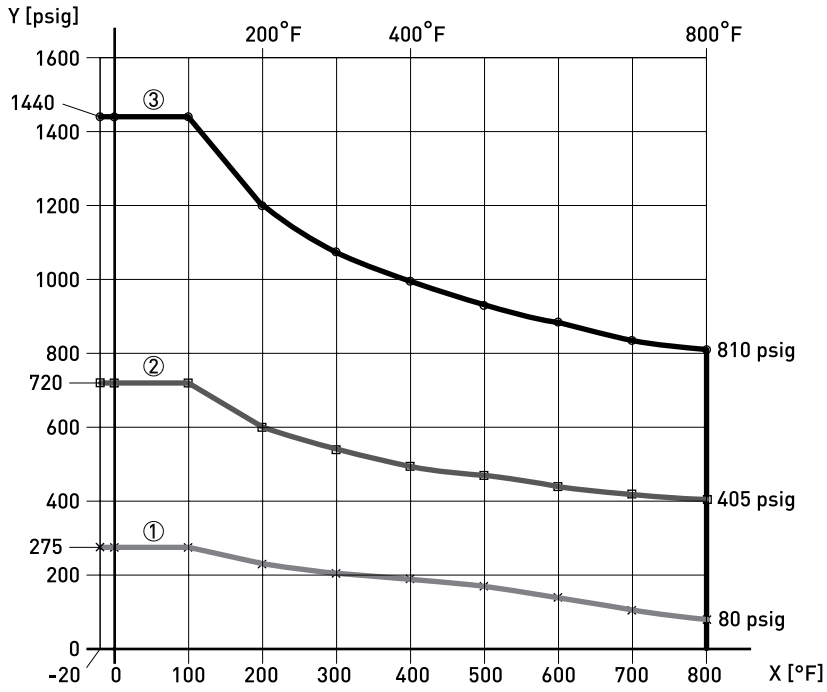


Figure 7-2: ANSI flange rating acc. to ASME B16.5 for group 2.1 materials

X: Process temperature in °F
Y: Process pressure in psig

① Class 150
② Class 300
③ Class 600

DIN flange rating acc. to EN 1092-1 for material group 14E0

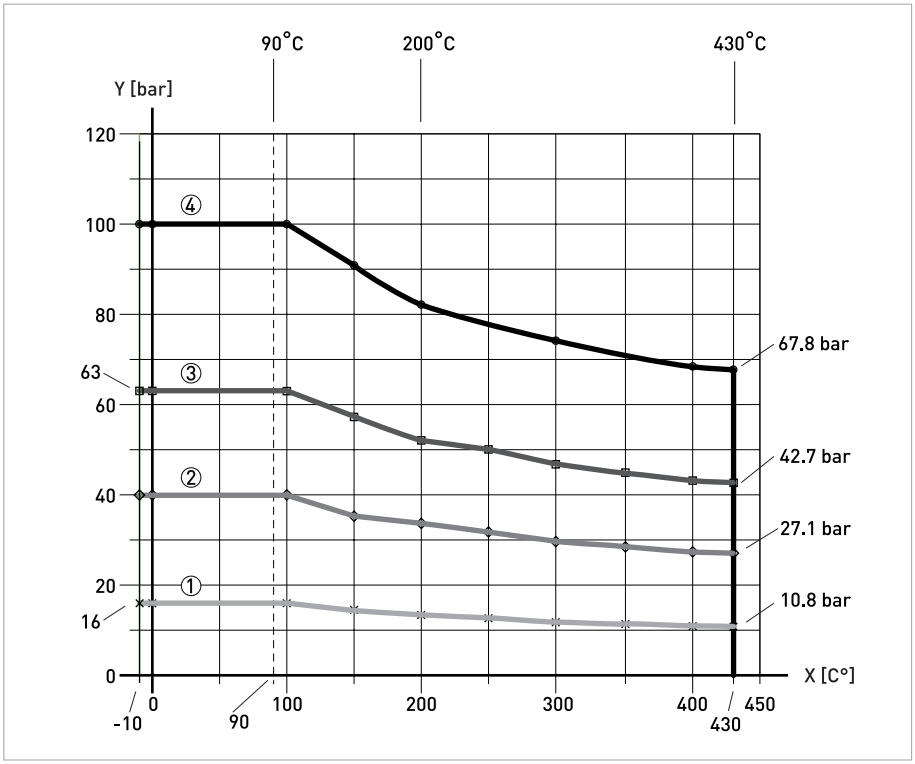


Figure 7-3: DIN flange rating acc. to EN 1092-1 for material group 14E0

X: Process temperature in °C
Y: Process pressure in bar

① PN16
② PN40
③ PN63
④ PN100

DIN flange rating acc. to EN 1092-1 for material group 10E0

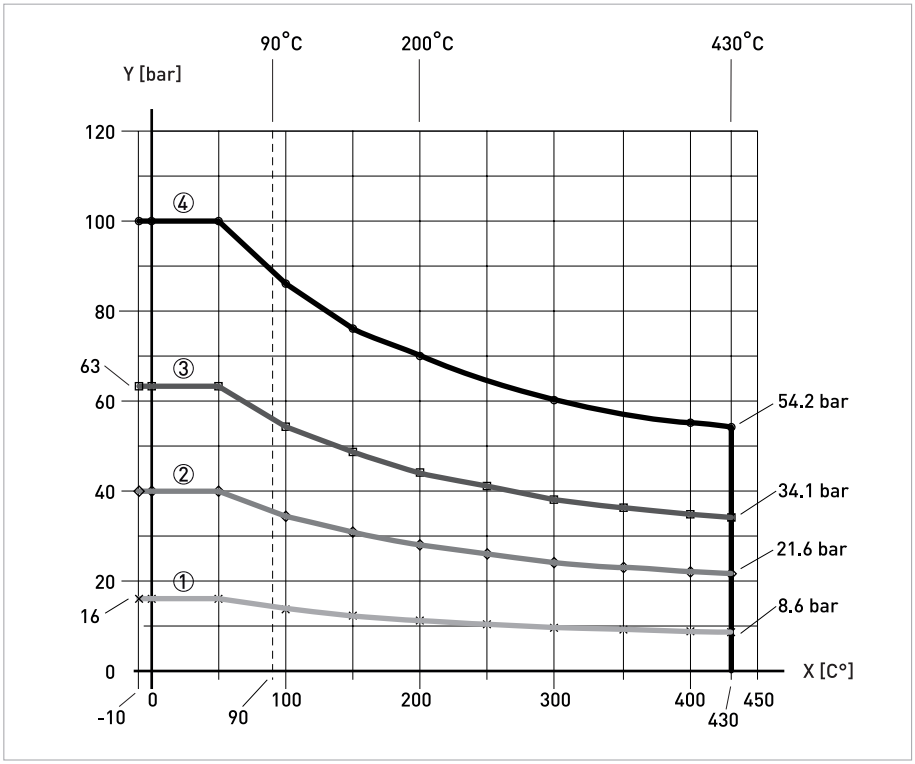


Figure 7-4: DIN flange rating acc. to EN 1092-1 for material group 10E0

X: Process temperature in °C
Y: Process pressure in bar

① PN16
② PN40
③ PN63
④ PN100

KROHNE – Process instrumentation and measurement solutions

- Flow
- Level
- Temperature
- Pressure
- Process Analysis
- Services

Head Office KROHNE Messtechnik GmbH
Ludwig-Krohne-Str. 5
47058 Duisburg (Germany)
Tel.: +49 203 301 0
Fax: +49 203 301 10389
info@krohne.com

The current list of all KROHNE contacts and addresses can be found at:
www.krohne.com

KROHNE