



OPTISWIRL 4200 Technical Datasheet

Vortex flowmeter

- Integrated pressure and temperature compensation
- Gross and net heat measurement for hot water and steam
- Stable measurements even under demanding process conditions with advanced technology for signal filtering (AVFD)



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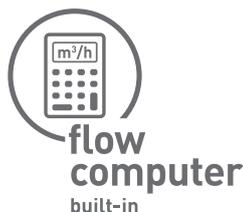
1.1 The all-in-one solution

Vortex flowmeters are suitable for a wide range of media. This is particularly true for the OPTISWIRL 4200. Its capability to master even fluctuating pressures and temperatures turns it into an ideal all-rounder for the measurement of energy carriers in auxiliary and supply processes.

Already the basic version of the **OPTISWIRL 4200** is equipped with a temperature compensation for saturated steam applications. With the optional pressure sensor the flowmeter has an integrated density compensation available, which even allows an exact measurement of gases and superheated steam with varying process conditions. The additional integrated gross and net heat measurement makes this flowmeter to be a reliable partner for advanced energy management systems.

With the innovative AVFD (Advanced Vortex Frequency Detection) the OPTISWIRL 4200 is fitted with an up-to-date signal filter. It analyses the measured signal and eliminates interferences and perturbations. Thereby, stable measurements can even be realised under demanding process conditions.

This vortex flowmeter was designed for the safety-related applications from the very beginning. It was developed according to the standard IEC 61508 edition 2. The certification is effected within the scope of a full assessment by TÜEV Sued. Thereby the flowmeter can be used for continuous volume flow measurement in safety-related applications with classification SIL 2/3.



Flow computer built-in

Many KROHNE flowmeters have a built-in flow computer that compensates for the effects of pressure and temperature on the flow measurement or to convert to standard volume. This saves both cost and installation efforts for an external flow computer and provides for additional benefits.

Highlights

- Development according to IEC 61508, edition 2
- Advanced technology for signal filtering - AVFD (Advanced Vortex Frequency Detection)
- Integrated pressure and temperature compensation
- Temperature compensation for saturated steam included as standard
- Integrated gross and net heat calculation for steam and hot water
- Comprehensive communication options
- Remote version with field housing converter with cable length up to 50 m / 164 ft
- Integrated reduction of nominal size
- Measurement of conductive and non-conductive liquids, gases and steam
- Communication options: 4...20 mA/HART®, Profibus PA and Foundation Fieldbus

Industries

- Chemicals
- Oil & Gas
- Power plants
- Food & Beverage
- Pharmaceuticals
- Iron, Steel and Metals
- Pulp & Paper
- Water

Applications

- Measurement of saturated steam and superheated steam
- Steam boiler monitoring
- Heat metering of steam and hot water
- Measurement of consumption of industrial gases
- Measurement of consumption in compressed air systems
- Monitoring of compressor output
- Evaluation of free air delivery (FAD)
- SIP and CIP processes in the food, beverage and pharmaceutical industries
- Safety-related measurement in SIL applications (SIL 2/3)

1.2 Options and variants

1. The universal device with temperature compensation for saturated steam integrated as standard



The **OPTISWIRL 4200 C** as compact flowmeter in a flange version is suitable for universal use in measuring liquids, gases and vapours.

The temperature compensation for saturated steam is integrated as standard, thus enabling direct compensation of the density; the mass and energy can also be measured.

The advanced signal filter technology AVFD (Advanced Vortex Frequency Detection) complements the high accurate measurement.

2. The easy to install sandwich version with optimised centering rings



The **OPTISWIRL 4200 C** as a compact flowmeter in a sandwich version is suitable for universal use in the measurement of liquids, gases and vapours.

The temperature compensation for saturated steam is integrated as standard.

The flowmeter is provided with additional optimised centering rings. The vortex flowmeter can be aligned centrally by turning the centering rings, eliminating any offset between the flowmeter and the pipeline.

3. The one-of-a-kind 2-wire device with integrated pressure and temperature compensation



The **OPTISWIRL 4200** as a flange or sandwich flowmeter is optionally available with integrated pressure and temperature compensation for gases, wet gases, gas mixtures or steam.

The advantage of this unique design couldn't be clearer:

- No additional cost-intensive installation of pressure and temperature sensors
- No additional cabling work
- No faulty measurement results, because pressure, temperature and volume flow can be read at a single point
- Direct measurement of mass and/or energy

4. Vortex flowmeter with shut-off valve for the pressure measurement



As an option, the **OPTISWIRL 4200** can be supplied with a shut-off valve to allow the pressure sensor to be exchanged without interrupting the process.

What is more, the pressure sensor can be shut off for the purpose of pressure or leak testing of the pipeline.

5. Dual measurement for twofold reliability



The **OPTISWIRL 4200** is optionally available as a dual version.

This is a genuine redundant system with two independent flow sensors and two signal converters. This provides twofold functional reliability and availability of the measurement.

This variant is ideally suited for measurements in multi-product pipelines. In such pipelines, two different products are moved through one after the other.

One signal converter can be programmed for one product, and the other signal converter for the other product.

As homogeneous redundant measurement system the dual version fulfills all requirements for the use in SIL 3 applications.

6. The OPTISWIRL 4200 F as remote version



The **OPTISWIRL 4200** is also available as a remote version with field housing converter.

This feature allows separating the signal converter from the flow sensor up to a distance of 50 m / 164 ft, in case the flow sensor is mounted in inaccessible areas.

The remote mounted signal converter allows easy operation and reading of values at eye level.

Additionally to the flow rates, measurements of the integrated pressure and temperature sensors can be displayed.

7. OPTISWIRL 4200 F1R / F2R with integrated nominal diameter reduction



The **OPTISWIRL 4200 F1R / F2R** with integrated nominal diameter reduction up to two nominal diameter sizes assures best results in accuracy and optimal measuring ranges even in pipelines with large diameters, which have been designed for a low pressure loss.

By forgoing complex pipeline reduction installations, space and cost saving installations can be realized. At the same time the number of potential leakages is reduced to a minimum.

8. OPTISWIRL 4200 with converter housing in stainless steel



The **OPTISWIRL 4200** with stainless steel housing are suitable for very harsh environmental conditions or in applications where resistance to chemical cleaning agents is required.

Consequently, the operating conditions here include outdoor use in offshore applications as well as in food or pharmaceutical production thanks to the IP66 and IP68 protection class.

High-pressure cleaning is also possible with the option of IP69K protection class.

1.3 Devices with integrated nominal diameter reduction

The device versions F1R and F2R offer an integrated nominal diameter reduction up to two nominal diameter sizes to assure best results in accuracy and optimum measuring ranges; even in pipelines with large diameters, which have been designed for a low pressure loss.

Nominal diameter of flow sensor	Nominal size of process connections									
	DN15	DN25	DN40	DN50	DN80	DN100	DN150	DN200	DN250	DN300
DN15	StV ①	F1R	F2R	-	-	-	-	-	-	-
DN25	-	StV ①	F1R	F2R	-	-	-	-	-	-
DN40	-	-	StV ①	F1R	F2R	-	-	-	-	-
DN50	-	-	-	StV ①	F1R	F2R	-	-	-	-
DN80	-	-	-	-	StV ①	F1R	F2R	-	-	-
DN100	-	-	-	-	-	StV ①	F1R	F2R	-	-
DN150	-	-	-	-	-	-	StV ①	F1R	F2R	-
DN200	-	-	-	-	-	-	-	StV ①	F1R	F2R
DN250	-	-	-	-	-	-	-	-	StV ①	F1R
DN300	-	-	-	-	-	-	-	-	-	StV ①

Table 1-1: Integrated nominal diameter reduction

① Standard version

1.4 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.

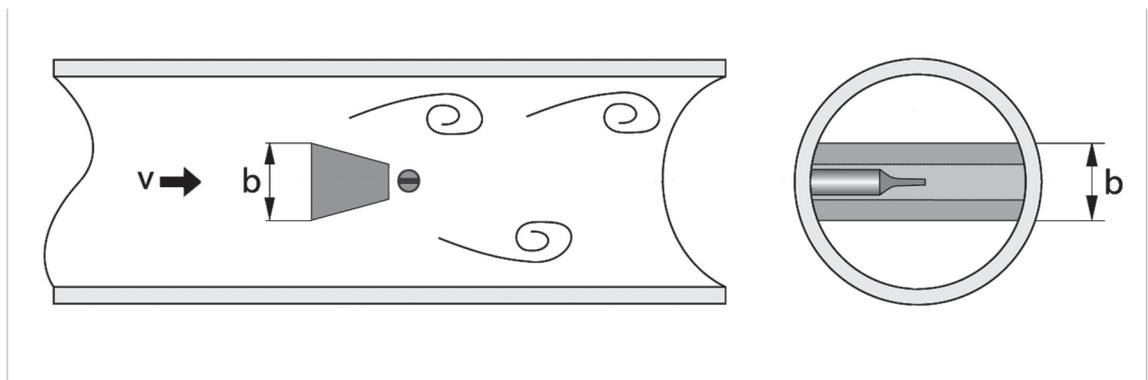


Figure 1-1: Functional principle

2.1 Technical data

- *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 (Download Center).*

Measuring system

Application range	Flow measurement of liquids, gases and vapours
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
	Remote version
Weather protection cover	Optional available cover to protect the signal converter housing against intense solar radiation or vandalism
Flow sensor	
Standard	Flange version (with integrated temperature measurement), flow sensor: F
	Sandwich version (with integrated temperature measurement), flow sensor: S
Option	Basic device with additional pressure measurement
	Basic device with additional pressure measurement and shut-off valve for pressure sensor
	Dual measuring device in both flange and sandwich version (redundant measurement)
	Dual measuring device with additional pressure measurement
	Flange version with single reduction of nominal diameter, flow sensor: F1R
	Flange version with double reduction of nominal diameter, flow sensor: F2R
Display and user interface	
Local display	Graphic display
Interface and display languages	The availability is depending on the language package and the communication options. German, English, French, Italian, Spanish, Russian, Chinese, Swedish, Danish, Czech, Polish, Turkish, Slovenian
Communication interfaces	HART [®] , Foundation Fieldbus and Profibus PA

Measuring accuracy

Reference conditions	
Reference conditions	Water at +20°C / +68°F
	Air at +20°C / +68°F and 1.013 bara / 14.7 psia
Maximum measuring error	
Volume flow (liquid)	±0.75% of measured value (Re ≥ 20000) ①
	±2.0% of measured value (10000 < Re < 20000)
Volume flow (gases and steam)	±1.0% of measured value (Re ≥ 20000)
	±2.0% of measured value (10000 < Re < 20000)
Mass flow (gases and steam)	±1.5% of measured value (Re ≥ 20000) ②
	±2.5% of measured value (10000 < Re < 20000) ②
Mass flow (liquid / water)	±1.5% of measured value (Re ≥ 20000)
	±2.5% of measured value (10000 < Re < 20000)
Normalised volume flow (gas)	±1.5% of measured value (Re ≥ 20000) ②
	±2.5% of measured value (10000 < Re < 20000) ②
Repeatability (volume flow)	±0.1% of measured value
① DN200/8" F1R and <1.5 m/s / 4.9 ft/s: ±1.25% of measured value DN250/10" F2R and <1.5 m/s / 4.9 ft/s: ±1.25% of measured value DN250 PN16 F2R and <1.5 m/s / 4.9 ft/s: ±1.5% of measured value DN250 PN16 F2R and >1.5 m/s / 4.9 ft/s: ±1% of measured value ② The maximum error of measurement refers to measurement at an operating pressure >65% of the full scale value of the applied pressure sensor.	
Note: In SIL mode, deviating measuring errors have to be taken into account. For details refer to the "Safety Manual".	

Operating conditions

Temperature	
Medium temperature	-40...+240°C / -40...+465°F
Ambient temperature ③	Non-Ex: -40...+85°C / -40...+185°F
	Ex: -40...+65°C / -40...+140°F
Storage temperature	-40...+85°C / -40...+185°F
③ Decreasing display contrast outside of the temperature range of 0...+60°C / +32...+140°F.	
Pressure	
Medium pressure	Max. 100 bar / 1450 psi (higher pressures on request)
Ambient pressure	Atmosphere: altitude up to 4000 m / 13123 ft above sea level
Media properties	
Density	Taken into consideration when sizing.
Viscosity	< 10 cP
Reynold's number	> 10000
Other conditions	
Use	Indoor / Outdoor
Humidity	Annual average ≤ 90% RH (no condensation)

Recommended flow velocities	
Liquids ④ , ⑤	0.3...7 m/s / 0.98...23 ft/s (optional up to 10 m/s / 32.8 ft/s taking cavitation into account)
Gases and steam ④	2.0...80 m/s / 6.6...262.5 ft/s
	DN15: 3.0...45 m/s / 9.8...148 ft/s; DN25: 2.0...70 m/s / 6.6...230 ft/s
④ These values represent the absolute limits of flow velocities. For more detailed information for your specific application refer to <i>Intended use</i> on page 30.	
⑤ $v_{min} = 0.7 \text{ m/s} / 2.3 \text{ ft/s}$ in SIL mode	
Other conditions	
Ingress protection	Compact version: Signal converter in aluminium housing, IP66/67 Signal converter in stainless steel housing, IP66, IP68, IP69K
	Remote version: Signal converter in aluminium housing, IP66/67; flow sensor housing, IP66/67 Signal converter in stainless steel housing, IP66, IP68, IP69K; flow sensor housing, IP66, IP68, IP69K

Installation conditions

Inlet section	≥ 15 DN without disturbing flow
	≥ 20 DN after a pipe diameter reduction
	≥ 20 DN after a single bend 90°
	≥ 30 DN after a double bend 2 x 90°
	≥ 40 DN after a double three-dimensional bend 2 x 90°
	≥ 50 DN after a control valve
	≥ 2 DN before a flow straightener; ≥ 8 DN after a flow straightener
Outlet section	≥ 5 x DN

Materials

Flow sensor and process connections	Standard: 1.4404 / 316L
	Option: Hastelloy® C-22 on request
Electronics housing	Aluminium die-cast, two-layer coating (epoxy/polyester)
	Option: 1.4409 / 316L / A 351-CF3M
	Option: die-cast aluminium with finish for advanced requirements
Pressure sensor gasket	Standard: FPM
	Option: FFKM, EPDM
Measuring tube gasket (Pick-up)	Standard: 1.4435 / 316L
	Option: Hastelloy® C-276
	Selection depends on flow sensor material / medium.

Process connections

Flange version	
DIN EN 1092-1	DN15...300, PN16...100 (higher pressures on request)
ASME B16.5	1/2...12", 150...600 lb (higher pressures on request)
JIS B2220	DN15...300, 10...20 K (higher pressures on request)
For detailed information on combination flange/pressure rating, refer to section "Dimensions and weights".	

Sandwich version	
DIN	DN15...100, PN100 (higher pressures on request)
ASME	1/2...4", 600 lb (higher pressures on request)
JIS	DN15...100, 10...20 K (higher pressures on request)

Electrical connections

Power supply (current output version)	The power supply has to be able to supply a minimum of 22 mA.
	Non-Ex: 12...36 VDC
	Ex i: 12...30 VDC
	Ex d: 12...32 VDC
Connection terminals	For wire cross-sections 0.5...2.5 mm ²
	Fastening torque: 0.6 N
Cable entries	Standard: M20 x 1.5
	Option: 1/2 NPT and G1/2 adapters
Connecting cable	Only for remote versions.
	Cable length: ≤ 50 m / 164 ft

Inputs and outputs

General	All inputs and outputs are electrically isolated from each other and from all other circuits.
Time constant	The time constant corresponds to 63% of the elapsed time of a processor procedure. 0...100 seconds (rounded up to 0.1 seconds)
Current output	
Type	4...20 mA HART® (passive)
Output data	Volume flow, mass flow, norm. volume flow, gross/net power, free air delivery, density, temperature (internal sensor), pressure, vortex frequency, flow velocity
Resolution	5 µA
Linearity / accuracy	0.1% (of read value)
Temperature coefficient	50 ppm/K (typically), 100 ppm/K (max.)
Error signal	According to NE 43
Description of abbreviations	U_{ext} = external voltage; R_L = load + resistance
Load	Minimum 0 Ω; maximum $R_L = ((U_{ext} - 12 \text{ VDC}) / 22 \text{ mA})$
HART®	
General	HART® protocol via passive current output
HART® revision	HART® 7; Burst mode; Catch device
System requirements	Load min. 250 Ω
Multidrop operation	4 mA
Binary output	
Function	Pulse output, frequency output, status output, limit switch
Type	Passive
	Proximity sensor according to DIN EN 60947-5-6 (NAMUR sensor) or pulse output signal according to VDI/VDE 2188 (category 2)
Temperature coefficient	50 ppm/K
Residual current	< 0.2 mA at 32 V ($R_i = 180 \text{ k}\Omega$)
Pulse width	0.5...2000 ms

Pulse output	
Output data	Volume, mass, norm. volume, gross/net energy
Pulse rate	Max. 1000 pulses/s
Power supply	Non-Ex: 24 VDC as NAMUR or open < 1 mA, maximum 36 V, closed 120 mA, U < 2 V
	Ex: 24 VDC as NAMUR or open < 1 mA, maximum 30 V, closed 120 mA, U < 2 V
Frequency output	
Output data	Volume flow, mass flow, norm. volume flow, gross/net power, free air delivery, density, temperature (internal sensor or via external input), pressure, vortex frequency, flow velocity, spec. enthalpy, spec. heat capacity, Reynolds number
Max. frequency	1000 Hz
Status output	
Output data	Status according to NE 107 (F, S, C), flow totalizer overflow, energy totalizer overflow, fluid type (in steam applications)
Limit switch	
Output data	Volume flow, mass flow, norm. volume flow, volume, mass, norm. volume, gross/net power, gross/net energy, free air delivery, density, temperature (internal sensor or via external input), pressure, vortex frequency, flow velocity, spec. enthalpy, spec. heat capacity, Reynolds number
Current input	
Type	4...20 mA (passive)
Resolution	6 µA
Linearity / accuracy	0.1% (of read value)
Temperature coefficient	100 ppm/K (typically), 200 ppm/K (max.)
Voltage drop	10 V

Communication interface

Profibus PA	
Description	Galvanically isolated according to IEC 61158-2
	Profile version: 3.02
	Current consumption: 16 mA
	Permissible bus voltage: 9...32 V; intrinsically safe: 9...24 V
	Independent of polarity at electrical connection
	Typical error current FDE (Fault Disconnection Electronic): 6 mA
	Bus address adjustable via local display at the measuring device
Function blocks	5 x analog input (AI), 2 x totaliser, 1 x analog output (AO)
Output data	Volume flow, norm. volume flow, mass flow, gross/net power, FAD, density, temperature 1, temperature 2, pressure, vortex frequency, velocity, specific enthalpy, specific heat capacity, Reynolds number, diagnostic data

Foundation Fieldbus	
Description	Galvanically isolated according to IEC 61158-2
	Current consumption: 16 mA
	Permissible bus voltage: 9...32 V; intrinsically safe: 9...24 V
	Bus interface with integrated reverse polarity protection
	Link Master function (LM) supported
	Tested with Interoperable Test Kit (ITK) version 6.1
Function blocks	5 x analog input (AI), 2 x Integrator (IT), 1 x PID, 1 x analog output (AO)
Output data	Volume flow, mass flow, norm. volume flow, corrected volume flow, temperature 1, temperature 2, pressure, density, velocity, gross power, net power, FAD, vortex frequency, Reynolds number, specific heat capacity, specific enthalpy, sensor electronics temperature, converter electronics temperature, diagnostic data

Approvals and certificates

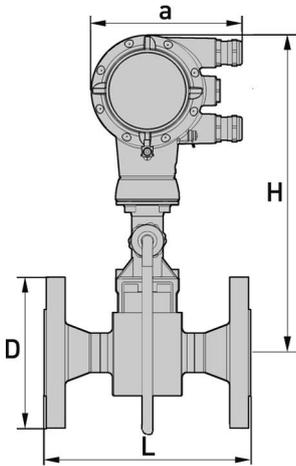
Declaration of conformity	This device fulfils the statutory requirements of the relevant directives and regulations. The manufacturer certifies successful testing of the product by applying the conformity mark on the device.
	For further information on directives, regulations, standards and certifications, please refer to the declaration of conformity which you can download from the manufacturer's website.
Standard version	Non-Ex
Functional safety according to IEC 61508	Depends on I/O variant and flow sensor. For detailed information refer to the "Safety manual".
Hazardous areas	
ATEX	II 2 G - Ex ia IIC T6...T2 Gb II 2 G - Ex d ia IIC T6...T2 Gb II 3 G - Ex nA IIC T6...T2 Gc II 2 D - Ex tb IIIC T70 Db
IECEX	Ex ia IIC T6...T2 Gb Ex d ia IIC T6...T2 Gb Ex nA IIC T6...T2 Gc Ex tb IIIC T70°C Db
QPS (USA & Canada)	IS Class I Div 1 XP Class I Div 1 NI Class I Div 2 DIP Class II, III Div 1
Other standards and approvals	
QPS (USA & Canada)	QPS Ordinary Locations
NAMUR	NE 06, NE 21, NE 23, NE 32, NE 43, NE 53, NE 107
Further approvals on request.	

Table 2-1: Technical data

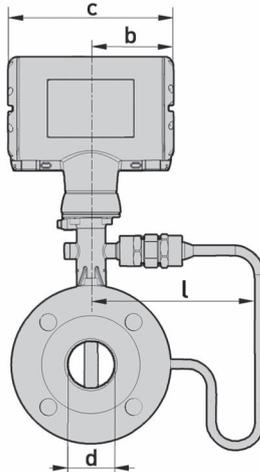
2.2 Dimensions and weights

2.2.1 Flange versions

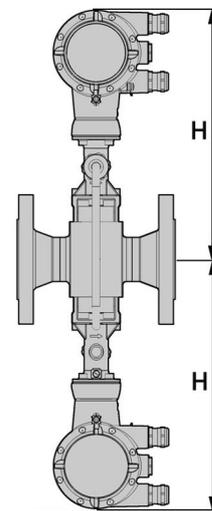
Flange version EN 1092-1



a = 148.5 mm / 5.85"



b = 85.8 mm / 3.38"
c = 171.5 mm / 6.76"



Option:
Version with two signal converter

Nominal size DN	Pressure rating PN	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
15	40	17.3	95	200	358.8	-	-	169.3	-	-
15	100	17.3	105	200	358.8	-	-	169.3	-	-
25	40	28.5	115	200	358.3	358.8	-	169.3	169.3	-
25	100	28.5	140	200	358.3	358.8	-	169.3	169.3	-
40	40	43.0	150	200	362.3	358.3	358.8	169.5	169.3	169.3
40	100	42.5	170	200	362.3	358.3	358.8	169.5	169.3	169.3
50	16	54.5	165	200	368.3	362.3	358.3	169.5	169.5	169.3
50	40	54.5	165	200	368.3	362.3	358.3	169.5	169.5	169.3
50	63	54.5	180	200	368.3	362.3	358.3	169.5	169.5	169.3
50	100	53.9	195	200	368.3	362.3	358.3	169.5	169.5	169.5
80	16	82.5	200	200	380.3	368.3	362.3	169.3	169.5	169.5
80	40	82.5	200	200	380.3	368.3	362.3	169.3	169.5	169.5
80	63	81.7	215	200	380.3	368.3	362.3	169.3	169.5	169.5
80	100	80.9	230	200	380.3	368.3	362.3	169.3	169.5	169.5
100	16	107	220	250	396.8	380.3	368.3	171.5	169.3	169.5
100	40	107	235	250	396.8	380.3	368.3	171.5	169.3	169.5
100	63	106.3	250	250	396.8	380.3	368.3	171.5	169.3	169.5
100	100	104.3	265	250	396.8	380.3	368.3	171.5	169.3	169.5
150	16	159.3	285	300	416.3	396.8	380.3	191.5	171.5	169.3

Nominal size DN	Pressure rating PN	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
150	40	159.3	300	300	416.3	396.8	380.3	191.5	171.5	169.3
150	63	157.1	345	300	416.3	396.8	380.3	191.5	171.5	169.3
150	100	154.1	355	300	416.3	396.8	380.3	191.5	171.5	169.3
200	10	206.5	340	300	442.1	416.3	396.8	202.8	191.5	171.5
200	16	206.5	340	300	442.1	416.3	396.8	202.8	191.5	171.5
200	25	206.5	360	300	442.1	416.3	396.8	202.8	191.5	171.5
200	40	206.5	375	300	442.1	416.3	396.8	202.8	191.5	171.5
250	10	260.4	395	380	468.8	442.1	416.3	229.5	202.8	191.5
250	16	260.4	405	380	468.8	442.1	416.3	229.5	202.8	191.5
250	25	258.8	425	380	468.8	442.1	416.3	229.5	202.8	191.5
250	40	258.8	450	380	468.8	442.1	416.3	229.5	202.8	191.5
300	10	309.7	445	450	492.8	468.8	442.1	255	229.5	202.8
300	16	309.7	460	450	492.8	468.8	442.1	255	229.5	202.8
300	25	307.9	485	450	492.8	492.8	442.1	255	229.5	202.8
300	40	307.9	515	450	492.8	492.8	442.1	255	229.5	202.8

Table 2-2: Dimensions of flange version EN 1092-1 [mm]

① F1R - single reduction

② F2R - double reduction

Nominal size DN	Pressure rating PN	with	without	F1R ① with	F1R ① without	F2R ② with	F2R ② without
		Pressure sensor		Pressure sensor		Pressure sensor	
15	40	6.1	5.5	-	-	-	-
15	100	7.1	6.5	-	-	-	-
25	40	7.9	7.3	7.2	6.6	-	-
25	100	9.9	9.3	9.7	9.1	-	-
40	40	10.8	10.2	9.7	9.1	8.9	8.3
40	100	14.8	14.2	13.3	12.7	12.5	11.9
50	16	12.7	12.1	11.4	10.8	10.6	10.0
50	40	12.9	12.3	11.9	11.3	11.2	10.6
50	63	16.9	16.3	15.0	14.4	14.3	13.7
50	100	18.4	17.8	17.2	16.6	16.6	16.0
80	16	17.4	16.8	15.6	15.0	14.2	13.6
80	40	19.4	18.8	17.1	16.5	15.8	15.2
80	63	23.4	22.8	20.3	19.7	19.0	18.4
80	100	27.4	26.8	24.0	23.4	22.8	22.2
100	16	22.0	21.4	21.5	20.9	18.7	18.1
100	40	25.0	24.4	24.9	24.3	22.1	21.5
100	63	30.0	29.4	30.1	29.5	27.4	26.8
100	100	36.0	35.4	36.7	36.1	34.0	33.4
150	16	35.8	35.2	33.9	33.3	32.3	31.7
150	40	41.8	41.2	41.4	40.8	40.2	39.6
150	63	59.8	59.2	58.3	57.7	59.0	58.4
150	100	67.8	67.2	69.2	68.6	70.8	70.2
200	10	38.4	37.8	40.7	40.1	43.1	42.5
200	16	38.4	37.8	40.3	39.7	44.3	43.7
200	25	47.4	46.8	49.5	48.9	50.8	50.2
200	40	55.4	54.8	58.0	57.4	58.5	57.9
250	10	58.0	57.4	63.1	62.5	59.8	59.2
250	16	59.0	58.4	64.7	64.1	61.5	60.9
250	25	75.0	74.4	78.5	77.9	76.8	76.2
250	40	93.0	92.4	96.3	95.7	96.1	95.5
300	10	76.3	75.7	81.1	80.5	85.8	85.2
300	16	82.8	82.2	87.6	87.0	92.9	92.3
300	25	99.3	98.7	105.1	104.5	113.0	112.4
300	40	128.1	127.5	132.0	131.4	143.2	142.6

Weight specifications for version with two signal converters + 3.2 kg / 7.05 lb

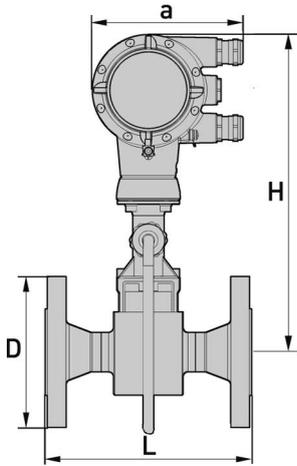
Table 2-3: Weight of flange version EN 1092-1 with signal converter in aluminium housing [kg]

① F1R - single reduction

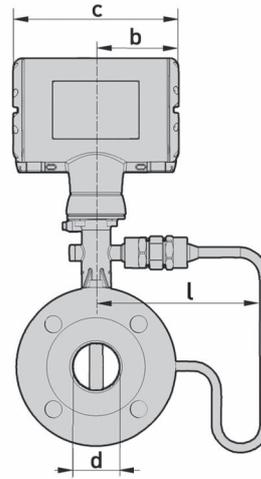
② F2R - double reduction

Weight for signal converter in stainless steel housing:
values of table above + 3 kg

Flange version ASME B16.5, metric



a = 148.5 mm / 5.85"



b = 85.8 mm / 3.38"
c = 171.5 mm / 6.76"

Nominal size NPS	Pressure rating Class	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
1/2	150	16	90	200	358.8	-	-	169.3	-	-
1/2	300	16	95	200	358.8	-	-	169.3	-	-
1/2	600	16	95	200	358.8	-	-	169.3	-	-
1	150	26.6	110	200	358.3	358.8	-	169.3	169.3	-
1	300	26.6	125	200	358.3	358.8	-	169.3	169.3	-
1	600	24	125	200	358.3	358.8	-	169.3	169.3	-
1 1/2	150	41	125	200	362.3	358.3	358.8	169.5	169.3	169.3
1 1/2	300	41	155	200	362.3	358.3	358.8	169.5	169.3	169.3
1 1/2	600	41	155	200	362.3	358.3	358.8	169.5	169.3	169.3
2	150	52.5	150	200	368.3	362.3	358.3	169.5	169.5	169.3
2	300	52.5	165	200	368.3	362.3	358.3	169.5	169.5	169.3
2	600	49.2	165	200	368.3	362.3	358.3	169.5	169.5	169.3
3	150	77.9	190	200	380.3	368.3	362.3	169.3	169.5	169.5
3	300	77.9	210	200	380.3	368.3	362.3	169.3	169.5	169.5
3	600	74.0	210	200	380.3	368.3	362.3	169.3	169.5	169.5
4	150	102.3	230	250	396.8	380.3	368.3	171.5	169.3	169.5
4	300	102.3	255	250	396.8	380.3	368.3	171.5	169.3	169.5
4	600	97.0	275	250	396.8	380.3	368.3	171.5	169.3	169.5
6	150	154.1	280	300	416.3	396.8	380.3	191.5	171.5	169.3
6	300	154.1	320	300	416.3	396.8	380.3	191.5	171.5	169.3
6	600	146.0	355	300	416.3	396.8	380.3	191.5	171.5	169.3
8	150	202.7	345	300	442.1	416.3	396.8	202.8	191.5	171.5
8	300	202.7	380	300	442.1	416.3	396.8	202.8	191.5	171.5
10	150	254.6	405	380	468.8	442.1	416.3	229.5	202.8	191.5

Nominal size NPS	Pressure rating Class	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
10	300	254.6	455	380	468.8	442.1	416.3	229.5	202.8	191.5
12	150	300.0	485	450	492.8	468.8	442.1	255.0	229.5	202.8
12	300	300.0	520	450	492.8	468.8	442.1	255.0	229.5	202.8

Table 2-4: Dimensions of flange version ASME B16.5 [mm]

① F1R - single reduction

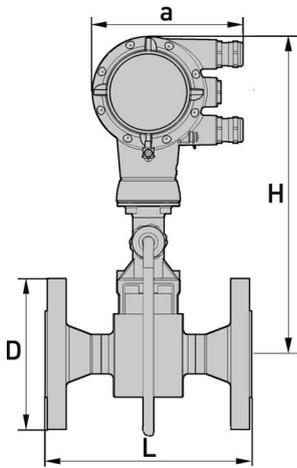
② F2R - double reduction

Nominal size NPS	Pressure rating Class	with	without	F1R with	F1R without	F2R with	F2R without
		Pressure sensor		Pressure sensor		Pressure sensor	
1/2	150	5.1	4.5	-	-	-	-
1/2	300	5.5	4.9	-	-	-	-
1/2	600	5.7	5.1	-	-	-	-
1	150	6.8	6.2	6.6	6.0	-	-
1	300	7.8	7.2	7.6	7.0	-	-
1	600	8.1	7.5	7.9	7.3	-	-
1 1/2	150	8.9	8.3	8.6	8.0	7.7	7.1
1 1/2	300	11.0	10.4	10.9	10.3	10.0	9.4
1 1/2	600	12.0	11.4	11.8	11.2	11.0	10.4
2	150	11.6	11.0	11.0	10.4	10.3	9.7
2	300	13.0	12.4	12.6	12.0	11.9	11.3
2	600	14.5	13.9	14.0	13.4	13.4	12.8
3	150	20.4	19.8	16.9	16.3	15.6	15.0
3	300	23.4	22.8	20.4	19.8	19.2	18.6
3	600	24.4	23.8	22.9	22.3	21.8	21.2
4	150	24.0	23.4	25.3	24.7	22.7	22.1
4	300	32.0	31.4	33.9	33.3	31.2	30.6
4	600	41.0	40.4	44.1	43.5	41.2	40.6
6	150	36.8	36.2	37.8	37.2	36.9	36.3
6	300	51.8	51.2	56.1	55.5	55.8	55.2
6	600	76.8	76.2	79.8	79.2	82.6	82.0
8	150	50.6	50.0	48.8	48.2	52.5	51.9
8	300	75.4	74.8	72.2	71.6	78.1	77.5
10	150	75.0	74.4	75.2	74.6	73.9	73.3
10	300	107.0	106.4	112.4	111.8	113.5	112.9
12	150	107.0	106.4	109.8	109.2	120.4	119.8
12	300	152.0	151.4	165.4	155.8	171.7	171.1

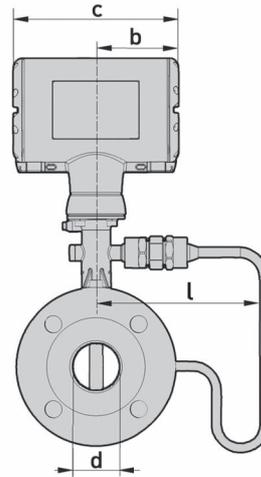
Table 2-5: Weight of flange version ASME B16.5 with signal converter in aluminium housing [kg]

Weight for signal converter in stainless steel housing:
values of table above + 3 kg

Flange version ASME B16.5, imperial



a = 148.5 mm / 5.85"



b = 85.8 mm / 3.38"
c = 171.5 mm / 6.76"

Nominal size NPS	Pressure rating Class	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
1/2	150	0.63	3.5	7.9	14.1	-	-	6.67	-	-
1/2	300	0.63	3.7	7.9	14.1	-	-	6.67	-	-
1/2	600	0.63	3.7	7.9	14.1	-	-	6.67	-	-
1	150	1.05	4.3	7.9	14.1	14.1	-	6.67	6.67	-
1	300	1.05	4.9	7.9	14.1	14.1	-	6.67	6.67	-
1	600	1.0	4.9	7.9	14.1	14.1	-	6.67	6.67	-
1 1/2	150	1.6	4.9	7.9	14.3	14.1	14.1	6.67	6.67	6.67
1 1/2	300	1.6	6.1	7.9	14.3	14.1	14.1	6.67	6.67	6.67
1 1/2	600	1.6	6.1	7.9	14.3	14.1	14.1	6.67	6.67	6.67
2	150	2.07	5.9	7.9	14.5	14.3	14.1	6.67	6.67	6.67
2	300	2.07	6.5	7.9	14.5	14.3	14.1	6.67	6.67	6.67
2	600	1.9	6.5	7.9	14.5	14.3	14.1	6.67	6.67	6.67
3	150	3.07	7.5	7.9	15.0	14.5	14.3	6.67	6.67	6.67
3	300	3.07	8.3	7.9	15.0	14.5	14.3	6.67	6.67	6.67
3	600	2.9	8.3	7.9	15.0	14.5	14.3	6.67	6.67	6.67
4	150	4.0	9.1	9.8	15.6	15.0	14.5	6.76	6.67	6.67
4	300	4.0	10	9.8	15.6	15.0	14.5	6.76	6.67	6.67
4	600	3.8	11	9.8	15.6	15.0	14.5	6.76	6.67	6.67
6	150	6.1	11	12	16.4	15.6	15.0	7.54	6.76	6.67
6	300	6.1	13	12	16.4	15.6	15.0	7.54	6.76	6.67
6	600	5.8	14	12	16.4	15.6	15.0	7.54	6.76	6.67
8	150	8.0	14	12	17.4	16.4	15.6	8.0	7.54	6.76
8	300	8.0	15	12	17.4	16.4	15.6	8.0	7.54	6.76
10	150	10	16	15	18.5	17.4	16.4	9.04	8.0	7.54

Nominal size NPS	Pressure rating Class	d	D	L	H	H F1R ①	H F2R ②	l	l F1R ①	l F2R ②
10	300	10	18	15	18.5	17.4	16.4	9.04	8.0	7.54
12	150	12	19	18	19.4	18.5	17.4	10.0	9.04	8.0
12	300	12	21	18	19.4	18.5	17.4	10.0	9.04	8.0

Table 2-6: Dimensions of flange version ASME B16.5 [inch]

① F1R - single reduction

② F2R - double reduction

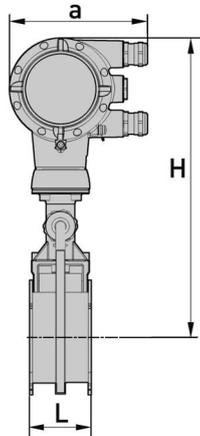
Nominal size NPS	Pressure rating Class	with	without	F1R with	F1R without	F2R with	F2R without
		Pressure sensor		Pressure sensor		Pressure sensor	
1/2	150	11	9.9	-	-	-	-
1/2	300	12	11	-	-	-	-
1/2	600	13	11	-	-	-	-
1	150	15	14	14.6	13.2	-	-
1	300	17	16	16.8	15.4	-	-
1	600	18	17	17.4	16.1	-	-
1 1/2	150	20	18	19.0	17.6	17.0	15.7
1 1/2	300	24.3	22.9	24.0	22.7	22.1	20.7
1 1/2	600	26.5	25.1	26.0	24.7	24.1	22.9
2	150	25.6	24.3	24.3	22.9	22.7	21.4
2	300	28.7	27.3	27.8	26.5	26.2	24.9
2	600	32.0	30.7	30.9	29.6	29.6	28.2
3	150	45.0	43.7	37.3	36.0	34.4	33.1
3	300	51.6	50.3	45.0	43.7	42.3	41.0
3	600	53.8	52.5	50.5	49.2	48.1	46.8
4	150	52.9	51.6	55.8	54.5	50.1	48.7
4	300	70.6	69.3	74.8	73.4	68.8	67.5
4	600	90.4	89.1	97.3	95.9	91.0	89.5
6	150	81.2	79.8	83.4	82.0	81.4	80.0
6	300	114.2	112.9	123.7	122.4	123.1	121.7
6	600	169.4	168.1	176	174.7	182.2	181.0
8	150	111.6	110.3	107.6	106.3	115.8	114.5
8	300	166.3	165.0	159.2	157.9	172.2	171.0
10	150	165.4	164.1	165.9	164.5	163.0	161.7
10	300	236.0	234.7	247.9	246.6	250.3	249.0
12	150	236.0	234.7	242.2	240.8	265.5	264.2
12	300	335.2	333.9	364.8	343.6	378.7	377.4

Table 2-7: Weight of flange version ASME B16.5 with signal converter in aluminium housing [lb]

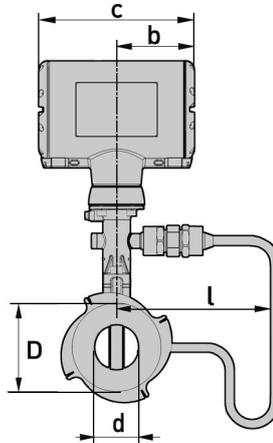
Weight for signal converter in stainless steel housing:
values of table above + 6.61 lb

2.2.2 Sandwich versions

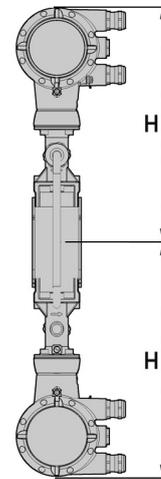
Sandwich version EN



a = 133 mm / 5.24"



b = 105 mm / 4.13"
c = 179 mm / 7.05"



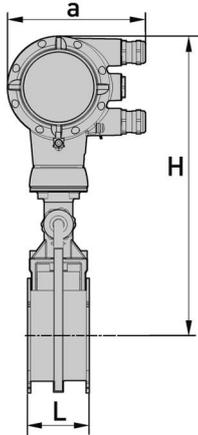
Dimension H x 2
Specified weight: + 2.8 kg / 6.2 lb

Nominal size DN	Pressure rating PN	Dimensions [mm]					Weight [kg]	
		d	D	L	H	l	with Pressure sensor	without
15	100	16	45	65	358.8	169.3	4.1	3.5
25	100	24	65	65	358.3	169.3	4.9	4.3
40	100	38	82	65	362.3	169.5	5.5	4.9
50	100	50	102	65	368.3	169.5	6.6	6.0
80	100	74	135	65	380.3	169.3	8.8	8.2
100	100	97	158	65	396.8	171.5	10.1	9.5

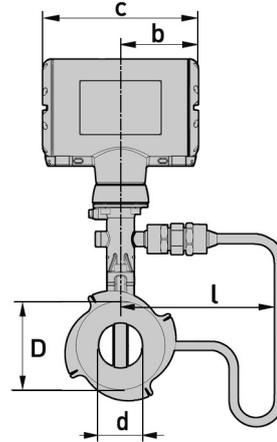
Table 2-8: Dimensions and weight of Sandwich version with signal converter in aluminium housing [mm and kg]

Weight for signal converter in stainless steel housing:
values of table above + 3 kg

Sandwich version ASME



a = 133 mm / 5.24"



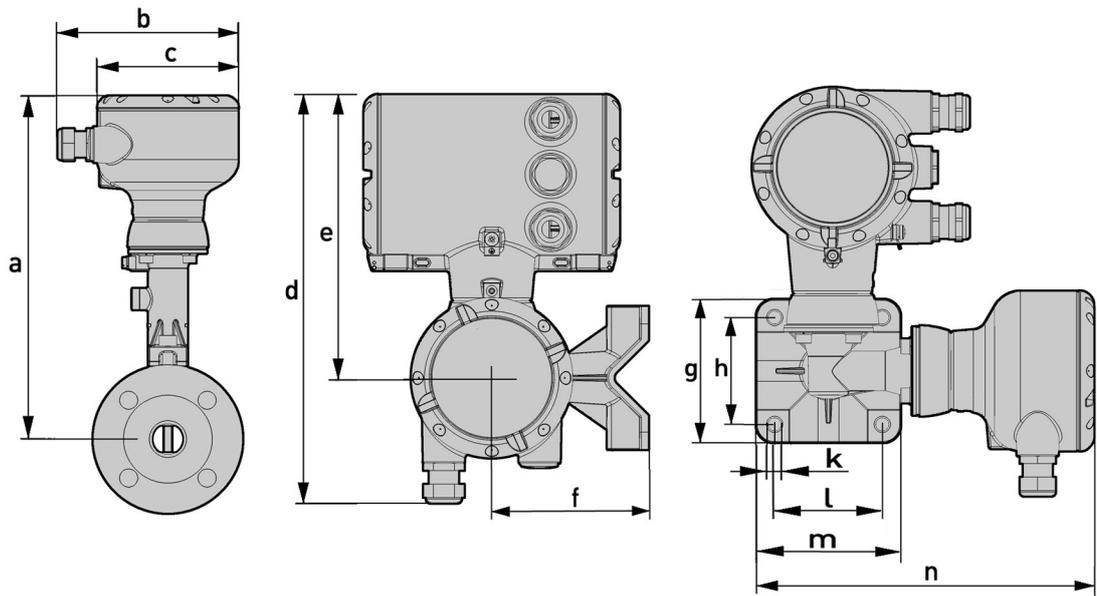
b = 105 mm / 4.13"
c = 179 mm / 7.05"

Nominal size NPS	Pressure rating Class	Dimensions [inch]					Weight [lb]	
		d	D	L	H	l	with Pressure sensor	without
1/2	150	0.63	1.77	2.56	14.13	6.67	9.04	7.72
1/2	300	0.63	1.77	2.56	14.13	6.67	9.04	7.72
1/2	600	0.55	1.77	2.56	14.13	6.67	9.04	7.72
1	150	0.94	2.56	2.56	14.13	6.67	10.8	9.48
1	300	0.94	2.56	2.56	14.13	6.67	10.8	9.48
1	600	0.94	2.56	2.56	14.13	6.67	10.8	9.48
1 1/2	150	1.5	3.23	2.56	14.27	6.67	12.13	10.8
1 1/2	300	1.5	3.23	2.56	14.27	6.67	12.13	10.8
1 1/2	600	1.5	3.23	2.56	14.27	6.67	12.13	10.8
2	150	1.97	4.02	2.56	14.50	6.67	14.55	13.23
2	300	1.97	4.02	2.56	14.50	6.67	14.55	13.23
2	600	1.97	4.02	2.56	14.50	6.67	14.55	13.23
3	150	2.91	5.31	2.56	14.98	6.67	19.4	18.08
3	300	2.91	5.31	2.56	14.98	6.67	19.4	18.08
3	600	2.91	5.31	2.56	14.98	6.67	19.4	18.08
4	150	3.82	6.22	2.56	15.63	6.75	22.27	20.94
4	300	3.82	6.22	2.56	15.63	6.75	22.27	20.94
4	600	3.82	6.22	2.56	15.63	6.75	22.27	20.94

Table 2-9: Dimensions and weight of Sandwich version with signal converter in aluminium housing [inch and lb]

Weight for signal converter in stainless steel housing:
values of table above + 6.61 lb

2.2.3 Remote version



	Flange & sandwich version						Flange version			
DN ▶	15	25	40	50	80	100	150	200	250	300
NPS ▶	1/2	1	1 1/2	2	3	4	6	8	10	12
[mm] ▶	315.7	315.2	319.2	325.2	337.2	353.7	373.2	398.9	425.7	449.7
["] ▶	12.4	12.4	12.6	12.8	13.3	13.9	14.7	15.7	16.8	17.7

Table 2-10: Dimension a [mm and inch]

	Flange version									
DN ▶	15	25	40	50	80	100	150	200	250	300
NPS ▶	1/2	1	1 1/2	2	3	4	6	8	10	12
F1R ① [mm] ▶	-	315.7	315.2	319.2	325.2	337.2	353.7	373.2	398.9	425.7
F1R ① ["] ▶	-	12.4	12.4	12.6	12.8	13.3	13.9	14.7	15.7	16.8
F2R ② [mm] ▶	-	-	315.7	315.2	319.2	325.2	337.2	353.7	373.2	398.9
F2R ② ["] ▶	-	-	12.4	12.4	12.6	12.8	13.3	13.9	14.7	15.7

Table 2-11: Dimension a F1/2R [mm and inch]

- ① F1R - single reduction
- ② F2R - double reduction

	b	c	d	e	f	g	h	j	k	l	m	n
[mm]	138.5	108.0	275.6	191.2	105.0	97.0	72.0	108.0	9.0	72.0	97.0	226.0
["]	5.46	4.25	10.9	7.53	4.14	3.82	2.84	4.25	0.35	2.84	3.82	8.90

Table 2-12: Dimension b...n [mm and inch]

2.3 Flow tables

Nominal size		Q_{\min}	Q_{\max}	Q_{\min}	Q_{\max}
DN - EN 1092-1	NPS - ASME B16.5	[m ³ /h]		[gph]	

Water

15	1/2	0.45	5.04	120	1331
25	1	0.81	11.34	215	2996
40	1 1/2	2.04	28.43	539	7512
50	2	3.53	49.22	934	13005
80	3	7.74	107.8	2045	28487
100	4	13.3	185.2	3514	48947
150	6	30.13	419.7	7961	110890
200	8	56.55	787.6	14954	208089
250	10	90.49	1260	23905	332989
300	12	127.3	1772	33611	488200

Values based on water at +20°C / +68°F

Air

15	1/2	6.8	32.4	1797	8561
25	1	10.21	113.4	2696	29966
40	1 1/2	24.5	324.5	6472	85856
50	2	42.42	562.6	11205	148644
80	3	92.91	1232	24543	325589
100	4	159.7	2117	42170	559436
150	6	361.7	4797	95536	1267398
200	8	678.7	9002	179275	2378304
250	10	1086	14406	286880	3805822
300	12	1527	20255	403369	5351184

Values based on air at +20°C / +68°F and 1.013 bara / 14.7 psia and density 1.204 kg/m³ / 0.0751 lb/ft³

Table 2-13: Measuring ranges for water and air

Gauge pressure [barg]		1		3.5		5.2		7	
Density [kg/m ³]		1.134		2.419		3.272		4.166	
Temperature [°C]		120.4		148.0		160.2		170.5	
Flow rate		min.	max.	min.	max.	min.	max.	min.	max.
DN EN 1092-1	NPS ASME B16.5	[kg/h]		[kg/h]		[kg/h]		[kg/h]	
15	1/2	5.88	36.79	7.42	78.5	8.62	106.6	9.73	134.9
25	1	11.43	128.7	16.69	274.6	19.40	371.2	21.89	472.3
40	1 1/2	28.65	368.9	41.83	786.7	48.63	1063	54.86	1353
50	2	49.60	638.8	72.41	1362	84.19	1841	94.97	2343
80	3	108.7	1399	158.7	2983	184.5	4033	208.1	5132
100	4	186.7	2404	272.6	5126	316.9	6930	357.5	8818
150	6	422.8	5446	617.4	11614	717.9	15700	809.8	19977
200	8	793.4	10220	1159	21794	1347	29461	1520	37488
250	10	1270	16355	1854	34876	2156	47145	2432	59990
300	12	1786	22996	2607	49037	3031	66288	3419	84350

Table 2-14: Measuring range for saturated steam: 1...7 barg

Gauge pressure [barg]		10.5		14		17.5		20	
Density [kg/m ³]		5.883		7.588		9.304		10.53	
Temperature [°C]		186.1		198.3		208.5		214.9	
Flow rate		min.	max.	min.	max.	min.	max.	min.	max.
DN EN 1092-1	NPS ASME B16.5	[kg/h]		[kg/h]		[kg/h]		[kg/h]	[kg/h]
15	1/2	12.78	190.6	16.49	246.0	20.21	301.5	22.87	341.3
25	1	26.01	667.2	29.55	853.0	32.71	950.0	34.80	1014
40	1 1/2	65.20	1867	74.07	2138	82.0	2381	87.24	2543
50	2	112.9	3233	128.3	3702	142.0	4123	151.1	4403
80	3	247.3	7083	280.9	8109	311.0	9032	330.8	9644
100	4	424.9	12170	482.7	13934	534.3	15519	568.4	16571
150	6	962.4	27572	1094	31567	1211	35158	1288	37542
200	8	1806	51741	2052	59237	2272	65975	2417	70450
250	10	2890	82797	3284	94792	3635	105576	3867	112736
300	12	4064	116418	4617	133283	5111	148445	5437	158512

Table 2-15: Measuring range for saturated steam: 10.5...20 barg

Gauge pressure [psig]		15		50		75		100	
Density [lb/ft³]		0.0721		0.1496		0.2033		0.2564	
Temperature [°F]		249.0		297.7		320.0		337.9	
Flow rate		min.	max.	min.	max.	min.	max.	min.	max.
DN EN 1092-1	NPS ASME B16.5	[lb/h]		[lb/h]		[lb/h]		[lb/h]	[lb/h]
15	1/2	12.32	82.42	16.26	171.1	18.97	232.8	21.32	293.8
25	1	25.4	288.4	36.59	598.8	42.68	814.9	47.95	1028
40	1 1/2	63.66	826.5	91.72	1715	107.0	2334	120.2	2947
50	2	110.3	1430	158.8	2970	185.3	4042	208.1	5102
80	3	241.4	3134	347.9	6506	405.8	8854	455.9	11175
100	4	414.8	5385	597.7	11180	697.2	15214	783.2	19202
150	6	939.7	12201	1354	25329	1580	34367	1775	43503
200	8	1764	22895	2541	47530	2964	64679	3330	81634
250	10	2822	36638	4066	76060	4743	103501	5329	130634
300	12	3968	51515	5717	106944	6669	145528	7492	183678

Table 2-16: Measuring range for saturated steam: 15...100 psig

Gauge pressure [psig]		150		200		250		300	
Density [lb/ft³]		0.3626		0.4682		0.5727		0.6781	
Temperature [°F]		365.9		387.9		406.0		421.8	
Flow rate		min.	max.	min.	max.	min.	max.	min.	max.
DN EN 1092-1	NPS ASME B16.5	[lb/h]		[lb/h]		[lb/h]		[lb/h]	[lb/h]
15	1/2	27.80	414.8	35.87	353.3	43.94	655.7	52.04	776.6
25	1	56.97	1452	64.71	1867	71.62	2079	78.06	2274
40	1 1/2	142.9	4090	162.3	4681	179.6	5213	195.7	5702
50	2	247.3	7081	280.9	8105	310.9	9025	338.8	9872
80	3	541.6	15510	615.2	17753	680.9	19769	742.1	21624
100	4	930.6	26650	1058	30504	1170	33968	1276	37155
150	6	2109	60375	2395	69107	2651	76956	2889	84176
200	8	3956	113296	4494	129681	4974	144410	5421	157958
250	10	6331	181300	7191	207519	7959	231089	8675	252769
300	12	8901	254917	10111	291783	11191	324923	12197	355406

Table 2-17: Measuring range for saturated steam: 150...300 psig

3.1 Intended use

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.

This device is a Group 1, Class A device as specified within CISPR11. 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.

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 devices are particularly suitable for the measurement of:

- Clean liquids with low viscosity (< 10 cP)
- Hydrocarbons with low viscosity (< 10 cP)
- Water
- Chemicals with low corrosiveness
- Saturated steam
- Superheated steam, including CIP (Cleaning in Place) and SIP (Sterilising in Place) applications in the food industry

Note the following:

- The flow sensors are made from stainless steel 1.4404 / 316L or Hastelloy® C-22.
- 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 data indicated on the nameplate for PS (stated pressures), TS (stated temperatures) and PT (test pressure).
- External forces and moments, caused e.g. by pipe stresses, have not been taken into account.

Primarily, volumetric flow and temperature are measured, with pressure measurement as an option. From these parameters the measuring device calculates the mass flow or standard volumetric flow using pre-programmed density data and then exports the measured values via various communication interfaces.

The devices are rated for the following flow velocities:

Liquids: DN15...DN300		V_{\min} : 0.3 m/s ③	0.98 ft/s	$V_{\min} [\text{m/s}] = 0.5 \times \sqrt{\frac{998}{\rho}} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	①
		V_{\max} : 10 m/s	32 ft/s	$V_{\max} [\text{m/s}] = 7 \times \left(\frac{998}{\rho} \right)^{0.47} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	②
Gases and steam:	DN15	V_{\min} : 3 m/s	10 ft/s	$V_{\min} [\text{m/s}] = 6 \times \sqrt{\frac{1.204}{\rho}} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	①
		V_{\max} : 45 m/s	147 ft/s	$V_{\max} [\text{m/s}] = 7 \times \left(\frac{998}{\rho} \right)^{0.47} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	②
	DN15C	V_{\min} : 3 m/s	10 ft/s	$V_{\min} [\text{m/s}] = 12 \times \sqrt{\frac{1.204}{\rho}} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	①
		V_{\max} : 55 m/s	180 ft/s	$V_{\max} [\text{m/s}] = 7 \times \left(\frac{998}{\rho} \right)^{0.47} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	②
	DN25	V_{\min} : 2 m/s	6.6 ft/s	$V_{\min} [\text{m/s}] = 6 \times \sqrt{\frac{1.204}{\rho}} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	①
		V_{\max} : 70 m/s	229 ft/s	$V_{\max} [\text{m/s}] = 7 \times \left(\frac{998}{\rho} \right)^{0.47} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	②
	DN25C	V_{\min} : 2 m/s	6.6 ft/s	$V_{\min} [\text{m/s}] = 12 \times \sqrt{\frac{1.204}{\rho}} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	①
		V_{\max} : 80 m/s	262 ft/s	$V_{\max} [\text{m/s}] = 7 \times \left(\frac{998}{\rho} \right)^{0.47} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	②
	DN40... DN300	V_{\min} : 2 m/s	6.6 ft/s	$V_{\min} [\text{m/s}] = 6 \times \sqrt{\frac{1.204}{\rho}} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	①
		V_{\max} : 80 m/s	262 ft/s	$V_{\max} [\text{m/s}] = 7 \times \left(\frac{998}{\rho} \right)^{0.47} \quad \rho \left[\frac{\text{kg}}{\text{m}^3} \right]$	②

Table 3-1: Flow velocities

- ① Use the larger value, according to the amount.
- ② Use the smaller value, according to the amount.
- ③ $v_{\min} = 0.7 \text{ m/s} / 2.3 \text{ ft/s}$ in SIL mode for liquid application.

DN15C and DN25C have a robust flow sensor (signal pick-up) for harsh measuring conditions and higher maximum velocity compared to the standard version.

3.2 Installation conditions

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

Any vibrations may distort the measuring result. That is why any vibrations in the pipeline must be prevented through suitable measures.

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.*
- *Devices in sandwich version may only be installed using centering rings.*
- *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 an 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 $>+65^{\circ}\text{C}$ / $+149^{\circ}\text{F}$, a connection cable and cable glands with a minimum service temperature of $+80^{\circ}\text{C}$ / $+176^{\circ}\text{F}$ must be used.*

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.

For devices with built-in pressure sensor, suitable measures must be taken to ensure that the maximum operating temperature of $+110^{\circ}\text{C}$ / $+230^{\circ}\text{F}$ is not exceeded at the pressure sensor. Additionally the pressure sensor must be protected against effects of frost.

3.2.1 Installation when measuring liquids

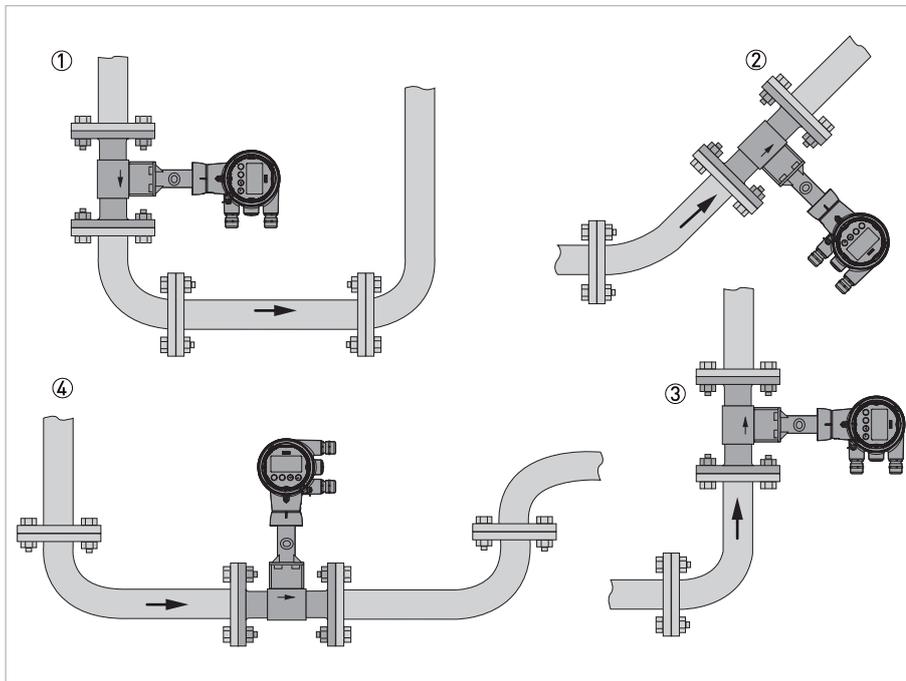


Figure 3-1: Recommended installation

- 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

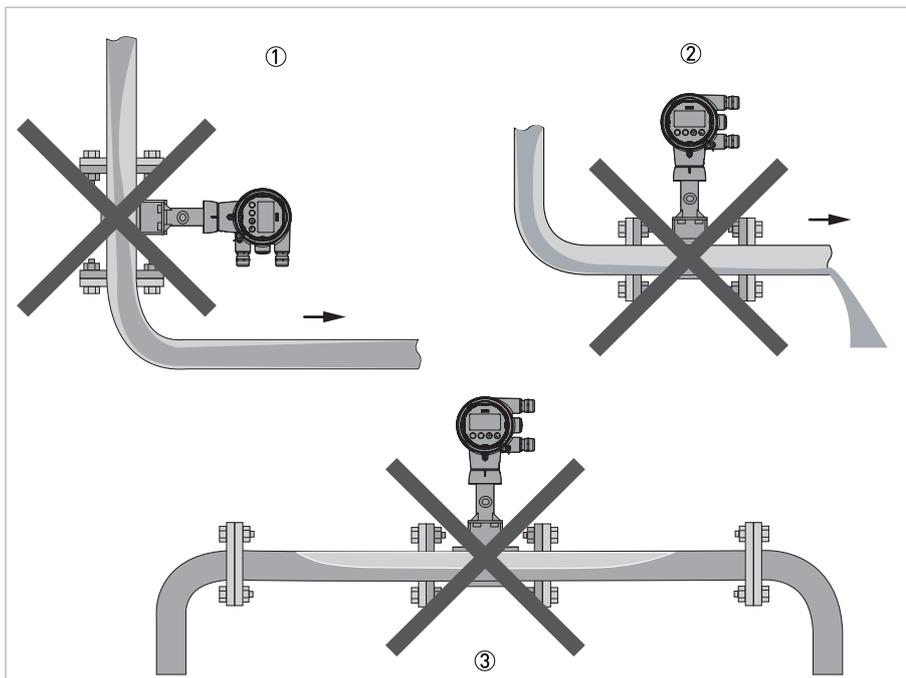


Figure 3-2: Not recommended installation

- 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

- *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.*

3.2.2 Installation when measuring steam and gases

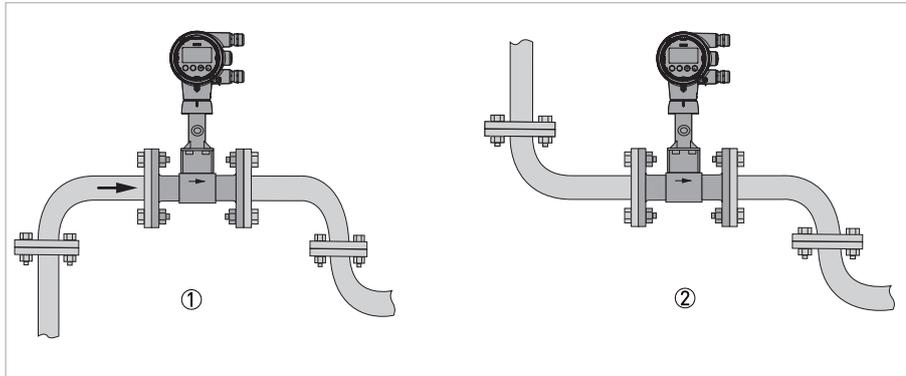


Figure 3-3: Recommended installation

- 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

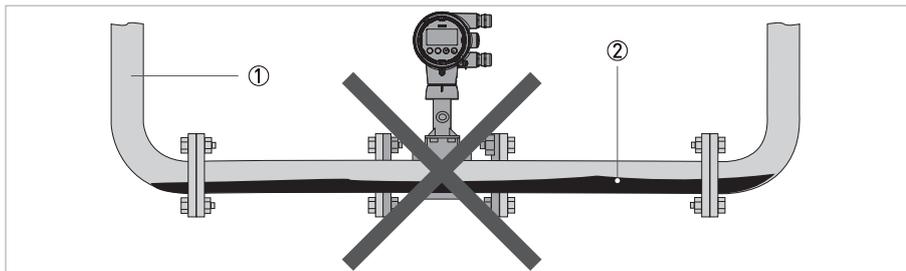


Figure 3-4: Not recommended installation

- ① Lower pipe bends
- ② Condensate

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.

3.2.3 Pipelines with control valve

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.

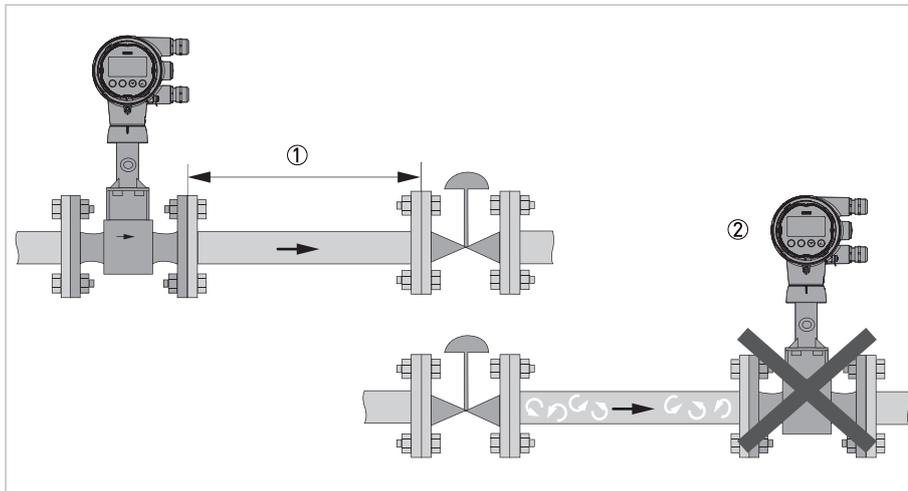


Figure 3-5: Pipelines with control valve

- 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

3.2.4 Preferred mounting position for device without pressure sensor

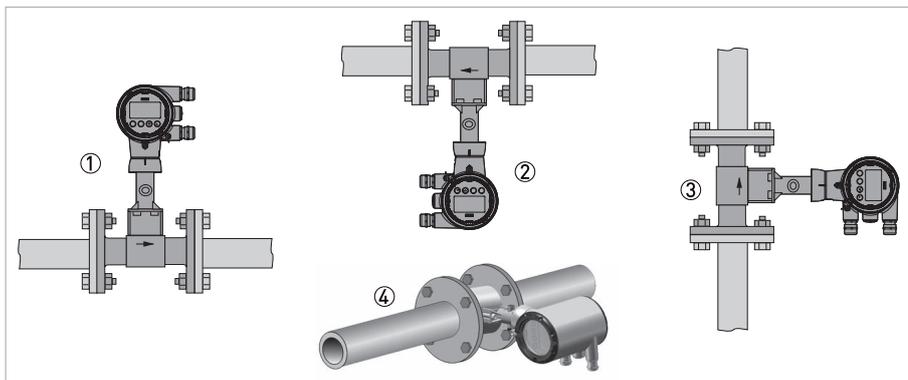


Figure 3-6: Preferred mounting position for device without pressure sensor

- ① Above a horizontal pipe
- ② Underneath a horizontal pipe (not permitted with lines at risk of condensate forming)
- ③ On a vertical pipe
- ④ Horizontal pipeline with signal converter orientation of 90° to the side

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

3.2.5 Preferred mounting position for device with pressure sensor

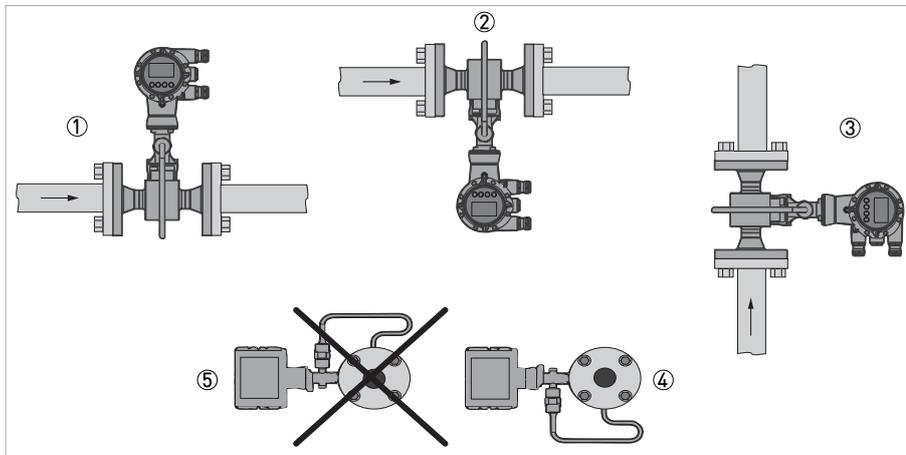


Figure 3-7: Preferred mounting position for device with pressure sensor

- ① Above a horizontal pipe
- ② Underneath a horizontal pipe (not permitted with lines at risk of condensate forming)
- ③ On a vertical pipe
- ④ Horizontal pipeline with signal converter orientation of 90° to side with pressure sensor syphon orientation downwards
- ⑤ **Not recommended:**
Horizontal pipeline with signal converter orientation of 90° to side with pressure sensor syphon orientation upwards

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

3.3 Minimum inlet sections

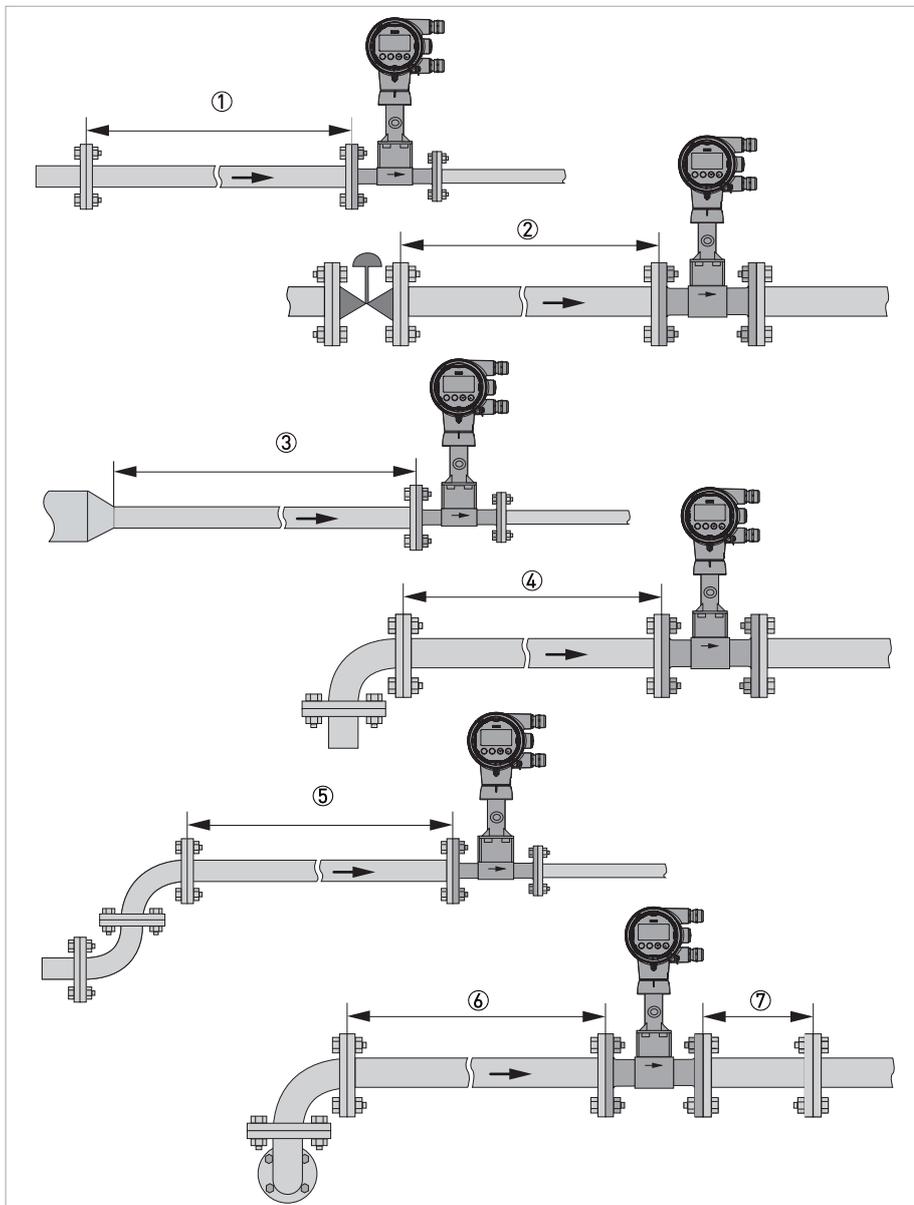


Figure 3-8: Minimum inlet sections

- 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 $90^\circ \geq 20$ DN
- ⑤ After a double bend $2 \times 90^\circ \geq 30$ DN
- ⑥ After a double three-dimensional bend $2 \times 90^\circ \geq 40$ DN
- ⑦ Outlet section > 5 DN

The nominal diameter of the flange is significant for the determination of the minimum inlet and outlet sections for the nominal diameter reduced versions of vortex flowmeter versions F1R and F2R.

3.4 Minimum outlet sections

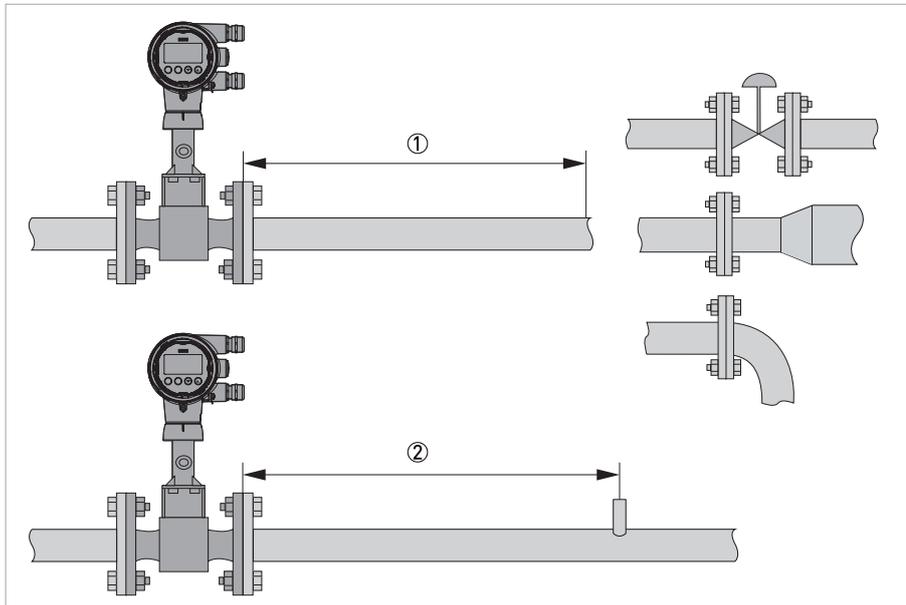


Figure 3-9: Minimum outlet sections

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

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.

3.5 Flow straightener

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

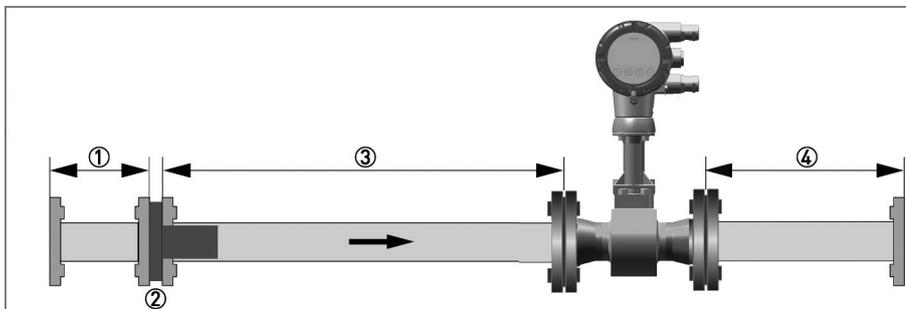


Figure 3-10: Flow straightener

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

3.6 Heat insulation

For applications with medium temperatures above $+160^{\circ}\text{C}$ / $+320^{\circ}\text{F}$ an insulation of the pipeline in accordance to the insulation guideline is suggested. Avoid higher electronic temperatures than $+80^{\circ}\text{C}$ / $+176^{\circ}\text{F}$.

The area above the signal converter support must not be heat-insulated.

The heat insulation ③ may only extend to the maximum height ① shown below.

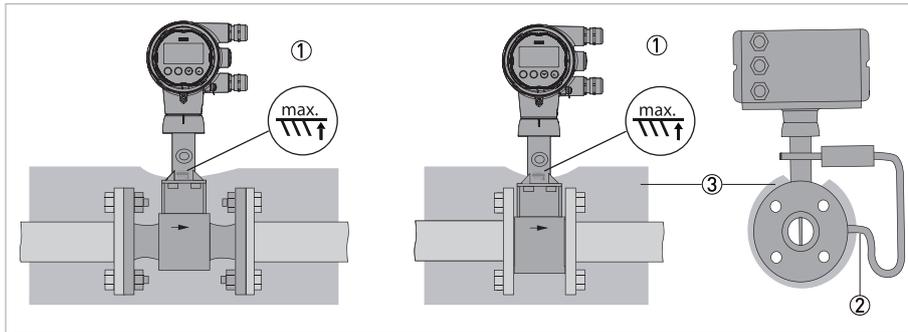


Figure 3-11: Mounting of the heat insulation

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

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

4.1 Connecting the signal converter

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

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

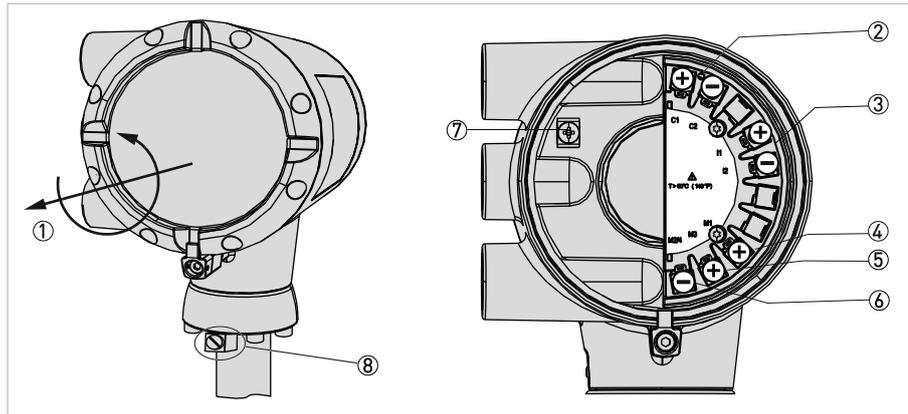


Figure 4-1: Connecting the signal converter

- ① Open the housing cover of the electrical terminal compartment using the key
- ② Signal converter supply and 4...20 mA loop
- ③ 4...20 mA current input, - external transmitter, optional
- ④ Terminal M1 binary (high current)
- ⑤ Terminal M3 binary (NAMUR)
- ⑥ Terminal M2/4 binary, common minus connection
- ⑦ Ground terminal in housing
- ⑧ Ground terminal on connection piece between flow sensor and signal converter

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

Steps for connecting the signal converter:

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

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

4.2 Electrical connections

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

4.2.1 Power supply

All versions are intended for connection to limited-energy circuits of max. 36 VDC / 4 A.

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

The required supply voltage can be calculated using the formula below:

$$U_{\text{ext.}} = R_L \cdot 22 \text{ mA} + 12 \text{ V}$$

with

$U_{\text{ext.}}$ = minimum supply voltage

R_L = total measuring loop resistance

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

4.2.2 Current output

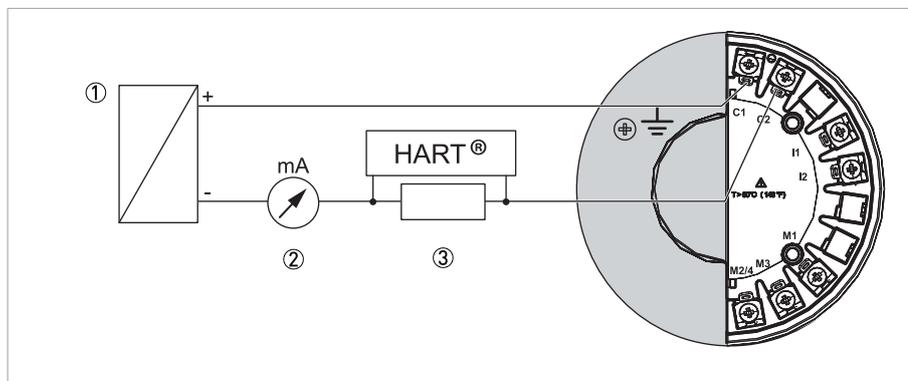


Figure 4-2: Electrical connection current output

- ① Power supply for current output
- ② Optional mA meter
- ③ Load for HART® ≥ 250 Ω

Connect current loop 4..20 mA to terminals C1+ and C2-.

When connection cables are long, a shielded or twisted cable may be necessary. The cable shield may only be grounded at one place (e.g. on the power supply unit).

4.2.3 Current input

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

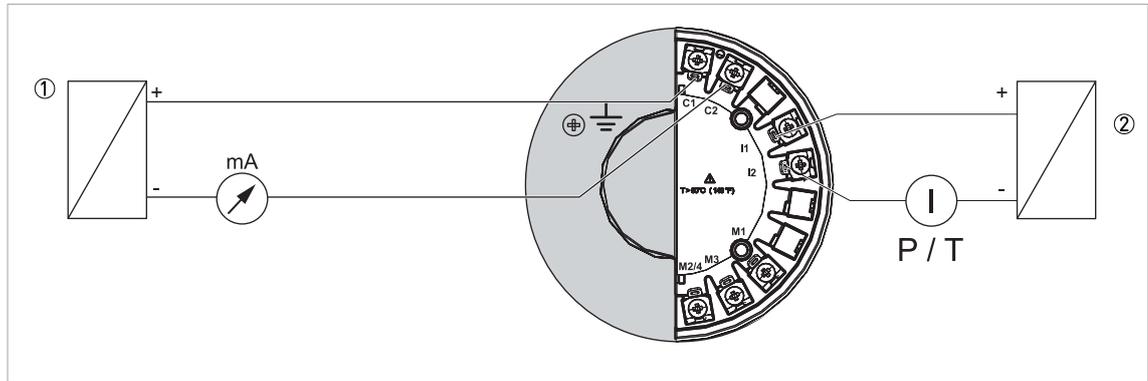


Figure 4-3: Electrical connection current input

- ① Power supply for the signal converter
- ② Power supply for an external temperature or pressure transmitter

The current input can be configured in menu C1.5. Depending on the configuration of the current input, the sources for temperature and/or pressure value have to be adjusted in menu C1.6 or C1.7.

4.2.4 Binary output

Unless otherwise ordered, the binary output is inactive by default and must thus be activated and configured as limit switch output, pulse output, frequency output or status output in menu C2.2 prior to first use. The binary output is electrically separated from the current output and must be supplied with power separately.

4.2.5 Limit switch output

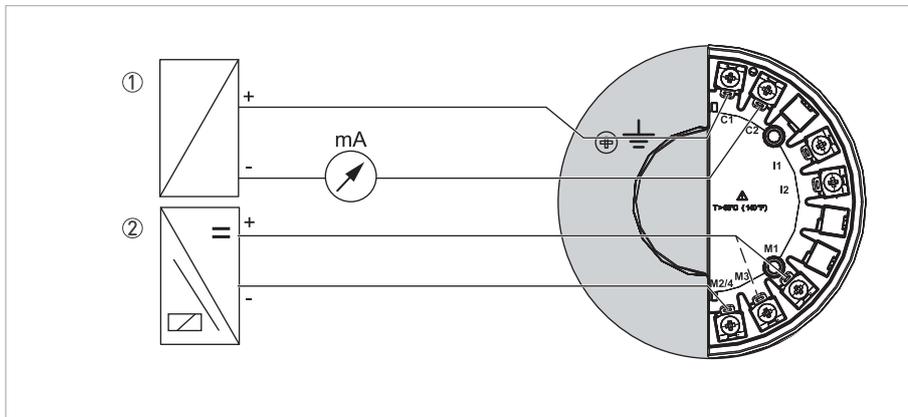


Figure 4-4: Connection of binary output

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

Binary output M_x can only be operated if the loop supply 4...20 mA is applied to the terminals C1+ and C2-. The binary output is inactive by default and must thus be activated in menu C2.2 prior to first use.

Connection of binary output

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

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

Terminal	M1	M3	M2/4
Connection NAMUR		+ (open collector, $R_i \sim 1 \text{ k}\Omega$)	Common
Connection transistor output	+ (open collector, $I_{max} < 100 \text{ mA}$)		Common

Table 4-1: Terminal connection

	N/C contact ①	N/O contact ②
Switching value reached	< 1 mA	> 3 mA
Switching value not reached	> 3 mA	< 1 mA

Table 4-2: Value range for NAMUR

① C2.2.6 Invert Signal On

② C2.2.6 Invert Signal Off

Value range applies only when connected to a switching amplifier with the following reference values:

- Open-circuit voltage $U_0 = 8.2$ VDC
- Internal resistance $R_i = 1$ k Ω

	U_L	I_L	U_H	I_H
via load R_L	0...2 V	0...2 mA	16...30 V	20...100 mA

Table 4-3: Value range for transistor output

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

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

4.2.6 Pulse output / Frequency output

The maximum frequency of both pulse output and frequency output is 1000 Hz.

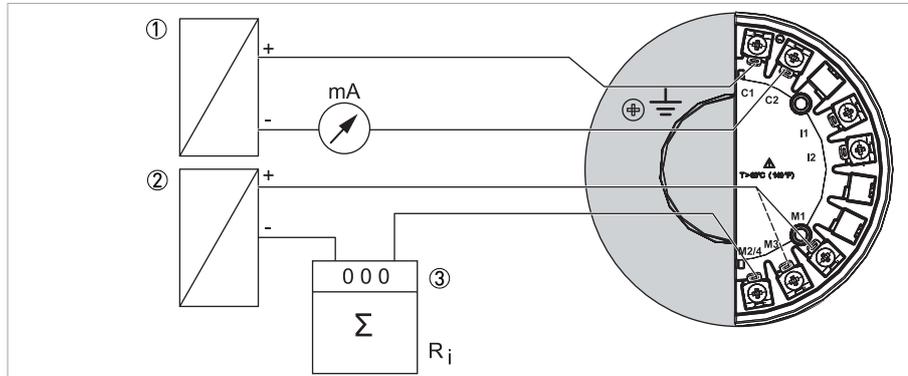


Figure 4-5: Electrical connection pulse output

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

The connection is made between terminal M2/4 Common (-) and M1 for Hi Current (+) or M3 NAMUR (+). Only one of the two connections M1 or M3 can be selected in menu C2.2. The output is selected as pulse or frequency output in menu C2.2.

The output is a passive "open collector" output which is electrically separated from the current interface and the flow sensor. It requires its own power supply ②. The total resistance must be adapted so that the total current I_{tot} does not exceed 120 mA.

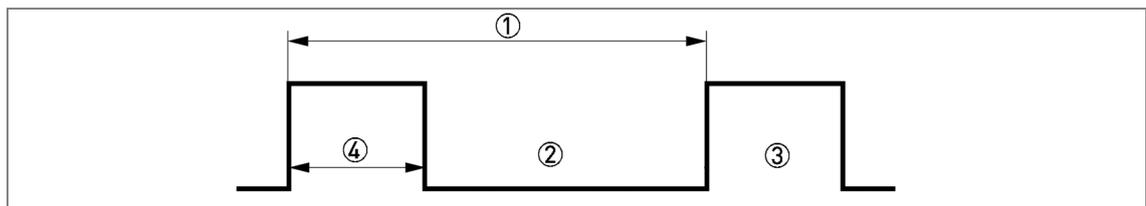


Figure 4-6: Pulse output signal definition

- ① T_{max}
- ② Closed
- ③ Open
- ④ Pulse width ≥ 0.5 ms

Make sure the pulse width is in line with the pulse rate.

4.2.7 Status output

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

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

NAMUR terminal M3...M2/4	
$R_T = 900 \ \Omega$	$U_{\max} = 36 \text{ VDC}$

Table 4-4: Technical data of terminals

For selection of status function and adjustable data of the status output refer to chapter "Menu description C - Setup", menu "C2.2.4 Status Output" and appropriate submenus.

4.3 Connection of remote version

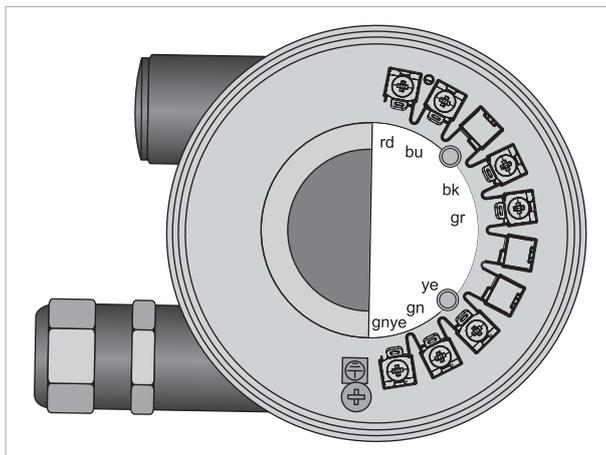


Figure 4-7: Connection terminals of remote version

The connection terminals in the connection box of the flow sensor and the wall bracket are identical in construction.

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

Table 4-5: Connection cable strand colour

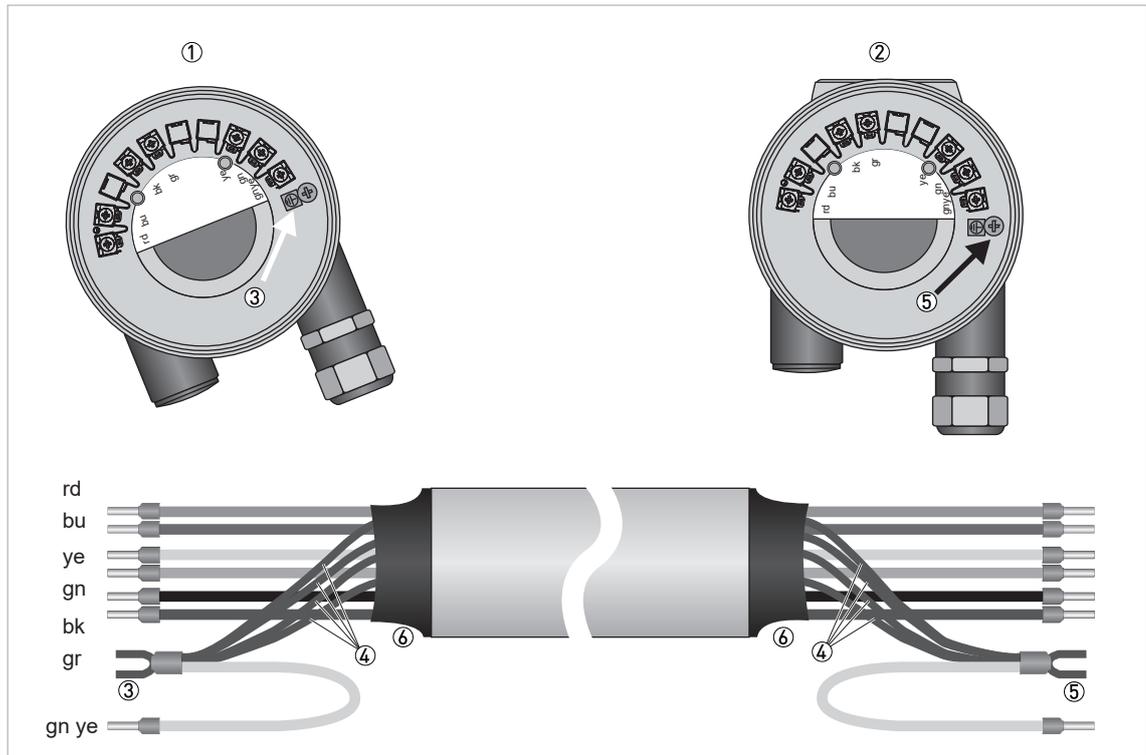


Figure 4-8: Connection of remote version

- ① Connection terminal flow sensor
- ② Connection terminal signal converter
- ③ Connection shielding flow sensor
- ④ Shielding (drain wire and overall shield)
- ⑤ Connection shielding signal converter
- ⑥ Heat shrink tubing

The maximum cable length is 50 m / 164 ft.

The cable can be shortened easily. All wires must be connected afterwards.

Please ensure that the shielding ④ has been properly connected to both terminals ③ and ⑤.

4.4 Foundation Fieldbus and Profibus PA fieldbus communication

For a detailed description of the communication interfaces refer to the supplementary instructions "VFC 200 Foundation Fieldbus" or "VFC 200 PROFIBUS PA".

Foundation Fieldbus:

The wiring between the device and the Foundation Fieldbus cable is independent of polarity. The signal converter Foundation Fieldbus interface will operate only if the additional power supply for the device is connected/available.

Profibus PA:

The wiring between the device and the Profibus PA bus is independent of polarity. The signal converter Profibus PA with MBP (Manchester Coded Bus Powered) interface will operate without an additional power supply connected.

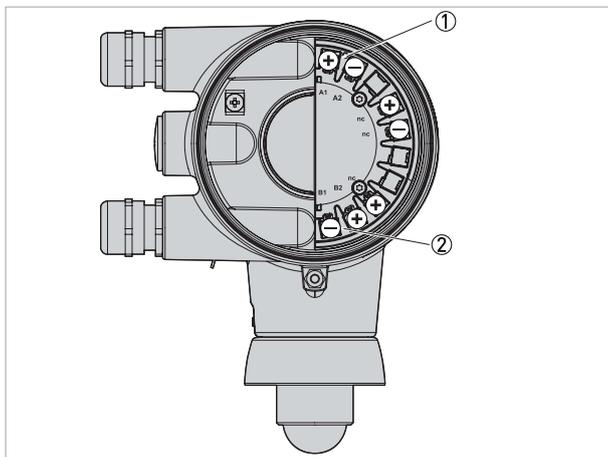
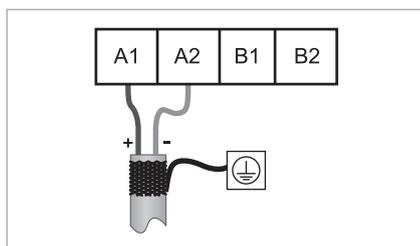


Figure 4-9: Connection terminals

- ① Incoming data lines with terminals A1 and A2
- ② Outgoing data line with terminals B1 and B2



or

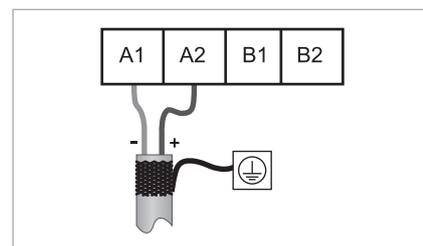


Table 4-6: Connection to a spur

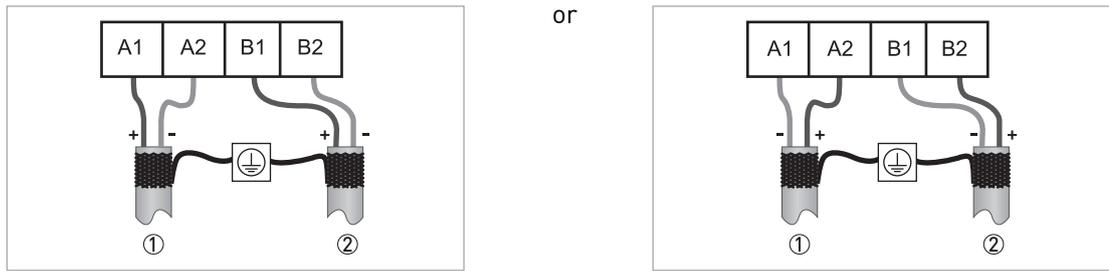


Table 4-7: Connection to a trunk

- ① e.g. incoming data lines
- ② e.g. outgoing data lines

4.5 Grounding connections

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

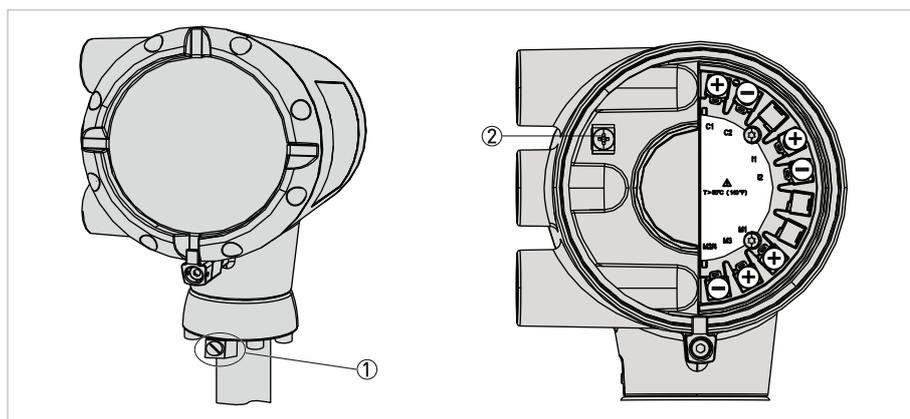


Figure 4-10: Grounding connection for compact version

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

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

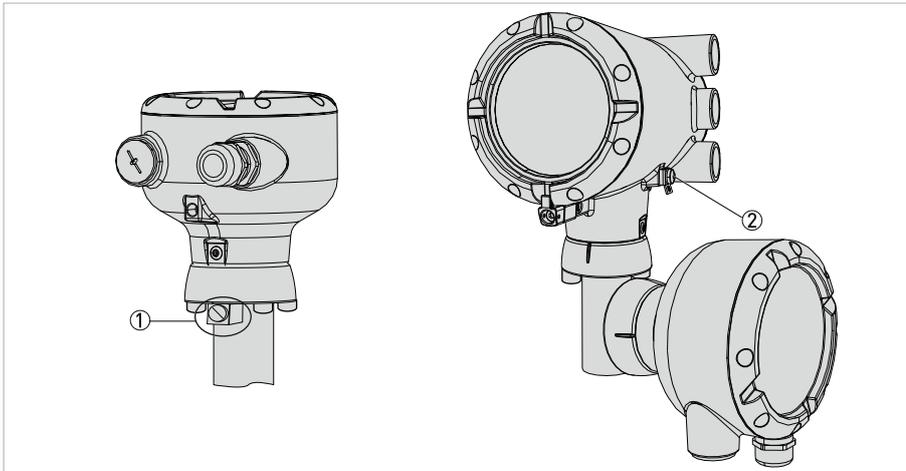


Figure 4-11: Grounding connection for remote version

- ① Electrical grounding connection on flow sensor
- ② Electrical grounding connection on signal converter housing

In the remote version, the flow sensor as well as the signal converter must be grounded.

4.6 Ingress protection

The signal converter in aluminium housing meets the requirements for IP66/67 in accordance with IEC 60529 both for the compact and for the remote version.

The signal converter in stainless steel housing meets the requirements for IP66, IP68, IP69K both for the compact and for the remote version.

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

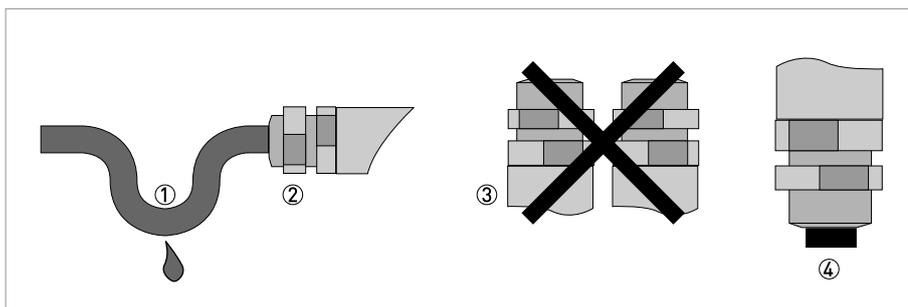
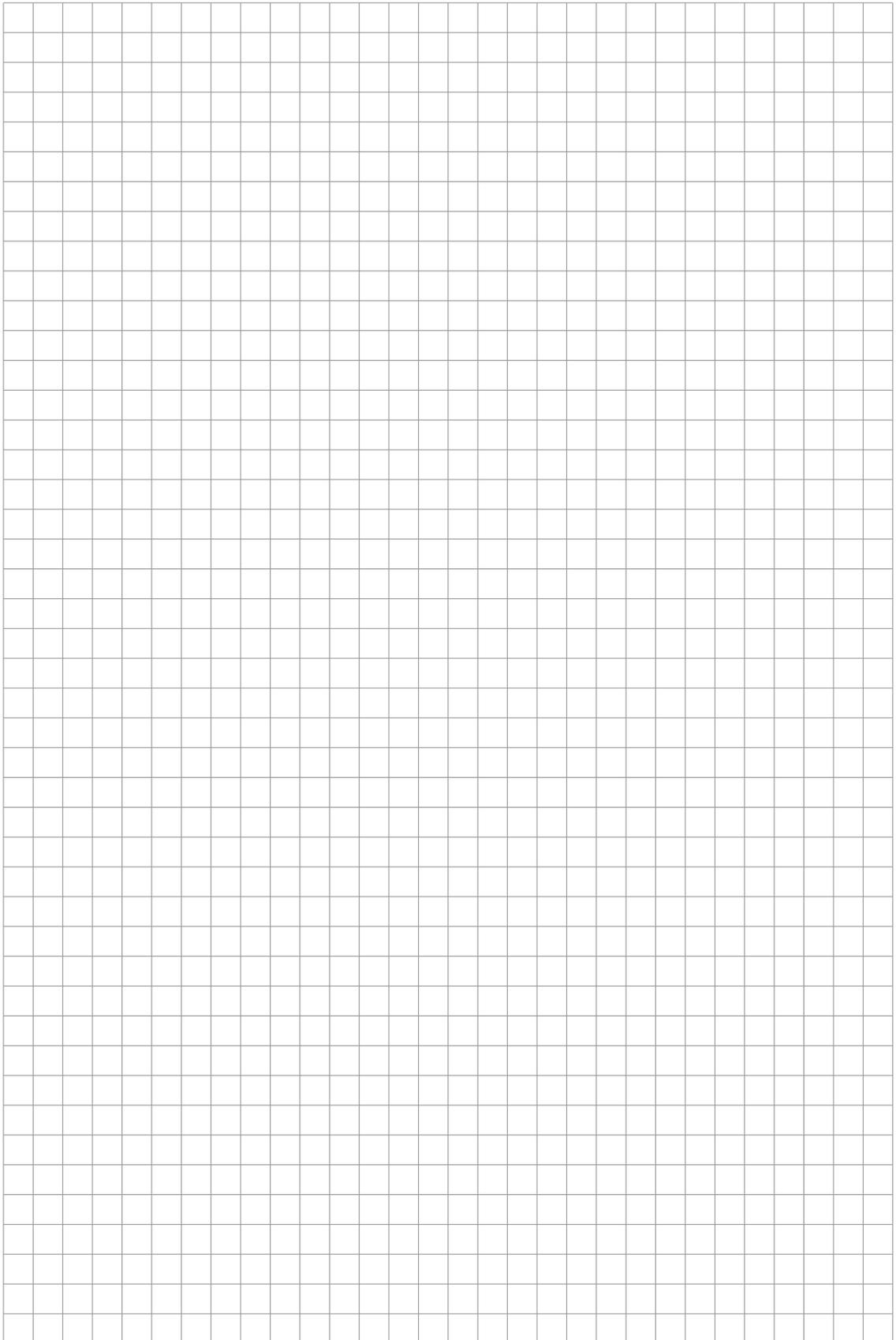
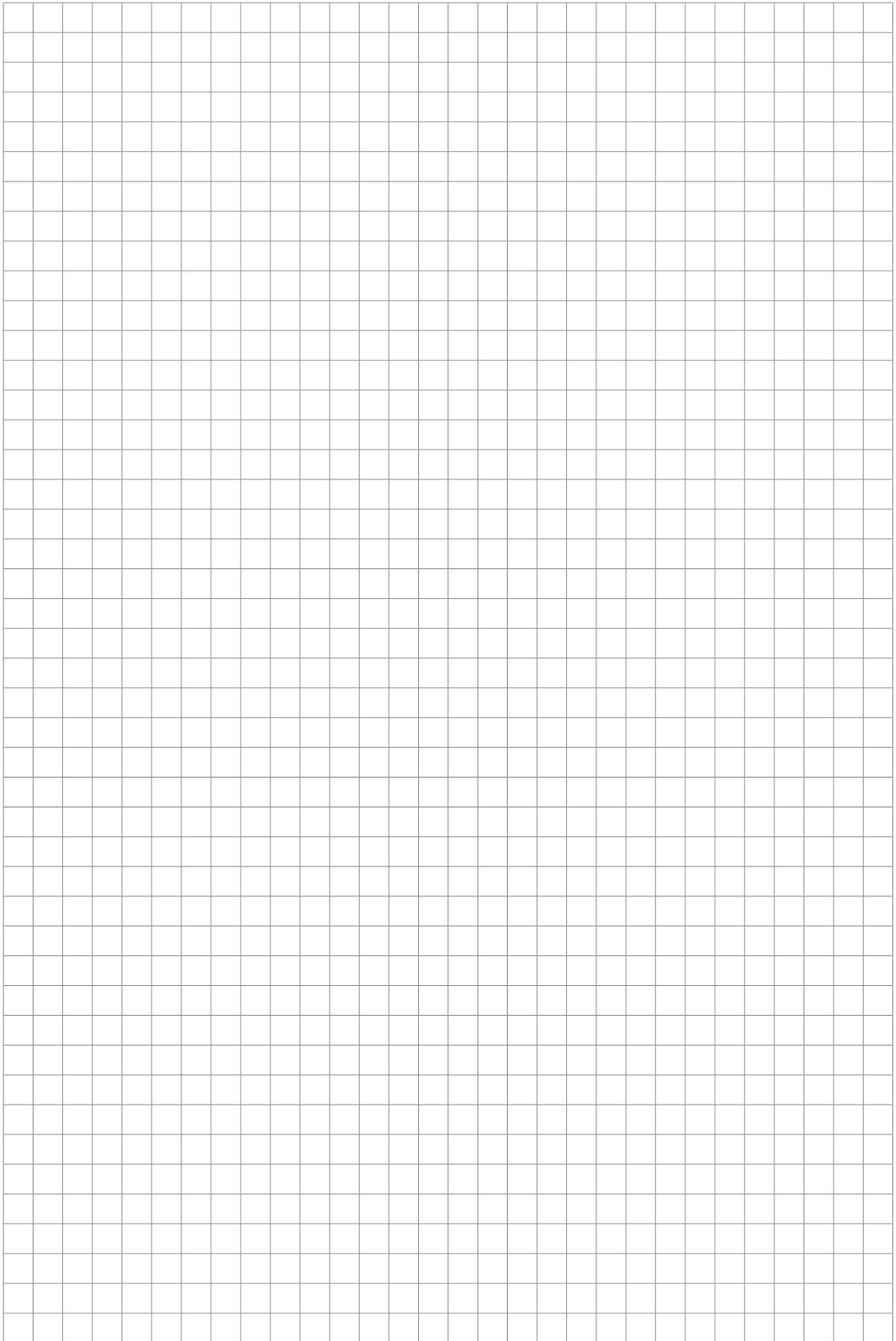


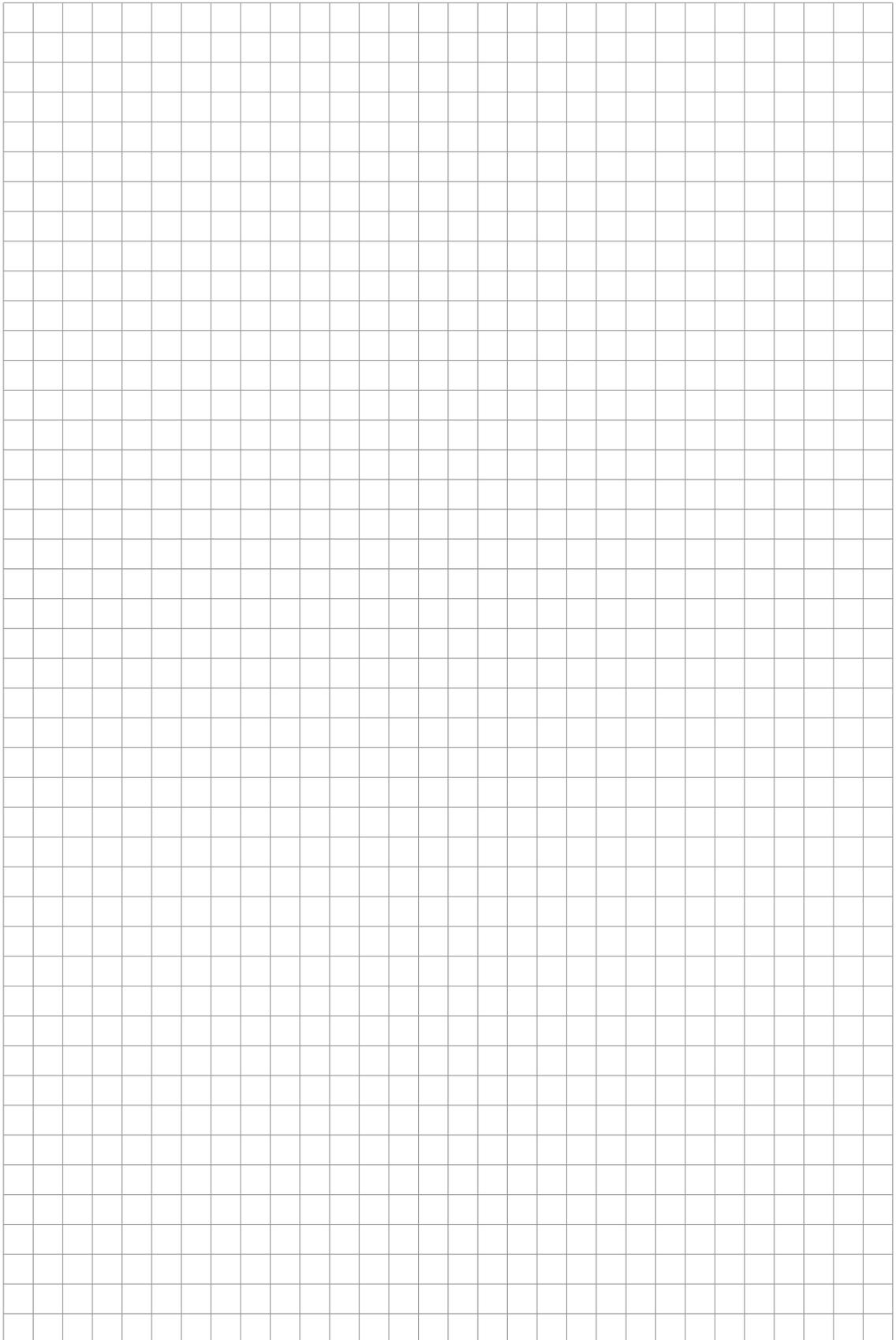
Figure 4-12: Cable gland

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 glands ② must be tightened. Note that the clamping range of the cable gland corresponds to the outer diameter of the cable.
- Align the measuring device so that the cable gland is never facing up ③ .
- Close any unused cable glands using blind plugs ④ suitable for the protection category.
- Do not remove the required cable bushing from the cable glands.







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