



MEMO

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Date: September 16, 2026

Project Name: Phase 1 of Rental Units in Village A Development

Project Number: RAE Project # 26052701

Re: Water Flow Meter Sizing and Selection (Revision 1)

RA Engineering Inc. (RAE) has been retained by PEC community Inc. (PEC) to conduct a water distribution analysis for the Base31 Full Build-Out development in Picton, Prince Edward County (County), Ontario. This revised technical memorandum (memo) is prepared to confirm the sizing and selection of a flowmeter to be installed in Phase 1 of Rental development. This memo shall be read in conjunction with the water modeling report prepared by RAE (26090101_RPT_PICTON_BASE 31 FULLBUILD-OUT_VER0).

Proposed Meter:

The County has suggested the following technical specifications for the proposed flowmeter and the signal converter. A 200mm flowmeter was suggested in the technical specifications. Relevant technical data are provided in **Appendix A**.

KROHNE WATERFLUX 3100W MAGNETIC FLOWMETER

"NO (ZERO) UPSTREAM / DOWNSTREAM STRAIGHT RUNS REQUIRED"

MODEL # VN46 4 EA0A40C162010000000000

- 200mm (8 inch) meter size
- 150 LB ANSI 304 Carbon Steel Flanged Connections
- Rilsan liner, Stainless Steel measuring electrodes
- IP 68 rated enclosure for Continuous Submergence w/ St. St. Termination Box: 30 Meters interconnect cables factory terminated and potted.
- NSF 61 approved for potable water

KROHNE IFC 100W REMOTED MOUNTED SIGNAL CONVERTER

MODEL VN31 4 NAA460010100003

- accuracy +/- 0.3 % of rate
- Backlit LCD display of Flow Rate / Totalizer & diagnostics
- 4 to 20 mA output / frequency / status output; Hart Protocol

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-
- Two totalizers; auto zero, empty pipe, low flow cutoff
 - 100 to 230 VAC supply voltage
 - NEMA 4X enclosure; 1/2" NPT electrical connections
 - CSA general purpose Special Inspection Approval

Flow Meter Sizing

Magnetic flowmeter type is proposed for this application. Generally, a minimum velocity of 1 m/s is to be maintained through the flowmeter for accurate readings with an ideal velocity of 4 to 6 m/s. A velocity of 2 to 3 m/s provides optimum accuracy when a head loss through the system becomes critical for the system operation.

Subsequent to the completion of the original water distribution analysis, additional developments identified as Villages B through H in Base31 were incorporated into the hydraulic model. As a result of the updated distribution system analysis, the required fire flow at the Phase 1 Rental development increased from approximately 150 L/s to 253 L/s. To accommodate this increased fire flow requirement, the proposed water service connection to Phase 1 Rental development has been increased from 200 mm to 250 mm.

The projected domestic water demands for the Phase 1 Rental development remain as follows:

- Average Daily Demand (ADD): 0.8 L/s.
- Maximum Daily Demand (MDD): 1.6 L/s
- Peak Hour Demand (PHD): 2.8 L/s
- Maximum Daily Demand plus Fire Flow: approximately 255 L/s

Three feasible meter sizes were assessed from a hydraulic and metering performance (accuracy) perspective:

250 mm Meter

The 250 mm flowmeter would match the size of the water service connection and would have no noticeable hydraulic impact to the downstream system. However, projected operating flows (ADD, MDD and PHD) correspond to very low velocities ranging from approximately 0.02 m/s to 0.06 m/s within a 250 mm meter. These low velocities may reduce measurement resolution and metering accuracy during normal operating conditions.

Under the governing MDD plus Fire Flow condition of approximately 255 L/s, the velocity through the 250 mm meter would be approximately 5.2 m/s, which is within the manufacturer's recommended operating range. A snip of the selected flow meter measurement accuracy against flow velocities is provided in **Figure 1** and further detailed in **Appendix A**.

200 mm Meter

A **200 mm (8-inch) meter** would provide relatively improved velocities under typical demand conditions (0.03 to 0.09 m/s velocity for the corresponding flow range of 0.8 to 2.8 L/s) while remaining within acceptable limits during the Maximum Daily Demand plus Fire Flow condition of approximately 255 L/s (8.1 m/s velocity). Hydraulic pressure loss through a one-size reduced (200 mm) flow meter and piping on the 250 mm watermain will be significantly low and negligible. Reduced meter sizing on watermains is very typical in municipal infrastructure.

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150 mm Meter

A 150 mm meter would provide better velocities during normal operating conditions compared to both the 250 mm and 200 mm alternatives. However, under the governing MDD plus Fire Flow condition of approximately 255 L/s, the resulting velocity through the meter would increase to approximately 14.4 m/s. This velocity exceeds the preferred operating range for the proposed flowmeter and would result in significantly greater pressure losses during fire flow events. Given the revised fire flow requirement, a 150 mm meter is no longer considered the optimal solution for this application.

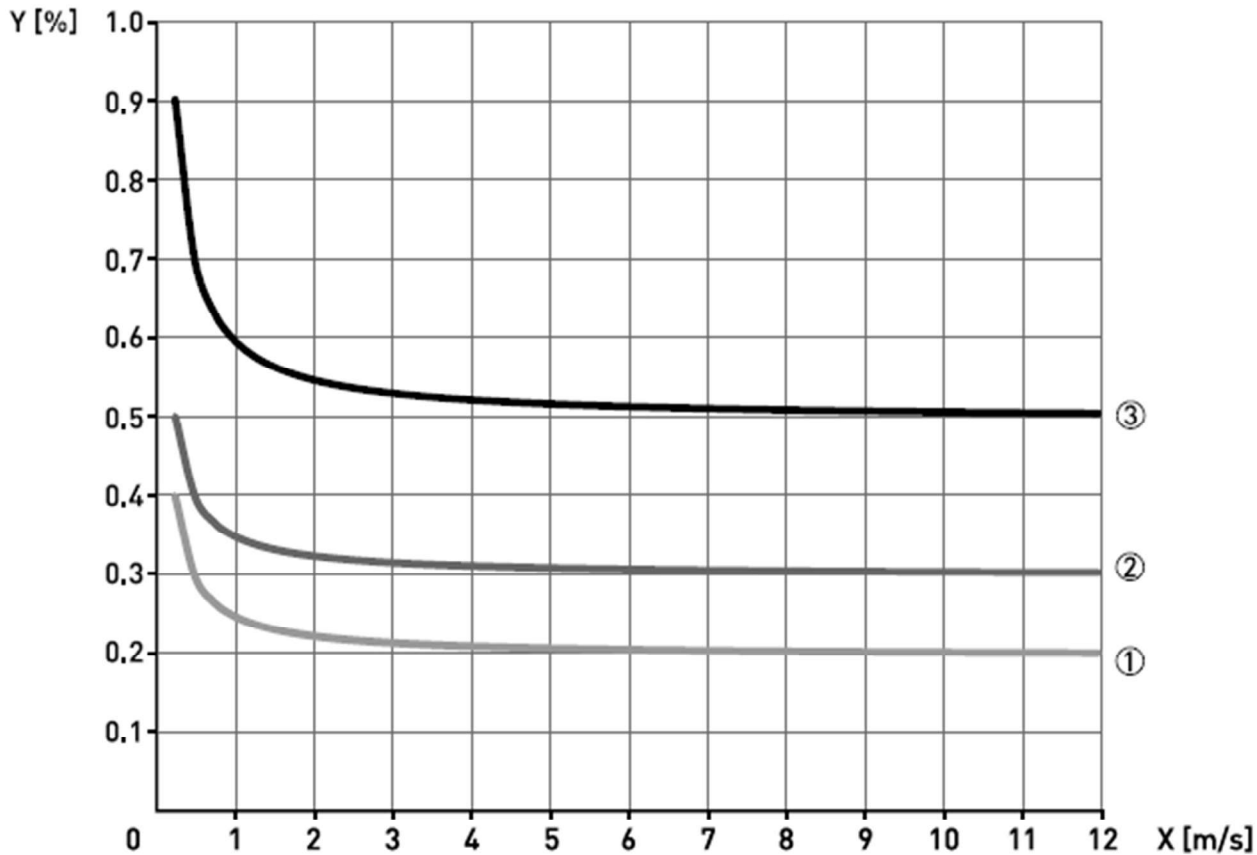
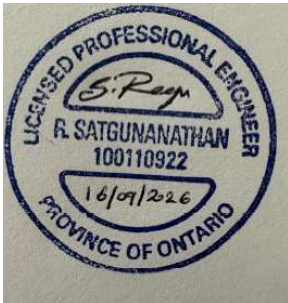


Figure 1: Flow Velocity Vs Accuracy Curve for the Selected Flowmeter (See Appendix A for Details)

Meter Sizing and Selection Recommendation:

The County's originally proposed **200 mm KROHNE WATERFLUX magnetic flowmeter** is **suitable** for the Phase 1 Rental development. Meter installation design shall meet the manufacturer's recommended parameters detailed in **Appendix A**.





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APPENDIX A

FLOW METER DATA SHEET



WATERFLUX 3000 Technical Datasheet

Electromagnetic flow sensor

- Easy installation without straight inlet or outlet lengths
- For installation in small spaces
- Wide range of approvals for potable water



The documentation is only complete when used in combination with the relevant documentation for the signal converter.

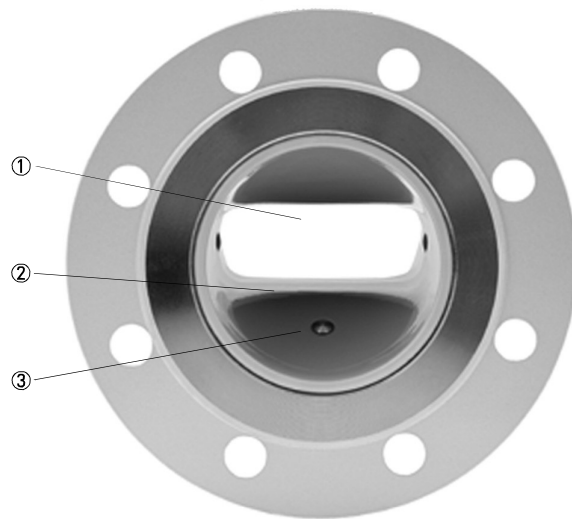
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1.1 The flow sensor with an unique rectangular design

The strengths of the **WATERFLUX 3000** sensor lies in its unique construction with a rectangular and reduced cross section and its efficient coil construction. The coils provide a stronger and more homogeneous magnetic field, leading to an improved signal to noise ratio. The measurement is therefore independent of the flow profile and measurements are very stable. This results in a very good low flow performance, with a minimal pressure drop and as such a minimal impact on the pressure strategy of the network.

Because of the unique **WATERFLUX 3000** flow sensor design, whereby the mean flow velocity and flow profile are optimized within the rectangular and reduced cross-section, the additional uncertainty for upstream disturbances is drastically reduced. The water meter can be installed directly behind an elbow or reducer in the pipe without a straight inlet or outlet lengths. A substantial reduction of the required inlet and outlet sections offers the option to reduce the size of the measurement pits.

The Rilsan® coating of the flow sensor is chemically resistant, durable and maintenance-free, flexible and tough, smooth and pore-free and free of solvents. The coating is widely used in the water industry and has received a wide range of drinking water certifications.



- ① Unique flow sensor design with rectangular cross section
- ② Rilsan® coating
- ③ Built-in reference electrode

Highlights

- Unique rectangular sensor construction results in good low flow performance and a large turndown ratio
- Large measuring range. High accuracy at peak as well as low flows
- Compliant with requirements for custody transfer (MID MI-001, ISO4064, EN 14154)
- Standard inhouse wet calibration
- Optional verification to MID Annex III (MI-001) for water meters (Module B and D)
- No inlet or outlet sections required when installed e.g. behind an elbow or reducer
- Bi-directional flow measurements
- Reference electrode. No grounding rings needed
- Suitable for subsoil installation and constant flooding (IP68).
- Special subsoil coating for subsurface installation
- Rilsan® polymer coating
- Drinking water approvals including ACS, DVGW, NSF, TZW and WRAS
- Long term reliability and maintenance free.
No moving parts, no wear and no obstruction in the flow
- Low pressure drop and minimal pressure impact on the network

Industries

- Water extraction
- Distribution networks
- District metering
- Revenue metering

Applications

- Measurement of potable water
- Measurement of raw water and irrigation water
- Outlet of water purification plants
- Monitoring of distribution networks
- Water consumption and billing

1.2 Options



Remote or compact version

The WATERFLUX 3050, 3100, 3300 or 3400 is available in a compact or remote (field) version. The remote version of the signal converter can be installed on a wall, a pipe or in a rack. The functionality of the compact and the remote version is identical.



Mains or battery powered

Where mains power is available, the WATERFLUX 3000 sensor can be combined with the IFC 050, IFC 100, IFC 300 and IFC 400 signal converter.

The WATERFLUX 3000 sensor can also be combined with the battery powered IFC 070 signal converter. For detailed information on the battery powered WATERFLUX 3070 please refer to the relevant documentation.



Maintenance free and buriable

The flow sensor (IP68) is suitable for submersion in flooded measurement chambers. With its robust construction it can also be buried underground. This can be a major cost saving as it eliminates the need for a measurement chamber. To protect the flow sensor a special coating is available. The remote version has an IP68 stainless steel connection box.

NiMi **EC type-examination Certificate**
 Number T18050 revision 1
 Project number 03684
 Page 1 of 1

Issued by NiMi Certis B.V.,
 designated and notified by the Netherlands to perform tasks with respect to
 conformity modules mentioned in article 9 of Directive 2004/22/EC, after
 having established that the Measuring instrument meets the applicable
 requirements of Directive 2004/22/EC, in:

Manufacturer Krohne Abwasser
 Korteplein 12
 3213 LC Oostwijk
 The Netherlands

Measuring instrument A water meter
 Type : WATERFLUX 3000 C
 WATERFLUX 3000 F + PC300a*
 Environment class : M1 / E2
 Temperature range liquid : +5 °C / +50 °C
 Temperature range ambient : +10 °C / +55 °C
 Measuring range : See § 1.2 of the description

Further properties are described in:
 - Description T18050 revision 1
 - Documentation Folder No. T18050-1, appertaining to this EC type-
 examination certificate and with respect to the PC300 converter the
 Documentation Folder belonging to Evaluation certificate
 number TCF181

Valid until 4 May 2021

Remarks This revision replaces the earlier version except for its documentation folder.
 * with a being F or W

Issuing Authority NiMi Certis B.V., Notified Body number 0122
 30 September 2011

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Custody transfer

In combination with the IFC 300 signal converter the WATERFLUX 3000 can be used for custody transfer applications. Optionally the WATERFLUX 3300 can be verified according to Annex III (MI-001) of the Measuring Instrument Directive (MID). All water meters for legal metrology purposes in Europe require certification under the MID.

1.3 Measuring principle

An electrically conductive fluid flows inside an electrically insulated pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils.

Inside of the fluid, a voltage U is generated:

$$U = v * k * B * D$$

in which:

v = mean flow velocity

k = factor correcting for geometry

B = magnetic field strength

D = inner diameter of flowmeter

The signal voltage U is picked off by electrodes and is proportional to the mean flow velocity v and thus the flow rate Q . A signal converter is used to amplify the signal voltage, filter it and convert it into signals for totalizing, recording and output processing.

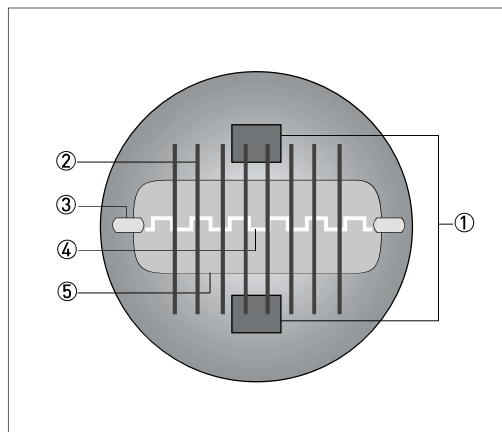


Figure 1-1: Measuring principle

- ① Field coils
- ② Magnetic field
- ③ Electrodes
- ④ Induced voltage (proportional to flow velocity)
- ⑤ Rectangular cross section

Rectangular cross section

The minimal height of the measuring tube decreases the distance between the field coils (1), resulting in a stronger and more homogeneous magnetic field (2). In addition, the mean flow velocity v increases due to the rectangular and reduced cross section. The large electrode spacing (D) and the increased flow velocity results in a higher magnetic signal voltage, also in the presence of a low flow rate.

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 (Downloadcenter).

Measuring system

Measuring principle	Faraday's law of induction
Application range	This electromagnetic flowmeter is designed exclusively to measure the flow of electrically conductive, liquid media.
Measured value	
Primary measured value	Flow velocity
Secondary measured value	Volume flow

Design

Features	Unique rectangular flow sensor design providing improved flow profile and signal to noise ratio resulting in highest accuracy and large turndown ratio
	Rilsan® polymer coated flow sensor approved for drinking water
	No internal or moving parts
	Built-in reference electrode
Modular construction	The measurement system consists of a flow sensor and a signal converter. It is available as compact and as separate version. More information about the signal converter can be found in the relevant documentation.
Compact version	With signal converter IFC 050: WATERFLUX 3050 C
	With signal converter IFC 100: WATERFLUX 3100 C
	With signal converter IFC 300: WATERFLUX 3300 C
	With signal converter IFC 400: WATERFLUX 3400 C
Remote version	In wall (W) mount version with IFC 050 signal converter: WATERFLUX 3050 W
	In wall (W) mount version with IFC 100 signal converter: WATERFLUX 3100 W
	In field (F), wall (W) or rack (R) mount version with signal converter IFC 300: WATERFLUX 3300 F, W or R
	In field (F), wall (W) or rack (R) mount version with signal converter IFC 400: WATERFLUX 3400 F, W or R
Nominal diameter	DN25...600 / 1...24": Rectangular bore

Measuring accuracy

Maximum measuring error	IFC 050: down to 0.5% of the measured value ± 1 mm/s
	IFC 100: down to 0.3% of the measured value ± 1 mm/s
	IFC 300: down to 0.2% of the measured value ± 1 mm/s
	IFC 400: down to 0.2% of the measured value ± 1 mm/s
	The maximum measuring error depends on the installation conditions.
	For detailed information refer to <i>Measurement accuracy</i> on page 16.
Repeatability	DN25...300 / 1...12": $\pm 0.1\%$ ($v > 0.5$ m/s / 1.5 ft/s) DN350...600 / 14...24": $\pm 0.2\%$ ($v > 0.5$ m/s / 1.5 ft/s)
Calibration / Verification	Standard:
	2 point calibration by a direct volume comparison.
	Option (for DN25...600):
	Verification to Measurement Instrument Directive (MID), Annex III. Standard: Verification at Ratio (Q3/Q1) = 80, Q3 ≥ 2 m/s / 6.6 ft/s Optional: Verification at Ratio (Q3/Q1) > 80
	Only in combination with the IFC 300 signal converter.
MID Annex III (MI-001) (Directive 2014/32/EU / UK Regulations 2016 No. 1153)	EC-Type examination certificate to MID Annex III
	Only in combination with the IFC 300 signal converter.
	Diameter range: DN25...600 / 1...24"
	Minimum straight inlet flow: 0 DN
	Minimum straight outlet flow: 0 DN
	Forward and reverse (bi-directional) flow
	Orientation: any
	Ratio (Q3/Q1) up to 640
	Liquid temperature range: + 0.1°C / 50°C
	Maximum operating pressure: $\leq$ DN200 / 8": 16 bar / 232 psi, $\geq$ DN250 / 10": 10 bar / 145 psi
	For detailed information refer to <i>Legal metrology</i> on page 13.

Operating conditions

Temperature	
Process temperature	-5...+70°C / +23...+158°F
Ambient temperature	Standard: DN25...200, remote or compact version with aluminium converter housing and with stainless steel flanges: -40...+65°C / -40...+149°F and compact version with stainless steel converter housing and with stainless steel flanges: -40...+55°C / -40...+130°F Standard: DN250...600, remote version with stainless steel converter housing and with carbon steel flanges: -20...+65°C / -4...+149°F and compact version with stainless steel converter housing and with carbon steel flanges: -20...+55°C / -4...+130°F Option: DN250...600 with low temperature carbon steel or stainless steel flanges: -40...+65°C / -40...+130°F
Protect electronics against self-heating at ambient temperatures above 55°C / 131°F	
Storage temperature	-50...+70°C / -58...+158°F
Measurement range	-12...+12 m/s / -40...+40 ft/s
Pressure	
Operating pressure	Up to 16 bar / 232 psi for DN25...200 / 1...12" Up to 10 bar / 150 psi for DN250...600 / 14...24"
Vacuum load	0 mbar / 0 psi absolute
Pressure loss	For detailed information refer to <i>Pressure loss</i> on page 22.
Chemical properties	
Physical condition	Electrically conductive liquids (For salt water please contact the factory).
Electrical conductivity	Standard measurement For detailed information refer to the relevant signal converter document.

Installation conditions

Installation	Assure that the flow sensor is always fully filled.
	For detailed information refer to <i>Installation</i> on page 23.
Flow direction	Forward and reverse
	Arrow on flow sensor indicates forward flow direction.
Straight inlet run	≥ 0 DN
	For detailed information refer to <i>Measurement accuracy</i> on page 16.
Straight outlet run	≥ 0 DN
	For detailed information refer to <i>Measurement accuracy</i> on page 16.
Dimensions and weights	For detailed information refer to <i>Dimensions and weights</i> on page 18.

Materials

Sensor housing	Sheet steel
Measuring tube	DN25...200 / 1...8": metallic alloy
	DN250...600 / 10...24": stainless steel
Flanges	DN250...600 / 10...24": steel 1.0460 / 1.0038 (RSt37-2) DN25...200 / 1...8": stainless steel 3.04 (optionally 3.16)
Liner	Rilsan®
Protective coating	On exterior of the meter: flanges, housing, signal converter (compact version) and/or connection box (field version)
	Standard: standard coating
	Option: subsoil or offshore coating
Connection box	Only for remote versions
	Standard: stainless steel
Measuring electrodes	Standard: stainless steel 1.4301 / AISI 304
	Option: Hastelloy® C
Reference electrode	Standard: stainless steel 1.4301 / AISI 304
	Option: Hastelloy® C
Grounding rings	Grounding rings can be omitted when the reference electrode is used.

Process connections

Flange	
EN 1092-1	Standard:
	DN25...200 / 1...8": PN 16
	DN250...600 / 10...24": PN 10
	Optional:
	DN250...600 / 10...24": PN 16 (DN350...600 / 14...24": 10 bar rated)
ASME	1"...12": 150 lb RF (232 psi / 16 bar rated) 14"...24": 150 lb (150 psi / 10 bar rated)
JIS	DN25...300 / 1"...12": 10 K DN350...600 / 14"...24": 7.5 K
AS 4087	DN25...600 / 1"...24": Class 16: on request (DN350...600 / 14"...24": 10 bar rated)
AS 2129	DN25...600 / 1"...24": Table D & E: on request (DN350...600 / 14"...24": 10 bar rated)
	For detailed information of nominal flange pressure and nominal diameter refer to <i>Dimensions and weights</i> on page 18.
Other connections	
Thread	DN25 / 1": G1" thread connection on request
	DN40 / 1 1/2": G1.5" & G2" thread connection on request
Other	Weld-on, clamp, oval flanges: on request

Electrical connections

	For detailed information refer to the documentation of the relevant signal converter.
Signal cable (remote versions only)	
Type A (DS)	In combination with the IFC 050, IFC 100, IFC 300 and the IFC 400 signal converter. Standard cable, double shielded. Max. length: 600 m / 1950 ft (depends on electrical conductivity and measuring sensor). For detailed information refer to the documentation of the relevant signal converter.
Type B (BTS)	Only in combination with the IFC 300 and IFC 400 signal converter. Optional cable, triple shielded. Max. length: 600 m / 1950 ft (depends on electrical conductivity and measuring sensor). For detailed information refer to the documentation of the relevant signal converter.
I/O	For full details of I/O options, including data streams and protocols, see technical datasheet of the relevant signal converter.

Approvals and certificates

CE	
This device fulfills the statutory requirements of the relevant directives. The manufacturer certifies successful testing of the product by applying the conformity mark on the device.	
	For more information on the directives, standards and the approved certifications, please refer to the declaration of conformity supplied with the device or downloadable from the manufacturer's website.
Custody transfer	Only in combination with the IFC 300 signal converter. Directive: 2014/32/EU / UK Regulations 2016 No. 1153 MID Annex III (MI-001) and MID Annex VI (MI-004) type examination certificate (DN25...600 / 1...24") Innerstaatliche Bauartzulassung als Kältezähler (For Germany, Switzerland and Austria)
Other approvals and standards	
Drinking water approvals	ACS, DVGW W270, NSF / ANSI / CAN Standard 61, TZW, KIWA (ATA), KTW, WRAS
Protection category acc. to IEC 60529	Standard:
	IP66/67, NEMA 4/4X/6
	Option:
	IP68 factory, NEMA 6P
	IP68 field, NEMA 6P
	IP68 is only available for separate design
Corrosion protection class acc. to ISO 12944-2	Standard: C3 medium
	Option: off-shore paint C5-I high - C5-M high
Shock test	IEC 60068-2-27
	30 g for 18 ms
Vibration test	IEC 60068-2-64
	f = 20...2000 Hz, rms = 4.5 g, t = 30 min

2.2 Legal metrology

*MID Annex III (MI-001) is **only** available in combination with the IFC 300 signal converter!*

2.2.1 MID Annex III (MI-001)

All new designs of water meters that are to be used for legal purposes in Europe require certification under the Measurement Instrument Directive (MID) 2014/32/EU / UK Regulations 2016 No. 1153. Annex III (MI-001) of the MID applies to water meters intended for the measurement of the volume of clean, cold or heated water in residential, commercial, and light industrial use. An EC-type examination certificate is valid in all countries of the European Union.

The WATERFLUX 3300 has a type examination certificate and can be verified to the MID Annex III (MI-001) for water meters with diameter DN25...DN600. The conformity assessment procedure followed for the WATERFLUX 3300 is Module B (Type Examination) and Module D (Quality Assurance of the Production Process).

The maximum permissible error on volumes delivered between Q2 (transitional) flow rate and Q4 (overload) flow rate is $\pm 2\%$.

The maximum permissible error on volumes delivered between Q1 (minimum) flow rate and Q2 (transitional) flow rate is $\pm 5\%$.

$$Q_1 = Q_3 / R$$

$$Q_2 = Q_1 * 1.6$$

$$Q_3 = Q_1 * R$$

$$Q_4 = Q_3 * 1.25$$

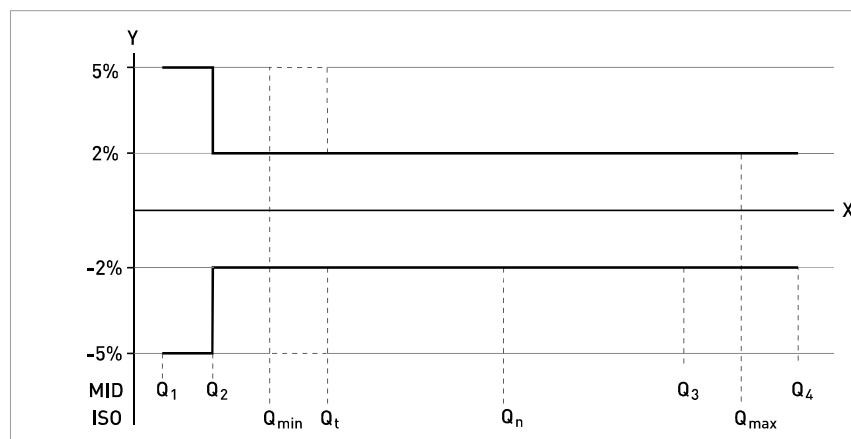


Figure 2-1: ISO flow rates added to figure as comparison towards MID

X: Flow rate

Y [%]: Maximum measuring error

MI-001 certified flow characteristics

DN	Span (R) Q3 / Q1	Flow rate [m ³ /h]			
		Minimum Q1	Transitional Q2	Permanent Q3	Overload Q4
25	640	0.025	0.040	16	20.0
40	640	0.0625	0.100	40	50.0
50	630	0.100	0.160	63	78.75
65	635	0.1575	0.252	100	125.0
80	640	0.25	0.400	160	200.0
100	625	0.40	0.640	250	312.5
125	640	0.625	1.00	400	500.0
150	630	1.00	1.60	630	787.5
200	508	1.575	2.52	630	787.5
250	400	2.50	4.00	1000	1250
300	400	4.00	6.40	1600	2000
350	160	15.625	25.0	2500	3125
400	160	25.00	40.0	4000	5000
450	160	25.00	40.0	4000	5000
500	160	39.375	63.0	6300	7875
600	100	63.00	100.8	6300	7875

2.2.2 Verification to MI-001

Verification to MI-001, standard at the following values for R, Q1, Q2 and Q3.
Verification at other values for R and Q3 available on request.

Verification to MID Annex III (MI-001)

DN	Span (R)	Flow rate [m ³ /h]		
		Q1	Q2	Q3
25	80	0.050	0.08	4
40	80	0.125	0.20	10
50	80	0.200	0.32	16
65	80	0.313	0.50	25
80	80	0.500	0.80	40
100	80	0.788	1.26	63
125	80	1.250	2.00	100
150	80	2.000	3.20	160
200	80	3.125	5.00	250
250	80	5.000	8.00	400
300	80	7.875	12.60	630
350	80	20.00	32.0	1600
400	80	31.25	50.0	2500
450	80	31.25	50.0	2500
500	80	50.00	80.0	4000
600	80	78.75	126	6300

2.3 Measurement accuracy

Every electromagnetic flowmeter is calibrated by direct volume comparison. The wet calibration validates the performance of the flowmeter under reference conditions against accuracy limits.

The accuracy limits of electromagnetic flowmeters are typically the result of the combined effect of linearity, zero point stability and calibration uncertainty.

Reference conditions

- Medium: water
- Temperature: +5...+35°C / +41...+95°F
- Operating pressure: 0.1...5 barg / 1.5...72.5 psig
- Inlet section: ≥ 3 DN
- Outlet section: ≥ 1 DN

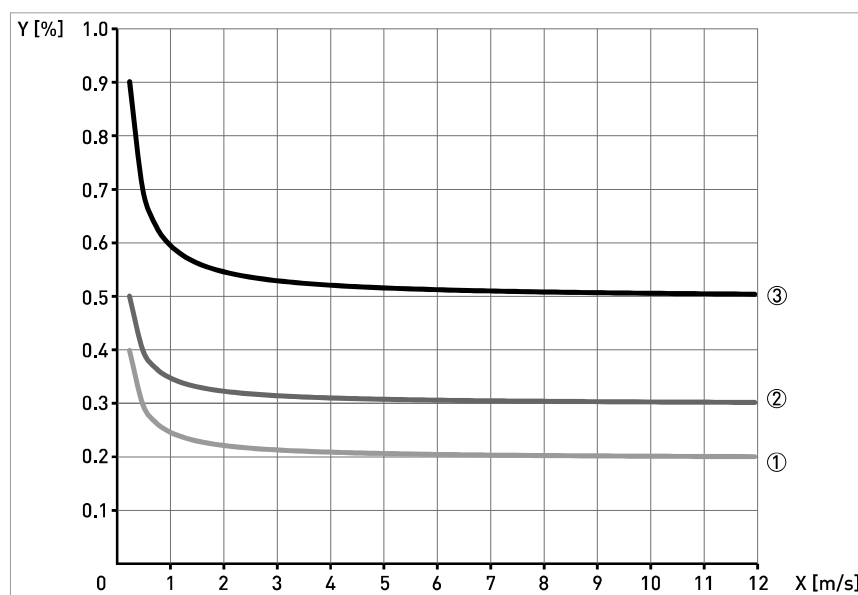


Figure 2-2: Flow velocity vs. accuracy

X [m/s]: flow velocity

Y [%]: deviation from the actual measured value

Converter type	Accuracy	Curve
IFC 050	0.5% of mv +1 mm/s	③
IFC 100	0.3% of mv +1 mm/s	②
IFC 300	0.2% of mv +1 mm/s	①
IFC 400	0.2% of mv +1 mm/s	①

2.3.1 WATERFLUX 3050, 3100 and 3300 without straight inlet and outlet sections

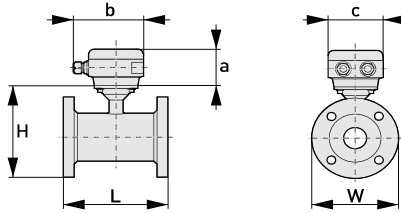
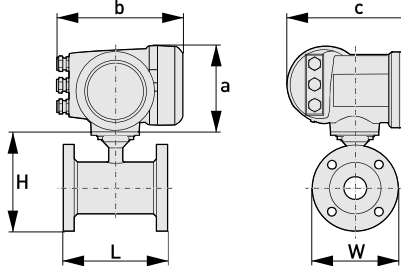
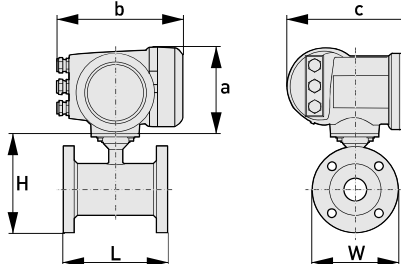
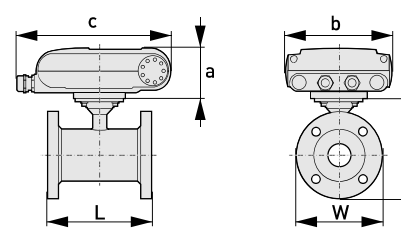
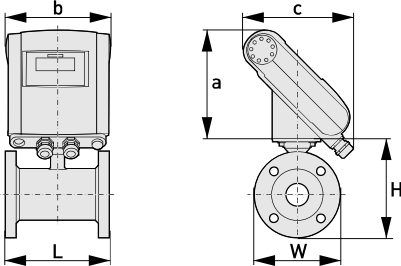
Disturbed flow profiles, such as those that occur behind elbows, tee pieces, reducers or valves installed in front of a flowmeter, affect the measuring performance. Therefore it is usually recommended to fit a straight inlet length in front of and straight outlet length behind a flowmeter.

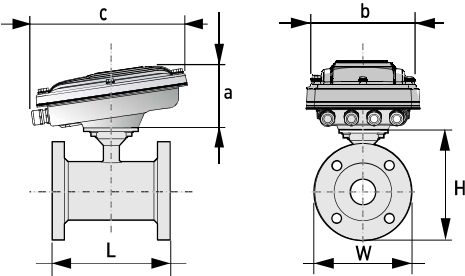
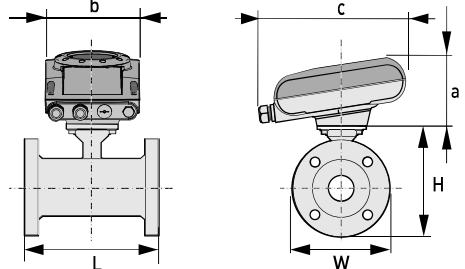
As a result of the unique WATERFLUX 3000 flow sensor design, whereby the mean flow velocity and flow profile are optimized within the rectangular and reduced cross section, the additional uncertainty for upstream disturbances are drastically reduced. Therefore the requirements for straight length and in front of and behind a meter are reduced.

Type certificate according MID Annex III (MI-001)

- In combination with the signal converter IFC 300
- Diameter range DN25...600 / 1...24"
- Minimum straight inlet and outlet pipe length of 0 DN
- Bi-directional flow

2.4 Dimensions and weights

Remote version		a = 88 mm / 3.5" b = 139 mm / 5.5" ① c = 106 mm / 4.2" Total height = H + a
Compact version with: IFC 300		a = 155 mm / 6.1" b = 230 mm / 9.1" ① c = 260 mm / 10.2" Total height = H + a
Compact version with: IFC 400		a = 160 mm / 6.3" b = 240 mm / 9.5" ① c = 260 mm / 10.2" Total height = H + a
Compact version with: IFC 100 (0°)		a = 82 mm / 3.2" b = 161 mm / 6.3" c = 257 mm / 10.1" ① Total height = H + a
Compact version with: IFC 100 (45°)		a = 186 mm / 7.3" b = 161 mm / 6.3" c = 184 mm / 7.3" ① Total height = H + a

Compact version with: stainless steel IFC 100 (10°)		a = 100 mm / 4" b = 187 mm / 7.36" ① c = 270 mm / 10.63" Total height = H + a
Compact version with: IFC 050 (10°)		a = 101 mm / 3.98" b = 157 mm / 6.18" c = 260 mm / 10.24" ① Total height = H + a

① The value may vary depending on the used cable glands.

- All data given in the following tables are based on standard versions of the flow sensor only.
- Especially for smaller nominal sizes of the flow sensor, the signal converter can be bigger than the flow sensor.
- Note that for other pressure ratings than mentioned, the dimensions may be different.
- For full information on signal converter dimensions see relevant documentation.

EN 1092-1

Nominal size DN [mm]	Dimensions [mm]			Approx. weight [kg]
	L	H	W	
25	150	151	115	5
40	150	166	150	6
50	200	186	165	13
65	200	200	185	11
80	200	209	200	17
100	250	237	220	17
125	250	266	250	21
150	300	300	285	29
200	350	361	340	36
250	400	408	395	50
300	500	458	445	60
350	500	510	505	85
400	600	568	565	110
450	600	618	615	125
500	600	671	670	120
600	600	781	780	180

ASME B16.5 / 150 lb

Nominal size [inch]	Dimensions [inch]			Approx. weight [lb]
	L	H	W	
1	5.91	5.83	4.3	18
1 1/2	5.91	6	4.9	21
2	7.87	7.05	5.9	34
3	7.87	8.03	7.5	42
4	9.84	9.49	9.0	56
5	9.84	10.55	10.0	65
6	11.81	11.69	11.0	80
8	13.78	14.25	13.5	100
10	15.75	16.3	16.0	148
12	19.7	18.8	19.0	210
14	27.6	20.7	21	290
16	31.5	22.9	23.5	370
18	31.5	24.7	25	420
20	31.5	27	27.5	500
24	31.5	31.4	32	680

2.5 Pressure loss

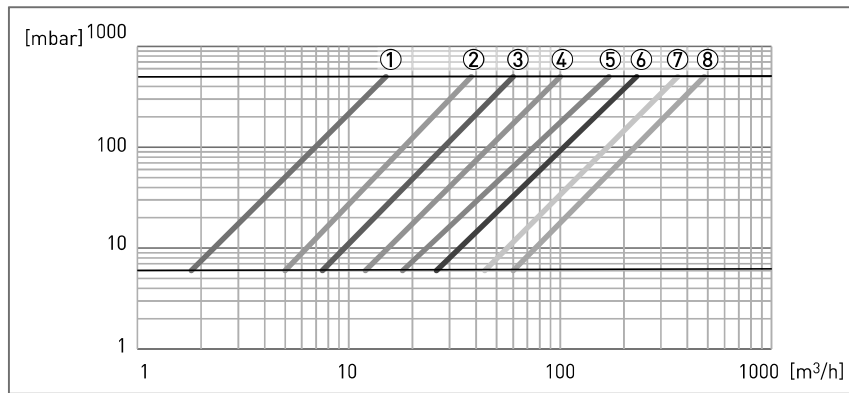


Figure 2-3: Pressure loss between 1...9 m/s / 3.3...30 ft/s for DN25...150 / 1...6"

- ① DN25 / 1"
- ② DN40 / 1 1/2"
- ③ DN50 / 2"
- ④ DN65 / 2 1/2"
- ⑤ DN80 / 3"
- ⑥ DN100 / 4"
- ⑦ DN125 / 5"
- ⑧ DN150 / 6"

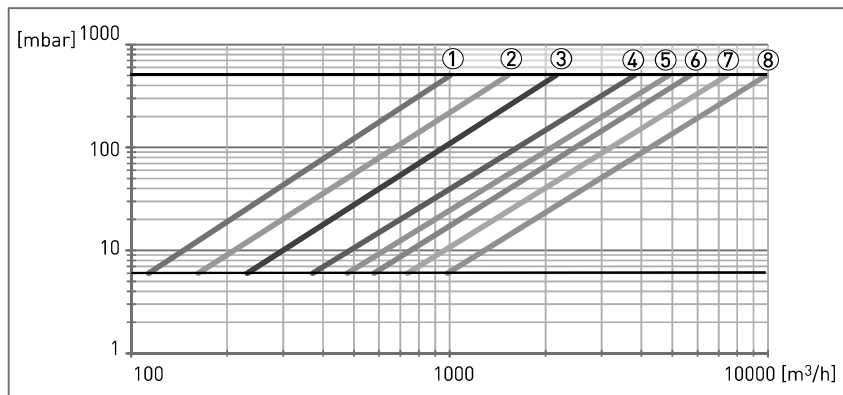


Figure 2-4: Pressure loss between 1...9 m/s / 3.3...30 ft/s for DN200...600 / 8...24"

- ① DN200 / 8"
- ② DN250 / 10"
- ③ DN300 / 12"
- ④ DN350 / 14"
- ⑤ DN400 / 16"
- ⑥ DN450 / 18"
- ⑦ DN500 / 20"
- ⑧ DN600 / 24"

3.1 General notes on installation

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

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

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.

3.2 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.

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

This electromagnetic flowmeter is designed exclusively to measure the flow of drinking water, raw water and irrigation water.

If the device is not used according to the operating conditions (refer to chapter Technical data), the intended protection could be affected.

3.3 Pre-installation requirements

Make sure that you have all necessary tools available:

- Allen key (4 mm)
- Small screwdriver
- Wrench for cable glands (remote version only)
- Wrench for wall mounting bracket (remote version only)
- Torque wrench for installing flowmeter in pipeline

3.4 General requirements

The following precautions must be taken to ensure reliable installation.

- *Make sure that there is adequate space to the sides.*
- *Protect the signal converter from direct sunlight and install a sun shade if necessary.*
- *Signal converters installed in control cabinets require adequate cooling, e.g. by fan or heat exchanger.*
- *Do not expose the signal converter to intense vibrations and mechanical shocks. The measuring devices are tested for a vibration/shock level as described in the chapter "Technical data".*
- *Avoid magnetic field! Keep at least 5 DN distance between electromagnetic flow sensors.*

3.4.1 Vibrations

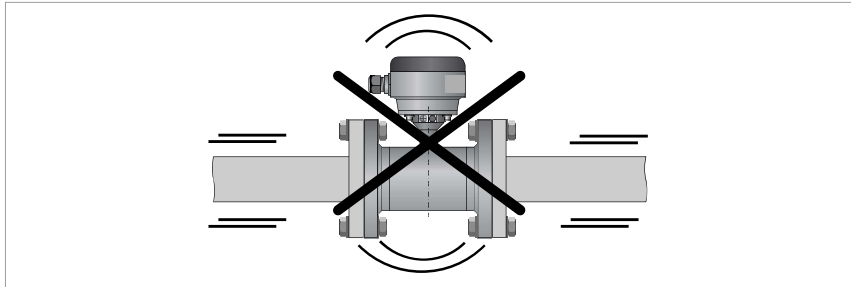


Figure 3-1: Avoid vibrations

3.4.2 Magnetic field

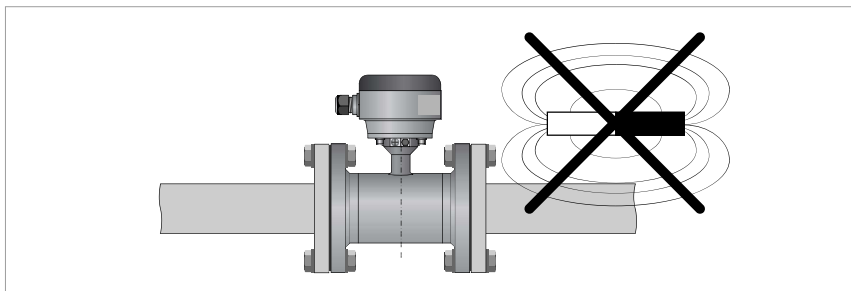


Figure 3-2: Avoid magnetic field

Keep at least 5 DN distance between electromagnetic flow sensors.

3.5 Installation conditions

For the highest measuring accuracy, respect the recommended inlet and outlet lengths in the following paragraphs. The flow sensor in combination with the IFC 300 signal converter, can be installed in a 0D/0D configuration (no inlet and no outlet length).

To prevent damage to the Rilsan® coating, the WATERFLUX 3000 flow sensor must be installed carefully. Take precautions during transport and installation to protect the in- and outlet of the flow sensor.

3.5.1 Inlet and outlet section

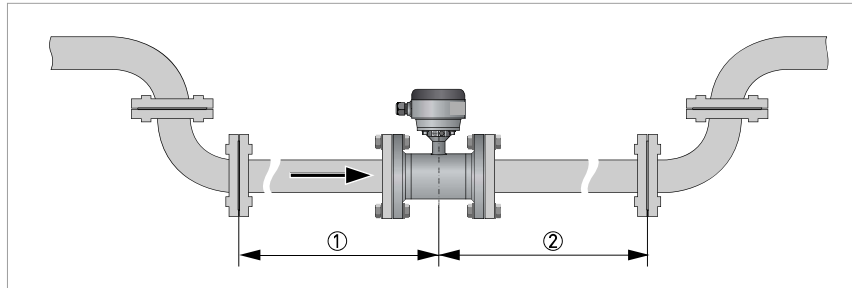


Figure 3-3: Minimal inlet and outlet section

- ① Inlet section: ≥ 0 DN
- ② Outlet section: ≥ 0 DN

3.5.2 T-section

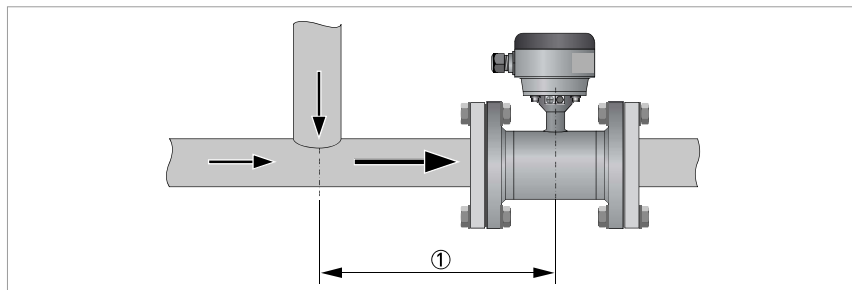


Figure 3-4: Distance behind a T-section

- ① ≥ 0 DN

3.5.3 Open discharge

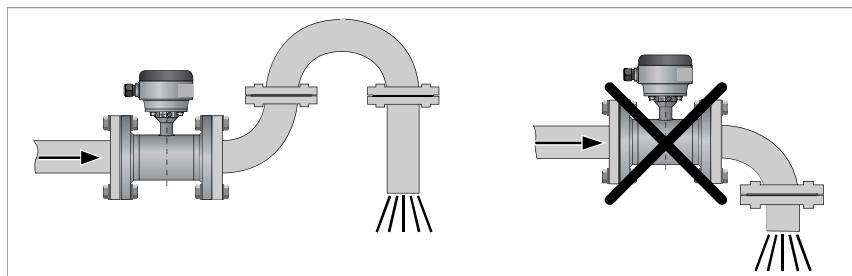


Figure 3-5: Installation in front of an open discharge

3.5.4 Bends

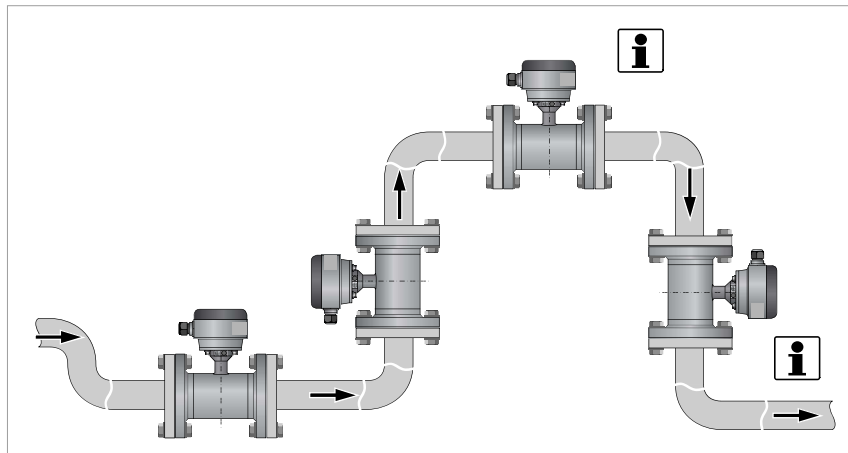


Figure 3-6: Installation in bending pipes (90°)

NOTE!

Recommended installation positions are at a lowered or ascending section of the pipeline installation. Installation at the highest point will enlarge the risk of flowmeter malfunction, because of air/gas bubbles.

Vertical installation in combination with an open discharge has to be avoided.

Vertical installation with a controlled back-pressure is possible.

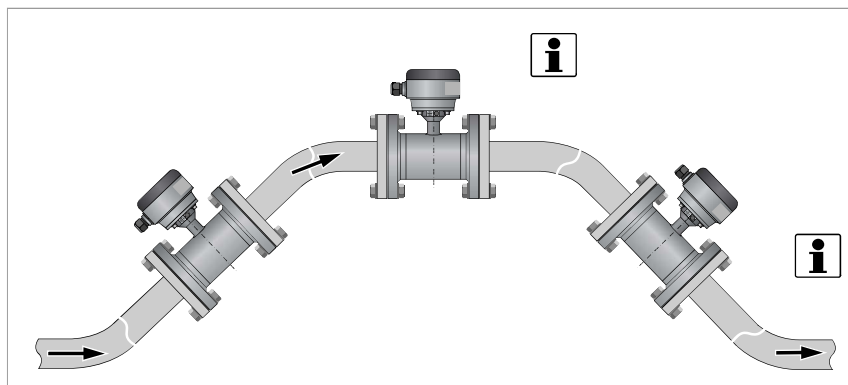


Figure 3-7: Installation in bending pipes (45°)

Avoid draining or partial filling of the flow sensor.

NOTE!

Vertical installation on a descending slope in the pipeline is only recommended when the back-pressure is controlled.

3.5.5 Pump

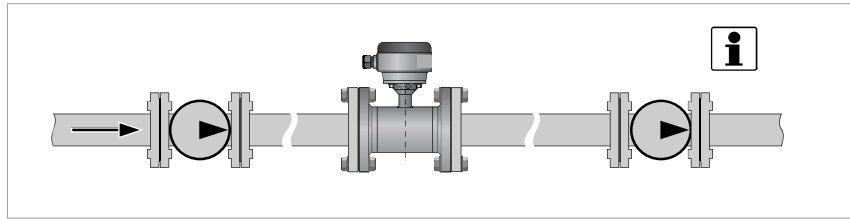


Figure 3-8: Installation behind a pump

NOTE!

Recommended position to install a flowmeter is downstream a pump (on a position where the flow disturbances of the pump are resolved).

An electromagnetic flowmeter can be installed in the suction line of a pump if there is no cavitation in the pipeline system.

3.5.6 Control valve

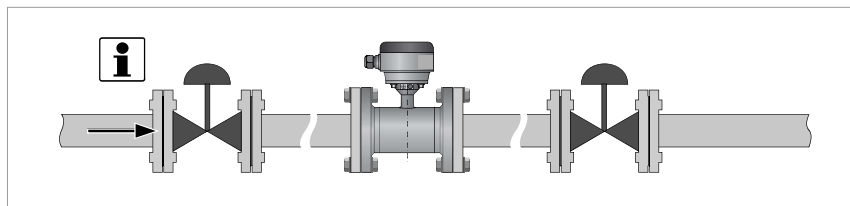


Figure 3-9: Installation in front of a control valve

NOTE!

Recommended position to install a flowmeter is upstream a control valve.

An electromagnetic flowmeter can be installed downstream of the control valve if there is no cavitation in the pipeline system (e.g. flow profile disturbances are resolved).

3.5.7 Air venting and vacuum forces

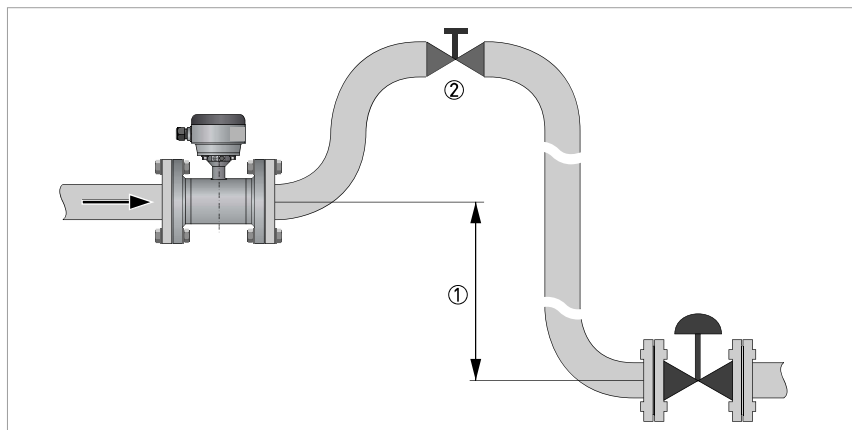


Figure 3-10: Air venting

- ① $\geq 5 \text{ m} / 17 \text{ ft}$
② Air ventilation point

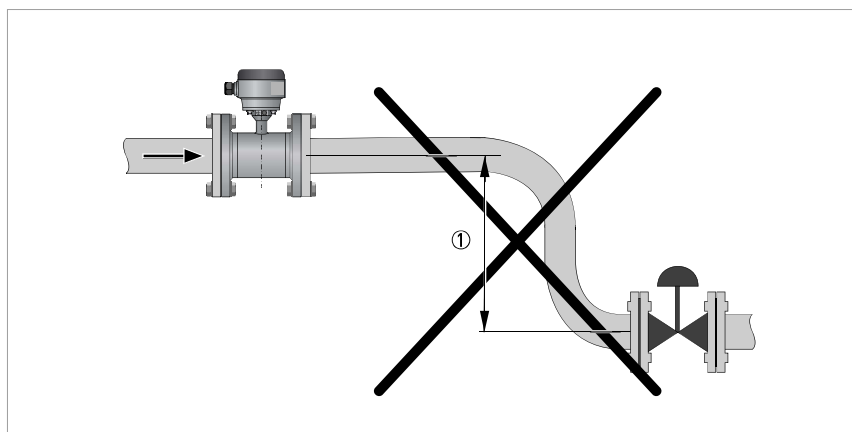


Figure 3-11: Vacuum

- ① $\geq 5 \text{ m} / 17 \text{ ft}$

3.5.8 Flange deviation

Max. permissible deviation of pipe flange faces:

$$L_{max} - L_{min} \leq 0.5 \text{ mm} / 0.02''$$

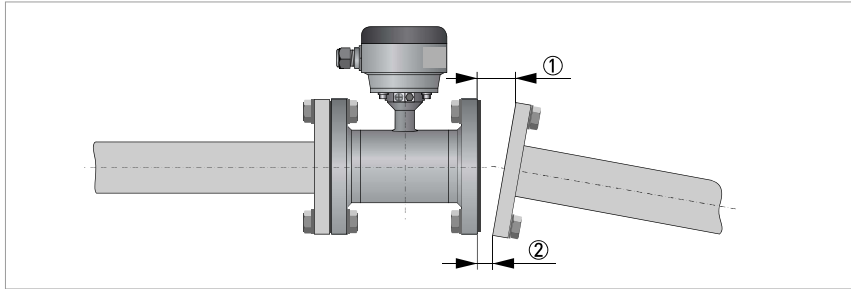


Figure 3-12: Flange deviation

- ① L_{max}
- ② L_{min}

3.5.9 Mounting position

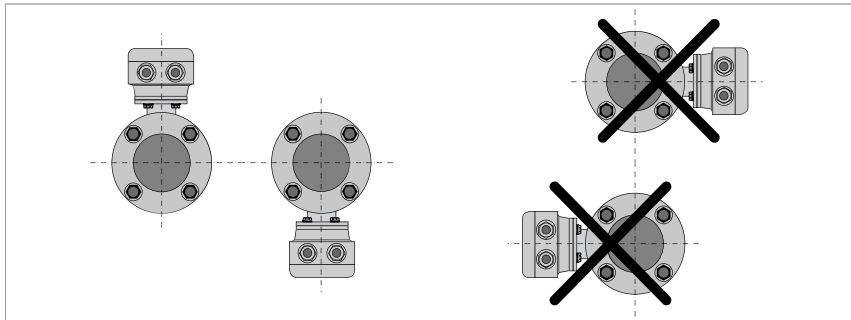


Figure 3-13: Mounting position

- Install the flow sensor with the signal converter aligned upwards or downwards.
- Install the flow sensor in line with the pipe axis.
- Pipe flange faces must be parallel to each other.

3.5.10 Installation in a metering pit and subsurface applications

The WATERFLUX 3000 flow sensor is rated IP68, NEMA 6P and is suitable for continuous submersion in flooded measurement chambers. The flow sensor can withstand a 10 meter water column and can be installed (buried) underground also (optional coating for subsurface application).

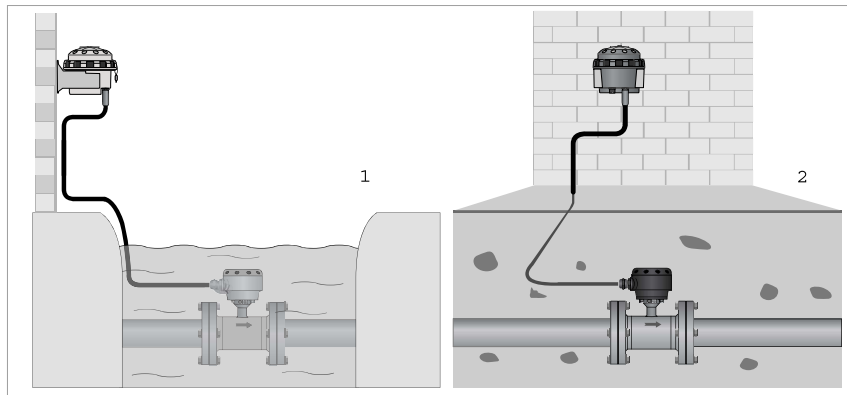


Figure 3-14: Examples of flooded and buried application

- ① Submersible
- ② Buried

The remote version of the IFC 050, IFC 100, IFC 300 and IFC 400 signal converters are IP66/67, NEMA 4/4X rated and can be installed in a dry area on the wall of the measuring pit for visual read out of the display.

Submersion applications

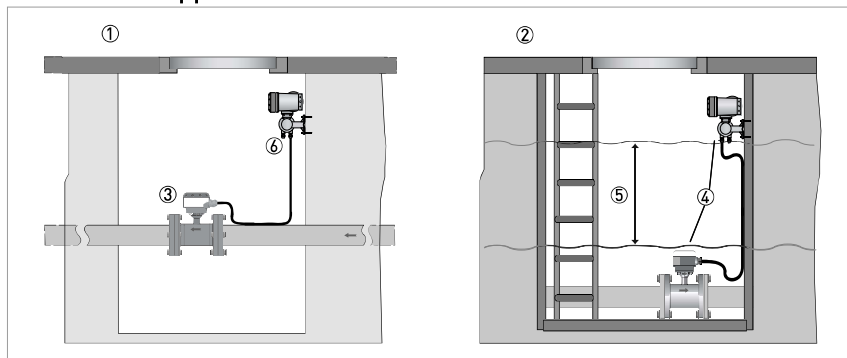


Figure 3-15: Examples of installation in measuring pit

- ① Periodic submersion
- ② Continuous submersion
- ③ Sensor (remote)
- ④ Remote version
- ⑤ Maximum water column 10 meter / 33 ft
- ⑥ Signal converter (remote)

3.6 Mounting

3.6.1 Torques and pressures

The maximum pressure and torque values for the flowmeter are theoretical and calculated for optimum conditions and use with carbon steel flanges.

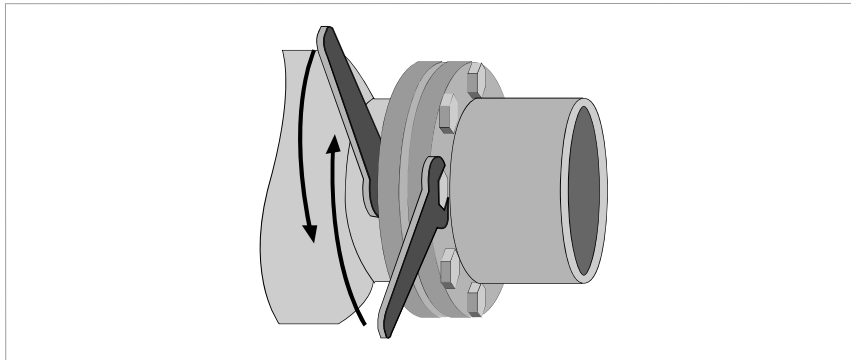


Figure 3-16: Tightening of bolts

Tightening of bolts

- Always tighten the bolts uniformly and in diagonally opposite sequence.
- Do not exceed the maximum torque value.
- Step 1: Apply approx. 50% of max. torque given in table.
- Step 2: Apply approx. 80% of max. torque given in table.
- Step 3: Apply 100% of max. torque given in table.

Nominal size DN [mm]	Pressure rating	Bolts	Max. torque [Nm] ^①
25	PN 16	4 x M 12	12
40	PN 16	4 x M 16	30
50	PN 16	4 x M 16	36
65	PN 16	8 x M 16	50
80	PN 16	8 x M 16	30
100	PN 16	8 x M 16	32
125	PN 16	8 x M 16	40
150	PN 10	8 x M 20	55
150	PN 16	8 x M 20	55
200	PN 10	8 x M 20	85
200	PN 16 ^②	12 x M 20	57
250	PN 10	12 x M 20	80
250	PN 16 ^②	12 x M 24	100
300	PN 10	12 x M 20	95
300	PN 16 ^②	12 x M 24	136
350	PN 10	16 x M 20	96
400	PN 10	16 x M 24	130
450	PN 10	20 x M 24	116
500	PN 10	20 x M 24	134
600	PN 10	20 x M 27	173

① The torque values also depend on variables (temperature, bolt material, gasket material, lubricants, etc.) outside the control of the manufacturer. Therefore these values should be regarded as indicative only.

② No full rating (max. 10 bar)

Nominal size [inch]	Flange class [lb]	Bolts	Max. torque [lbs.ft] ^①
1	150	4 x 1/2"	4
1 1/2	150	4 x 1/2"	11
2	150	4 x 5/8"	18
2 1/2	150	8 x 5/8"	27
3	150	4 x 5/8"	33
4	150	8 x 5/8"	22
5	150	8 x 3/4"	33
6	150	8 x 3/4"	48
8	150	8 x 3/4"	66
10	150	12 x 7/8"	74
12	150	12 x 7/8"	106
14	150 ②	12 x 1"	87
16	150 ②	16 x 1"	84
18	150 ②	16 x 1 1/8"	131
20	150 ②	20 x 1 1/8"	118
24	150 ②	20 x 1 1/4"	166

① The torque values also depend on variables (temperature, bolt material, gasket material, lubricants, etc.) outside the control of the manufacturer. Therefore these values should be regarded as indicative only.

② No full rating (max. 150 psi / 10 bar).

4.1 Safety instructions

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

Observe the national regulations for electrical installations!

*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.*

*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 Grounding

*The device must be grounded in accordance with regulations in order to protect personnel
against electric shocks.*

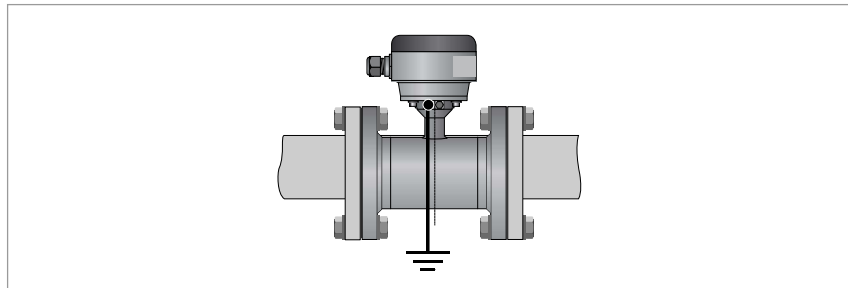
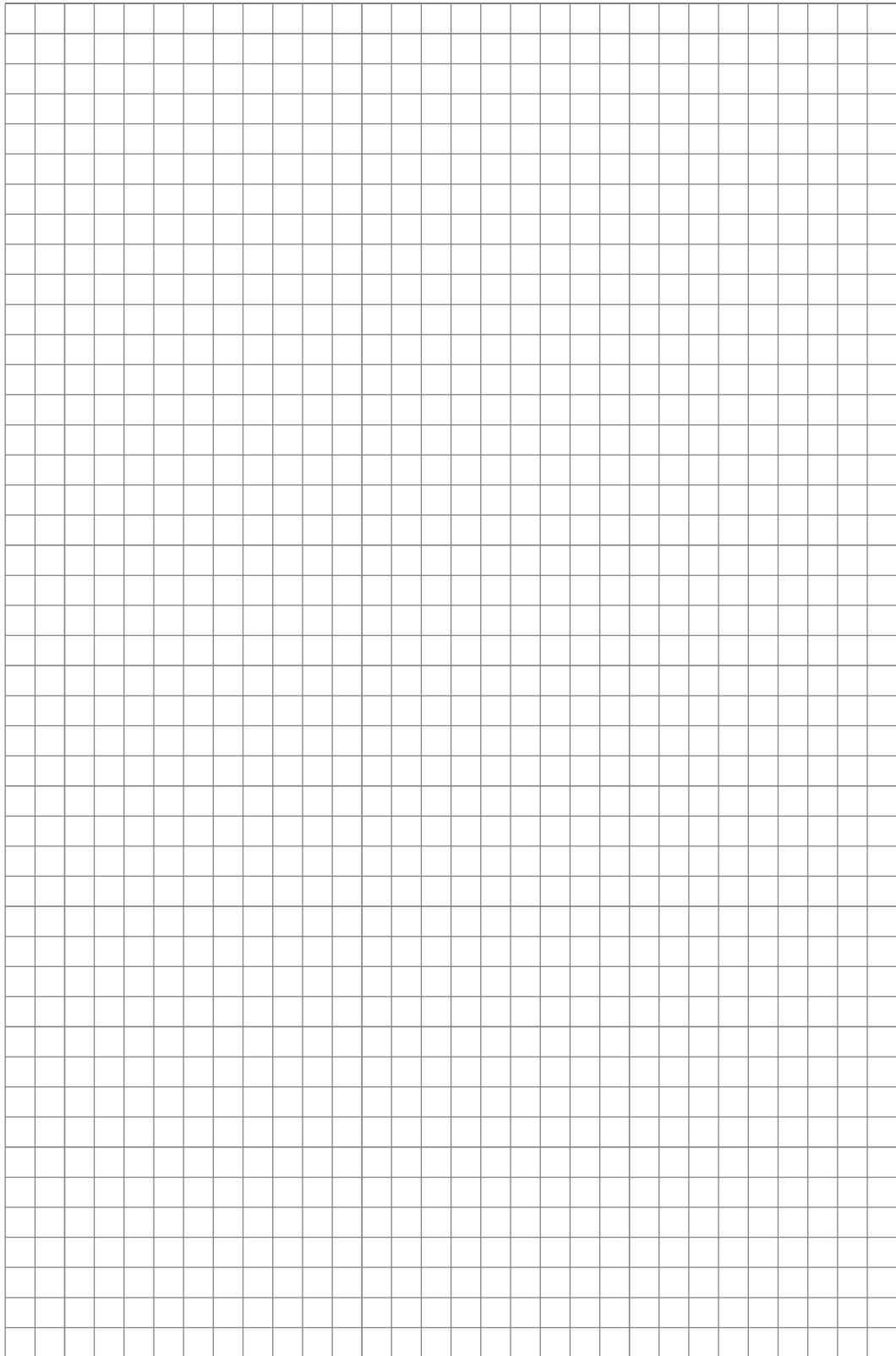


Figure 4-1: Grounding

Grounding without grounding rings. The flow sensor is equipped with a reference electrode.

4.3 Connection diagrams

*For the connection diagrams and more information on the connection of the flow sensor, please
refer to the documentation of the applicable signal converter.*



KROHNE – Products, Solutions and Services

- Process instrumentation for flow, level, temperature, pressure measurement and process analytics
- Flow metering, monitoring, wireless and remote metering solutions
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www.krohne.com

KROHNE



IFC 100 Technical Datasheet

Signal converter for electromagnetic flowmeters

- Extended accuracy option
- Diagnostics of device and application
- Certified for use in hazardous areas



The documentation is only complete when used in combination with the relevant documentation for the flow sensor.

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1.1 The all-round solution

The **IFC 100** electromagnetic signal converter combines an attractive price with a wide range of features and benefits including an excellent measuring accuracy.

The signal converter is compatible with almost any flow sensor in the OPTIFLUX and WATERFLUX range.

The signal converter supplies the current required by two field coils to generate a magnetic field. It converts the flow proportional signal voltage into digital values and filters out electrical noise and interference signals. From the filtered signal, the flow velocity, the volume flow and the mass flow are calculated.

The **IFC 100** signal converter provides a large variety of flowmeter and process diagnostic functions guaranteeing reliable measurements. Detection of deposits or coating on the electrodes, temperature and conductivity changes in the medium, gas bubbles or solids, and an empty pipe are good examples of process diagnostics functions.

The flow velocity and volume can be read from the display or in analogue form via the current output (4...20 mA) as well as by frequency, pulse and status outputs. Measuring values and diagnostic information can be transmitted via the HART® interface.



(signal converter in wall-mounted aluminium housing)

- ① Large graphic display with backlit
- ② Push buttons (4) for operator control without opening the housing
- ③ Intuitive navigation and quick menu setup

Highlights

- For operation with a wide range of OPTIFLUX and WATERFLUX flow sensors
- For flow sensors over a diameter range from DN2.5 up to DN1200
- Housing in aluminium with a polyester topcoat or in stainless steel (option)
- Tropicalized electronics to protect it from humidity (option)
- Available outputs: 4...20 mA current output, pulse/frequency output and status output/limit switch
- Control input option
- HART® as standard
- Power supply via 100...230 VAC (standard) or 24 VDC or 24 VAC/DC (optional)
- Clearly readable values due to angle of the signal converter housing which prevents dirt and dust on the display
- Extended calibration option for higher measuring accuracy down to 0.2% of the measuring value
- Excellent price/performance ratio

Industries

- Machinery
- Water & Wastewater
- HVAC, energy management
- Chemical
- Food and Beverages
- Metals and Mining

Applications

- Flow in electrically conductive mediums with a minimum conductivity of 5 $\mu\text{S}/\text{cm}$
- Water flow measurements in a wide range of industries
- Water based chemicals
- Sludge and slurries
- Sanitary applications and (HoCIP, SIP) liquid food & beverages

1.2 Options and variants

Compact or remote wall-mounted housing



(signal converter in wall-mounted aluminium housing)

For an optimal reading of the display, the compact variant comes in a 0° and a 45° version.

The signal converter can be rotated in 90° increments to suit different installation positions.

The compact 0° version is designed for flowmeters in vertical pipelines, the compact 45° version for horizontal installations.

The wall mounted signal converter can be installed remotely for locations where the flow sensor is difficult to access, or ambient temperature conditions or vibrations prevent a compact variant.

Variant for use in hazardous areas



(Compact version as 0° version)

The IFC 100 signal converter is available in a variant suitable for hazardous areas with approvals to ATEX, IECEx, FM, CSA and NEPSI.

Stainless steel housing (option)



(signal converter in wall-mounted stainless steel housing)

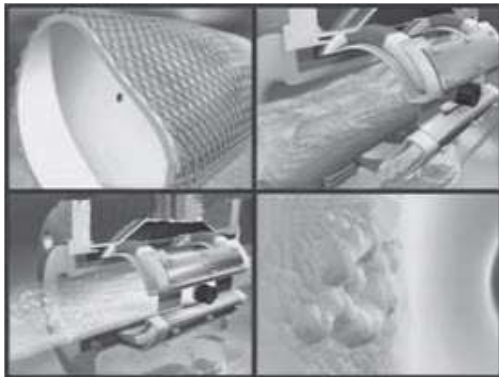
Whereas the standard housing material is aluminium with a polyester topcoat, the **IFC 100** can optionally be ordered in a stainless steel housing.

The robust housing is suitable for many applications in the food and beverage industry. It is designed for environments where extreme chemicals or aggressive cleaning are used.

The housing is dual rated to IP67/69 protection category to resist wash down cleaning and no glass is used for the display window.

The mounting angle for the compact housing and the rounded edges in the wall-mount position prevent dirt and water from building up on the surface.

Diagnostics of device and application



The primary focus of a user for a flowmeter is that it delivers reliable measurements. To achieve this all our electromagnetic flowmeters are calibrated before leaving the factory.

In addition, the **IFC 100** provides a range of diagnostic functions on the flow sensor, signal converter and process, integrated in the signal converter.

Potential problems including gas bubbles, solids, electrode corrosion, deposits on electrodes, conductivity changes, empty pipe can be detected by the diagnostics features.

OPTICHECK tool for on-site verification



(Suitcase with OPTICHECK and all cables and accessories)

The OPTICHECK provides an inline health check of the device under test by an external tool. When the tool is connected on site, it gathers measuring data to ensure that the flowmeter performs within 1% of its factory calibration.

The baseline can be historic repair data from the factory or on-site test results after performing a full verification.

A hard copy of the verification report can be printed for every flowmeter. The verification data are digitally stored.

Contact us for more information or for an on-site service visit.

1.3 Signal converter/flow sensor combination possibilities

Flow sensor	Flow sensor + signal converter IFC 100	
	Compact (0°/45° version)	Remote wall-mounted housing
OPTIFLUX 1000	OPTIFLUX 1100 C	OPTIFLUX 1100 W
OPTIFLUX 2000	OPTIFLUX 2100 C	OPTIFLUX 2100 W
OPTIFLUX 4000	OPTIFLUX 4100 C	OPTIFLUX 4100 W
OPTIFLUX 5000	OPTIFLUX 5100 C	OPTIFLUX 5100 W
OPTIFLUX 6000	OPTIFLUX 6100 C	OPTIFLUX 6100 W
WATERFLUX 3000	WATERFLUX 3100 C	WATERFLUX 3100 W
OPTIPROBE	OPTIPROBE 100 C	OPTIPROBE 100 W

1.4 Measuring principle

An electrically conductive fluid flows inside an electrically insulated pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils. Inside of the fluid, a voltage U is generated:

$$U = v * k * B * D$$

in which:

v = mean flow velocity

k = factor correcting for geometry

B = magnetic field strength

D = inner diameter of flowmeter

The signal voltage U is picked off by electrodes and is proportional to the mean flow velocity v and thus the flow rate Q . A signal converter is used to amplify the signal voltage, filter it and convert it into signals for totalizing, recording and output processing.

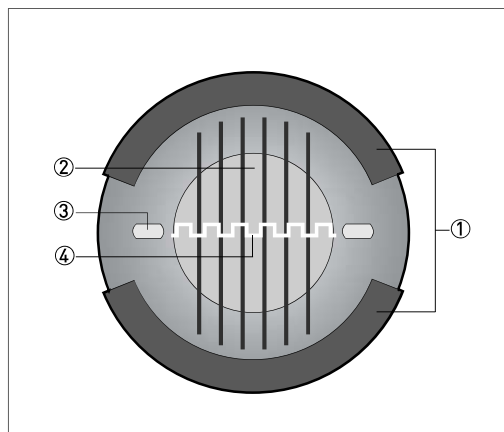


Figure 1-1: Measuring principle

- ① Field coils
- ② Magnetic field
- ③ Electrodes
- ④ Induced voltage (proportional to flow velocity)

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 (Downloadcenter).

Measuring system

Measuring principle	Faraday's law of induction
Application range	Continuous measurement of current volume flow, flow velocity, conductivity, mass flow (at constant density), coil temperature of the flow sensor

Design

Modular construction	The measuring system consists of a flow sensor and a signal converter.
Flow sensor	
OPTIFLUX 1000	DN10...150 / 3/8...6"
OPTIFLUX 2000	DN25...1200 / 1...48"
OPTIFLUX 4000	DN2.5...1200 / 1/10...48"
OPTIFLUX 5000	Flange: DN15...300 / 1/2...12" Sandwich: DN2.5...100 / 1/10...4"
OPTIFLUX 6000	DN2.5...150 / 1/10...6"
WATERFLUX 3000	DN25...600 / 1...24"
OPTIPROBE	DN80...3200 / 3...128" This insertion type flow sensor is available in two models. Model A has a fixed insertion length of 25 mm / 1". Model B has a varying insertion length of 25...400 mm / 1...15.7".
	With the exception of the OPTIFLUX 1000 and WATERFLUX 3000 all flow sensors are also available as Ex versions.
Signal converter	
Compact version (C)	OPTIFLUX x100 C (x = 1, 2, 4, 5, 6) or WATERFLUX 3100 C or OPTIPROBE 300 C (0° & 45° version)
Remote version (W)	IFC 100 W
	With the exception of the OPTIFLUX 1000 and WATERFLUX 3000 all flow sensors are also available as Ex versions.
Options	
Outputs	Current output (including HART®), pulse output, frequency output, status output and/or limit switch
Counter	2 internal counters with a max. of 10 counter places (e.g. for counting volume and/or mass units)
Verification	Integrated verification, diagnostic functions: measuring device, empty pipe detection, stabilisation
Communication interface	HART® as standard

Display and user interface	
Graphic display	LC display, backlit white.
	Size: 128 x 64 pixels, corresponds to 59 x 31 mm = 2.32" x 1.22"
	Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Operating elements	4 push buttons for operator control of the signal converter without opening the housing.
Remote control	PACTware™ (including Device Type Manager (DTM))
	HART® Hand Held Communicator from Emerson Process
	AMS® from Emerson Process
	PDM® from Siemens
	All DTMs and drivers are available free of charge from the manufacturer's website.
Display functions	
Operating menu	Setting the parameters using 2 measuring pages, 1 status page, 1 graphic page (measured values and graphics are freely adjustable)
Language of display texts (as language package)	Standard: English, French, German, Dutch, Portuguese, Swedish, Spanish, Italian
	Eastern Europe: English, Slovenian, Czech, Hungarian
	Northern Europe: English, Danish, Polish, Finnish, Norwegian
	Southern Europe: English, Turkish
	China: English, German, Chinese
	Russia: English, German, Russian
Units	Metric, British and US units selectable as required from lists for volume/mass flow and counting, flow velocity, electrical conductivity, temperature

Measuring accuracy

Max. measuring accuracy	Standard: ±0.3% of the measured value ±1 mm/s, depending on the flow sensor.
	Option (optimised accuracy with extended calibration): ±0.2% of the measured value ±1.5 mm/s, depending on the flow sensor.
	For further information refer to the technical data of the respective flow sensor.
	Special calibrations are available on request.
	Current output electronics: ±10 µA; ±100 ppm/°C (typically: ±30 ppm/°C)
Repeatability	±0.1%

Operating conditions

Temperature	
Process temperature	Refer to the technical data of the flow sensor.
Ambient temperature	-40...+65°C / -40...+149°F For compact devices is the maximum ambient temperature reduced depending on the flow sensor type and the process temperature. For details refer to the flow sensor manual. It is advised to protect the signal converter from external heat sources such as direct sunlight as higher temperatures reduce the life cycle of electronic components. Ambient temperatures below -25°C / -13°F may affect the readability of the display.
Storage temperature	-40...+70°C / -40...+158°F
Pressure	
Medium	Refer to the technical data of the flow sensor.
Ambient pressure	Atmosphere: altitude up to 2000 m / 6561.7 ft above sea level
Chemical properties	
Electrical conductivity	All media except for water: $\geq 5 \mu\text{S/cm}$ (also refer to the technical data of the flow sensor) Water: $\geq 20 \mu\text{S/cm}$
Type of measurement	Electrical conductive liquids
Solid content (volume)	$\leq 10\%$ for OPTIFLUX flow sensors
Gas content (volume)	$\leq 3\%$ for OPTIFLUX flow sensors
Flow rate	For detailed information, refer to chapter "Flow tables".
Other conditions	
Ingress protection according to IEC 60529	Standard version with aluminium housing: IP66/67 (according to NEMA 4/4X) Optional version with stainless steel housing: IP69

Installation conditions

Installation	For detailed information, refer to chapter "Installation".
Inlet/outlet runs	Refer to the technical data of the flow sensor.
Dimensions and weight	For detailed information refer to chapter "Dimensions and weight".

Materials

Signal converter housing	Standard: Aluminium with a polyester topcoat Option: Stainless steel 1.4404 / AISI 316L
Flow sensor	For housing materials, process connections, liners, grounding electrodes and gaskets, refer to the technical data of the flow sensor.

Electrical connection

General	Electrical connection is carried out in conformity with the VDE 0100 directive "Regulations for electrical power installations with line voltages up to 1000 V" or equivalent national specifications.
Power supply	100...230 VAC (-15% / +10%), 50/60 Hz; non-Ex: standard; Ex: optional 240 VAC + 5% is included in the tolerance range.
	24 VDC (-55% / +30%); only available as non-Ex version 12 VDC - 10% is included in the tolerance range.
	24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%); non-Ex: standard; Ex: optional 12 V is not included in the tolerance range.
Power consumption	AC: 7 VA
	DC: 4 W
Signal cable	Only necessary for remote versions.
	DS 300 (type A) Max. length: 600 m / 1968 ft (depending on electrical conductivity and flow sensor version)
Cable entries	Standard: M20 x 1.5 (8...12 mm)
	Option: 1/2 NPT, PF 1/2

Inputs and outputs

General	All outputs are electrically isolated from each other and from all other circuits.
	All operating data and output values can be adjusted.
Description of abbreviations	V_{ext} = external voltage; R_L = load + resistance; V_0 = terminal voltage; I_{nom} = nominal current
Current output	
Output data	Volume flow, mass flow, diagnostic value, flow velocity, coil temperature, conductivity
Settings	Without HART®
	Q = 0%: 0...20 mA; Q = 100%: 10...21.5 mA
	Error identification: 20...22 mA
	With HART®
	Q = 0%: 4...20 mA; Q = 100%: 10...21.5 mA
	Error identification: 3...22 mA
Operating data	
Active	$V_{\text{int, nom}} = 20 \text{ VDC}$
	$I \leq 22 \text{ mA}$
	$R_L \leq 750 \Omega$
	HART® at terminals A
Passive	$V_{\text{ext}} \leq 32 \text{ VDC}$
	$I \leq 22 \text{ mA}$
	$V_0 \geq 2 \text{ V}$ at $I = 22 \text{ mA}$
	$R_L \leq (V_{\text{ext}} - V_0) / I_{\text{max}}$
HART®	
Description	HART® protocol via active and passive current output
	HART® version: V5
	Universal Common Practice HART® parameter: completely supported
Load	$\geq 230 \Omega$ at HART® test point; Note maximum load for current output!
Multi-drop mode	Yes, current output = 4 mA
	Multi-drop address adjustable in operation menu 1...15
Device drivers	Available for FC 375/475, AMS, PDM, FDT/DTM
Registration (HART Communication Foundation)	Yes

Pulse output / frequency output	
Output data	Pulse output: volume flow, mass flow
	Frequency output: volume flow, mass flow, diagnostic value, flow velocity, coil temperature, conductivity
Function	Adjustable as pulse or frequency output
Pulse rate/frequency	Adjustable final value: 0.01...10000 pulse/s or Hz
Settings	Pulses per volume or mass unit or max. frequency for 100% flow
	Pulse width: adjustable as automatic, symmetric or fixed (0.05...2000 ms)
Operating data	
Passive	$V_{\text{ext}} \leq 32 \text{ VDC}$
	f_{max} in operating menu set to $f_{\text{max}} \leq 100 \text{ Hz}$: $I \leq 100 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$ closed: $V_{0, \text{max}} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $V_{0, \text{max}} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$
	f_{max} in operating menu set to $100 \text{ Hz} < f_{\text{max}} \leq 10 \text{ kHz}$: $I \leq 20 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$ closed: $V_{0, \text{max}} = 1.5 \text{ V}$ at $I \leq 1 \text{ mA}$ $V_{0, \text{max}} = 2.5 \text{ V}$ at $I \leq 10 \text{ mA}$ $V_{0, \text{max}} = 5.0 \text{ V}$ at $I \leq 20 \text{ mA}$
Low flow cut off	
Function	Switching point and hysteresis separately adjustable for each output, counter and the display
Switching point	Set in increments of 0.1%.
	0...20% (current output, frequency output) or 0...±9.999 m/s (pulse output)
Hysteresis	Set in increments of 0.1%.
	0...5% (current output, frequency output) or 0...5 m/s (pulse output)
Time constant	
Function	The time constant corresponds to the elapsed time until 63% of the end value has been reached according to a step function.
Settings	Set in increments of 0.1 seconds.
	0...100 seconds

Status output / limit switch	
Function and settings	Adjustable as automatic measuring range conversion, display of flow direction, counter overflow, error, switching point or empty pipe detection
	Valve control with activated dosing function
	Status and/or control: ON or OFF
Operating data	
Passive	$V_{\text{ext}} \leq 32 \text{ VDC}$ $I \leq 100 \text{ mA}$ open: $I \leq 0.05 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$ closed: $V_{0, \text{max}} = 0.2 \text{ V}$ at $I \leq 10 \text{ mA}$ $V_{0, \text{max}} = 2 \text{ V}$ at $I \leq 100 \text{ mA}$
Control input	
Function	Hold value of the outputs (e.g. for cleaning work), set value of the outputs to "zero", counter and error reset, range change.
	Start of dosing when dosing function is activated.
Operating data	
Passive	$V_{\text{ext}} \leq 32 \text{ VDC}$ $I_{\text{nom}} = 6.5 \text{ mA}$ at $V_{\text{ext}} = 24 \text{ VDC}$ $I_{\text{nom}} = 8.2 \text{ mA}$ at $V_{\text{ext}} = 32 \text{ VDC}$ Contact open (off): $V_0 \leq 2.5 \text{ V}$ at $I_{\text{nom}} = 0.4 \text{ mA}$ Contact closed (on): $V_0 \geq 8 \text{ V}$ at $I_{\text{nom}} = 2.8 \text{ mA}$

Approvals and certificates

Declaration of conformity	This device fulfils the statutory requirements of the relevant directives. The manufacturer certifies successful testing of the product by applying the conformity mark on the device. For more information on the directives, standards and the approved certifications, please refer to the declaration of conformity supplied with the device or downloadable from the manufacturer's website.
Marine certificate	
EU RO MR Type Approval	Certificate mutually recognized by: ABS, BV, CCS, CRS, DNG-GL, IRS, KR, ClassNK, PRS, RINA, RS For certificate and details refer to the manufacturer website.
Standard version	Non-Ex
Hazardous areas	
ATEX	Option (only OPTIFLUX 2100 C and OPTIFLUX 4100 C)
	II 2 G Ex e [ia] mb IIC T4 (DN10...20; DN200...300; DN350...3000)
	II 2 G Ex d e [ia] mb IIC T4 (DN25...150)
	II 2 G Ex e [ia] mb q T4/T3 (DN25...150; DN200...300)
	II 2 D Ex tD A21 IP64 T120°C (all nominal sizes)
	Option (only W version)
	II 2 G Ex e [ia] mb IIC T4
	II 2 D Ex tD A21 IP64 T135°C
IECEx	Option (only OPTIFLUX 2100 C and OPTIFLUX 4100 C)
	Ex e [ia] mb IIC T4 (DN10...20; DN200...300; DN350...3000)
	Ex d e [ia] mb IIC T4 (DN25...150)
	Ex tD A21 IP64 T120°C (all nominal sizes)
	Option (only W version)
	Ex e [ia] mb IIC T4
	Ex tD A21 IP64 T135°C
FM/CSA	Option (only OPTIFLUX 2100 C and OPTIFLUX 4100 C)
	Class I, Div 2, Group A, B, C and D
	Option (only W version)
	Class I, Div 2, Group A, B, C and D
	Ordinary location
Other standards and approvals	
Vibration resistance	Tested according to IEC 60068-2-64
NAMUR	NE 21, NE 43, NE 53

Table 2-1: Technical data

2.2 Dimensions and weight

2.2.1 Housing

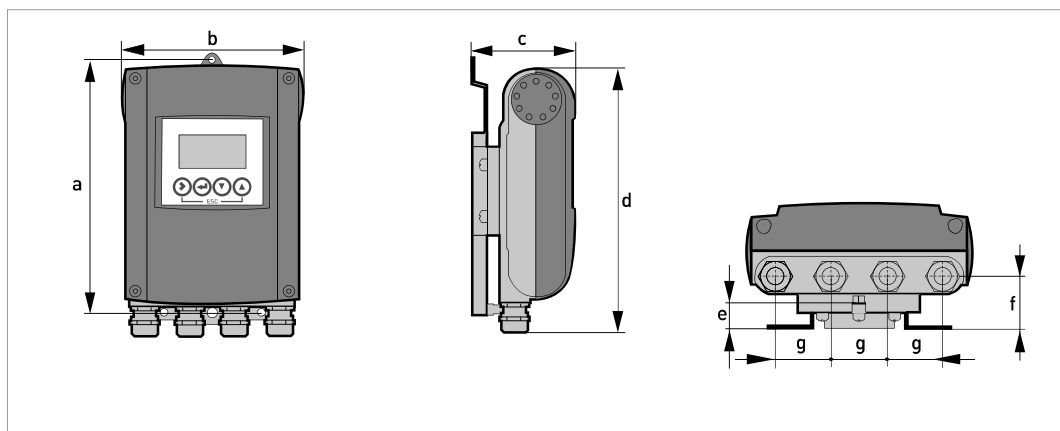


Figure 2-1: Dimensions of the wall-mounted version, aluminium housing

	Dimensions [mm]							Weight [kg]
	a	b	c	d	e	f	g	
Wall-mounted version	241	161	95.2	257	19.3	39.7	40	1.9

Table 2-2: Dimensions and weight in mm and kg

	Dimensions [inch]							Weight [lb]
	a	b	c	d	e	f	g	
Wall-mounted version	9.50	6.34	3.75	10.12	0.76	1.56	1.57	4.2

Table 2-3: Dimensions and weight in inch and lb

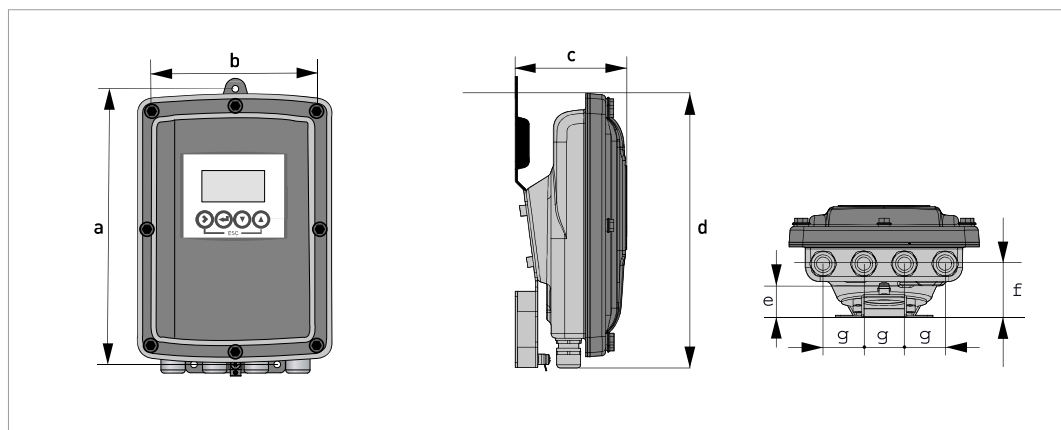


Figure 2-2: Dimensions of wall-mounted and compact 10° version, stainless steel housing

	Dimensions [mm]							Weight [kg]
	a	b	c	d	e	f	g	
Wall-mounted version	268	187	110	276	29	53	40	Approx. 3.5

Table 2-4: Dimensions and weight in mm and kg

	Dimensions [inch]							Weight [lb]
	a	b	c	d	e	f	g	
Wall-mounted version	10.55	7.36	4.33	10.87	1.14	2.09	1.57	Approx. 7.2

Table 2-5: Dimensions and weight in inch and lb

The compact 10° version is without mounting plate.

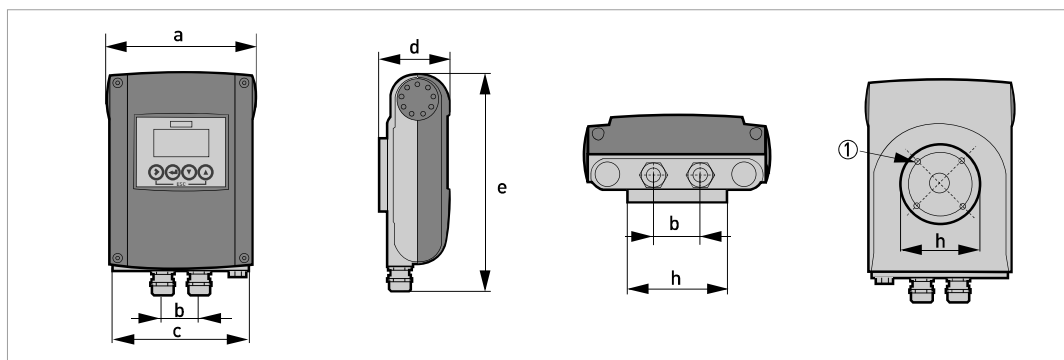


Figure 2-3: Dimensions of compact 0° version, aluminium housing

① 4 x M 6

	Dimensions [mm]								Weight [kg]
	a	b	c	d	e	f	g	h	
0° version	161	40	155	81.5	257	-	-	Ø72	Std: 1.9 Ex: 2.4

Table 2-6: Dimensions and weight in mm and kg

	Dimensions [inch]								Weight [lb]
	a	b	c	d	e	f	g	h	
0° version	6.34	1.57	6.1	3.21	10.12	-	-	Ø2.83	Std: 4.2 Ex: 5.3

Table 2-7: Dimensions and weight in inch and lb

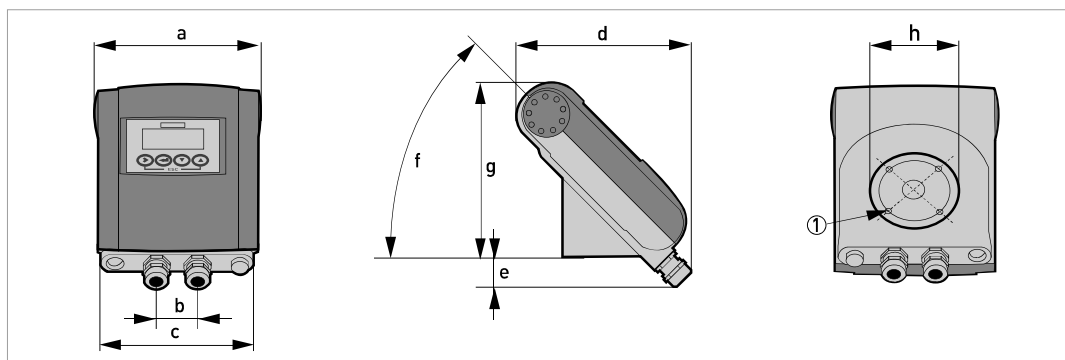


Figure 2-4: Dimensions of compact 45° version, aluminium housing

① 4 x M 6

	Dimensions [mm]								Weight [kg]
	a	b	c	d	e	f	g	h	
45° version	161	40	155	184	27.4	45°	186	Ø72	Std: 2.1 Ex: 2.6

Table 2-8: Dimensions and weight in mm and kg

	Dimensions [inch]								Weight [lb]
	a	b	c	d	e	f	g	h	
45° version	6.34	1.57	6.10	7.24	1.08	45°	7.32	Ø2.83	Std: 4.6 Ex: 5.7

Table 2-9: Dimensions and weight in inch and lb

2.2.2 Mounting plate of wall-mounted version, aluminium housing

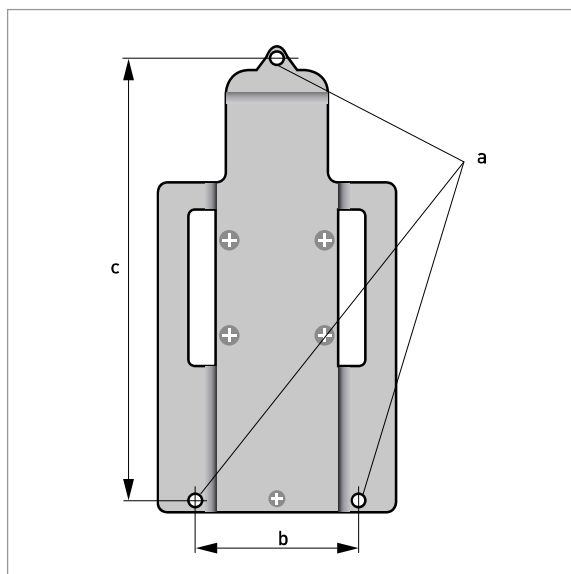


Figure 2-5: Dimensions of mounting plate of wall-mounted version, aluminium housing

	[mm]	[inch]
a	Ø6.5	Ø0.26
b	87.2	3.4
c	241	9.5

Table 2-10: Dimensions in mm and inch

2.2.3 Mounting plate of wall-mounted version, stainless steel housing

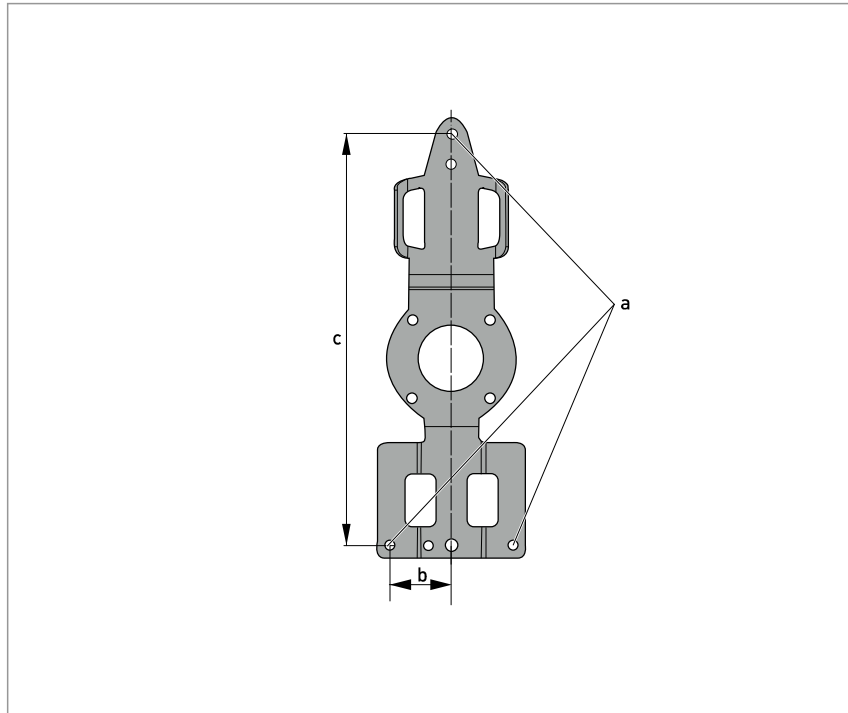


Figure 2-6: Dimensions of mounting plate of wall-mounted version, stainless steel housing

	[mm]	[inch]
a	Ø6.5	Ø0.26
b	40	1.6
c	267.9	10.55

Table 2-11: Dimensions in mm and inch

2.3 Flow tables

	$Q_{100\%}$ in m ³ /h			
v [m/s]	0.3	1	3	12
DN [mm]	Minimum flow	Nominal flow		Maximum flow
2.5	0.005	0.02	0.05	0.21
4	0.01	0.05	0.14	0.54
6	0.03	0.10	0.31	1.22
10	0.08	0.28	0.85	3.39
15	0.19	0.64	1.91	7.63
20	0.34	1.13	3.39	13.57
25	0.53	1.77	5.30	21.21
32	0.87	2.90	8.69	34.74
40	1.36	4.52	13.57	54.29
50	2.12	7.07	21.21	84.82
65	3.58	11.95	35.84	143.35
80	5.43	18.10	54.29	217.15
100	8.48	28.27	84.82	339.29
125	13.25	44.18	132.54	530.15
150	19.09	63.62	190.85	763.40
200	33.93	113.10	339.30	1357.20
250	53.01	176.71	530.13	2120.52
300	76.34	254.47	763.41	3053.64
350	103.91	346.36	1039.08	4156.32
400	135.72	452.39	1357.17	5428.68
450	171.77	572.51	1717.65	6870.60
500	212.06	706.86	2120.58	8482.32
600	305.37	1017.90	3053.70	12214.80
700	415.62	1385.40	4156.20	16624.80
800	542.88	1809.60	5428.80	21715.20
900	687.06	2290.20	6870.60	27482.40
1000	848.22	2827.40	8482.20	33928.80
1200	1221.45	3421.20	12214.50	48858.00

Table 2-12: Flow rate in m/s and m³/h

	Q ₁₀₀ % in US gallons/min			
v [ft/s]	1	3.3	10	40
DN [inch]	Minimum flow	Nominal flow		Maximum flow
1/10	0.02	0.09	0.23	0.93
1/6	0.06	0.22	0.60	2.39
1/4	0.13	0.44	1.34	5.38
3/8	0.37	1.23	3.73	14.94
1/2	0.84	2.82	8.40	33.61
3/4	1.49	4.98	14.94	59.76
1	2.33	7.79	23.34	93.36
1.25	3.82	12.77	38.24	152.97
1.5	5.98	19.90	59.75	239.02
2	9.34	31.13	93.37	373.47
2.5	15.78	52.61	159.79	631.16
3	23.90	79.69	239.02	956.09
4	37.35	124.47	373.46	1493.84
5	58.35	194.48	583.24	2334.17
6	84.03	279.97	840.29	3361.17
8	149.39	497.92	1493.29	5975.57
10	233.41	777.96	2334.09	9336.37
12	336.12	1120.29	3361.19	13444.77
14	457.59	1525.15	4574.93	18299.73
16	597.54	1991.60	5975.44	23901.76
18	756.26	2520.61	7562.58	30250.34
20	933.86	3112.56	9336.63	37346.53
24	1344.50	4481.22	13445.04	53780.15
28	1829.92	6099.12	18299.20	73196.79
32	2390.23	7966.64	23902.29	95609.15
36	3025.03	10082.42	30250.34	121001.37
40	3734.50	12447.09	37346.00	149384.01
48	5377.88	17924.47	53778.83	215115.30

Table 2-13: Flow rate in ft/s and US gallons/min

3.1 Intended use

The electromagnetic flowmeters are designed exclusively to measure the flow and conductivity of electrically conductive, liquid media.

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

If the device is not used according to the operating conditions (refer to chapter "Technical data"), the intended protection could be affected.

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.

3.2 Installation specifications

The following precautions must be taken to ensure reliable installation.

- *Make sure that there is adequate space to the sides.*
- *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.*
- *Signal converters installed in control cabinets require adequate cooling, e.g. by fan or heat exchanger.*
- *Do not expose the signal converter to intense vibrations. The measuring devices are tested for a vibration level as described in the chapter "Technical data".*
- *Protect the device from excessive solar heat or UV light. Install an adequate protection (e.g. sun shade) to prevent damage to the housing and electronics.*

3.3 Mounting of the compact version

Turning the housing of the compact version is not permitted.

The signal converter is mounted directly on the flow sensor. For installation of the flowmeter, please observe the instructions in the supplied product documentation for the flow sensor.

3.4 Mounting the wall-mounted housing, remote version

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.

3.4.1 Wall mounting

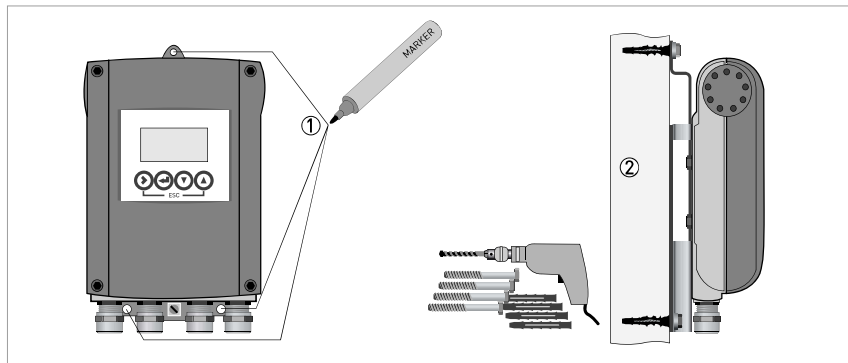


Figure 3-1: Mounting the wall-mounted housing

- ① Prepare the holes with the aid of the mounting plate. For further information refer to *Mounting plate of wall-mounted version, aluminium housing* on page 20.
- ② Fasten the device securely to the wall with the mounting plate.

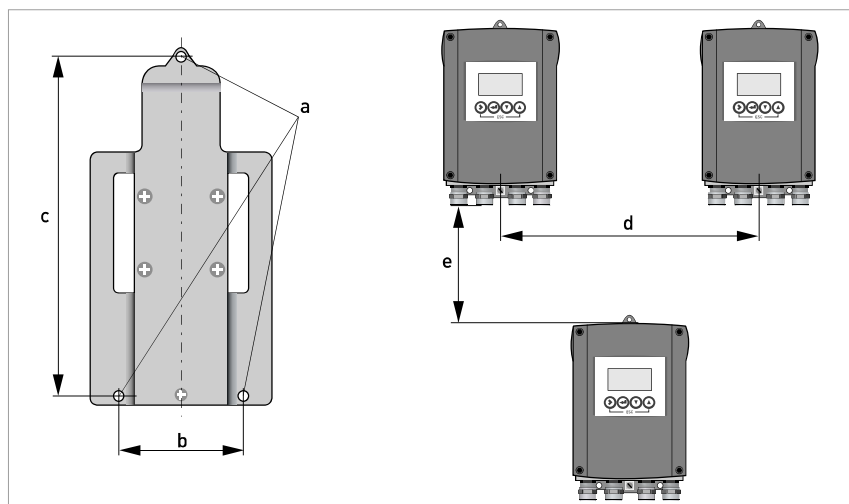


Figure 3-2: Wall mounting of multiple devices (aluminium housing)

	[mm]	[inch]
a	Ø6.5	Ø0.26
b	87.2	3.4
c	241	9.5
d	310	12.2
e	257	10.1

Table 3-1: Dimensions in mm and inch

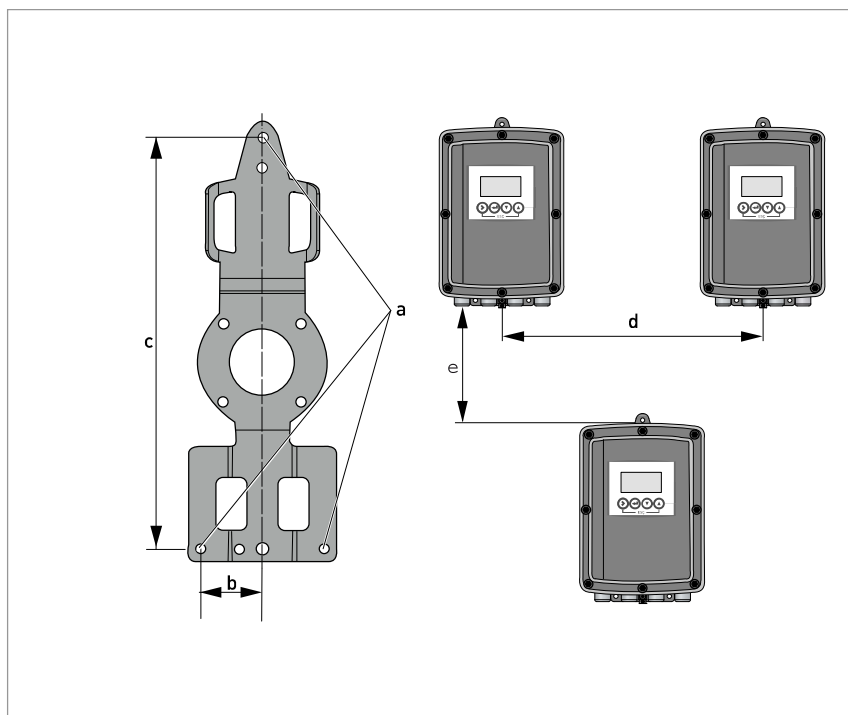


Figure 3-3: Wall mounting of multiple devices (stainless steel housing)

	[mm]	[inch]
a	Ø6.5	Ø0.26
b	268	10.5
c	40	1.6
d	336	13.2
e	257	10.1

Table 3-2: Dimensions in mm and inch

4.1 Important notes on electrical connection

Electrical connection is carried out in conformity with the VDE 0100 directive "Regulations for electrical power installations with line voltages up to 1000 V" or equivalent national regulations.

The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

- Use suitable cable entries for the various electrical cables.
- The flow sensor and signal converter have been configured together at the factory. For this reason, please connect the devices in pairs. Ensure that the flow sensor constant GK/GKL (refer to nameplates) are identically set.
- If delivered separately or when installing devices that were not configured together, set the signal converter to the DN size and GK/GKL of the flow sensor.

4.2 Preparing the signal and field current cables

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.

4.2.1 Signal cable A (type DS 300), construction

- Signal cable A is a double-shielded cable for signal transmission between the flow sensor and signal converter.
- Bending radius: $\geq 50 \text{ mm} / 2''$

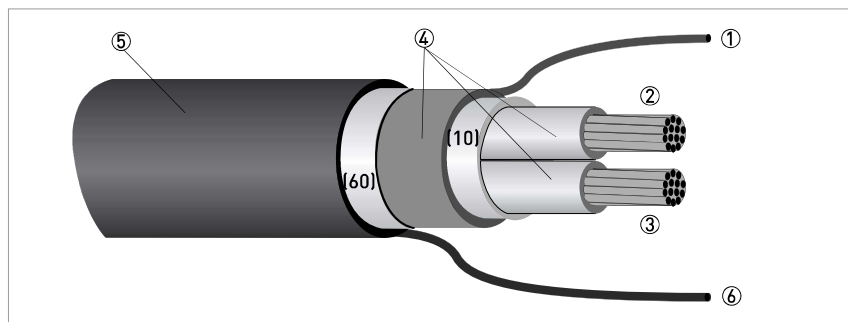


Figure 4-1: Construction of signal cable A (standard version)

- ① Stranded drain wire [1] for the inner shield [10], $1.0 \text{ mm}^2 \text{ Cu}$ / AWG 17 (not insulated, bare)
- ② Insulated wire [2], $0.5 \text{ mm}^2 \text{ Cu}$ / AWG 20
- ③ Insulated wire [3], $0.5 \text{ mm}^2 \text{ Cu}$ / AWG 20
- ④ Insulation layers
- ⑤ Outer sheath
- ⑥ Stranded drain wire [6] for the outer shield [60]

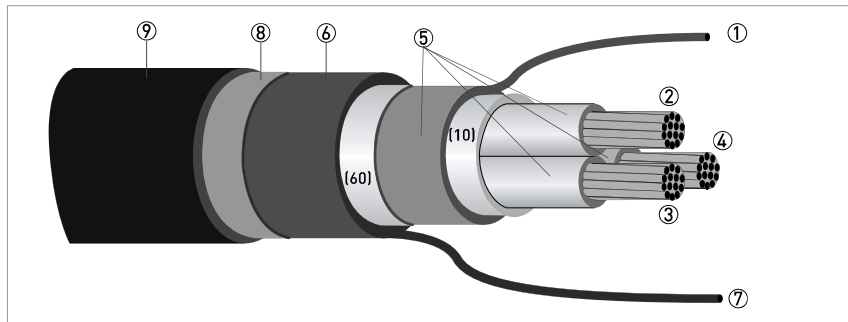


Figure 4-2: Construction of signal cable A (armoured version)

- ① Stranded drain wire (1) for the inner shield (10), 1.0 mm² Cu / AWG 17 (not insulated, bare)
- ② Insulated wire (2), 0.5 mm² Cu / AWG 20
- ③ Insulated wire (3), 0.5 mm² Cu / AWG 20
- ④ Insulated wire (4), 0.5 mm² Cu / AWG 20
- ⑤ Insulation layers
- ⑥ Outer sheath
- ⑦ Stranded drain wire (6) for the outer shield (60)
- ⑧ Armoured braiding layer
- ⑨ Outer jacket

4.2.2 Length of signal cable A

For temperatures of the medium above 150°C / 300°F, a special signal cable and a ZD intermediate socket are necessary. These are available including the changed electrical connection diagrams.

Flow sensor	Nominal diameter		Min. electrical conductivity [μS/cm]	Curve for signal cable A
	DN [mm]	[inch]		
OPTIFLUX 1000 F	10...150	3/8...6	5	A1
OPTIFLUX 2000 F	25...150	1...6	20	A1
	200...1200	8...48		A2
OPTIFLUX 4000 F	2.5...150	1/10...6	5	A1
	200...1200	8...48		A2
OPTIFLUX 5000 F	2.5...100	1/10...4	5	A1
	150...250	6...10		A2
OPTIFLUX 6000 F	2.5...150	1/10...6	5	A1
WATERFLUX 3000 F	25...600	1...24	20	A1
OPTIPROBE F	80...3200	3...128	300	A1

Table 4-1: Length of signal cable A

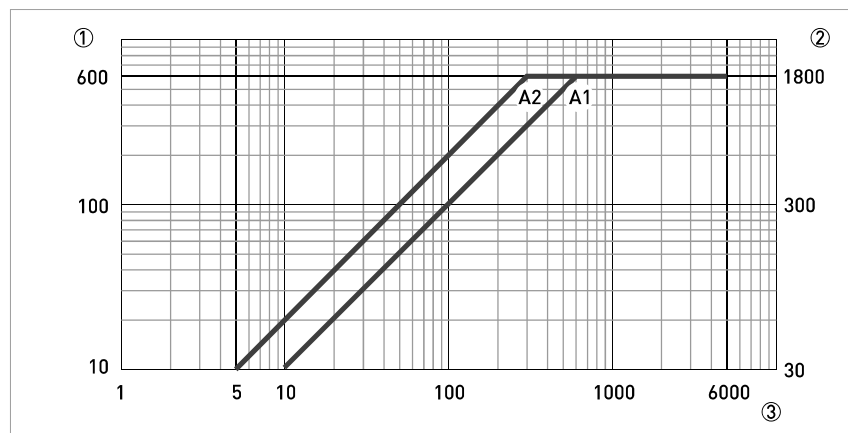


Figure 4-3: Maximum length of signal cable A

- ① Maximum length of signal cable A between the flow sensor and signal converter [m]
- ② Maximum length of signal cable A between the flow sensor and signal converter [ft]
- ③ Electrical conductivity of the medium being measured [μS/cm]

4.2.3 Connection diagram for signal and field current cable

The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

- A shielded 2-wire copper cable is used as the field current cable. The shielding **MUST** be connected in the housing of the flow sensor and signal converter.
- The outer shield (60) is connected in the terminal compartment of the flow sensor directly via the shield and a clip.
- Bending radius of signal and field current cable: $\geq 50 \text{ mm} / 2''$
- The following illustration is schematic. The positions of the electrical connection terminals may vary depending on the housing version.

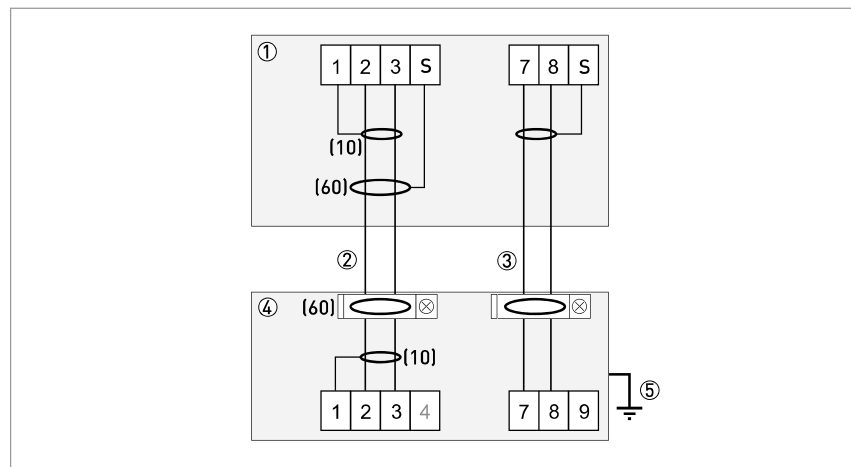


Figure 4-4: Connection diagram for signal and field current cable

- ① Electrical terminal compartment in the signal converter
- ② Signal cable A (type DS 300)
- ③ Field current cable C (type LiYCY)
- ④ Electrical terminal compartment in the flow sensor
- ⑤ Functional ground FE
- (10) inner cable shield
- (60) outer cable shield

4.3 Connecting the power supply

The device must be grounded in accordance with regulations in order to protect personnel against electric shocks.

- The housings of the devices, which are designed to protect the electronic equipment from dust and moisture, should be kept well closed at all times. Creepage distances and clearances are dimensioned to VDE 0110 and IEC 60664 for pollution severity 2. Supply circuits are designed for overvoltage category III and the output circuits for overvoltage category II.
- Fuse protection ($I_N \leq 16\text{ A}$) for the infeed power circuit, and also a separator (switch, circuit breaker) to isolate the signal converter should be provided for the device in accordance with applicable regulations.

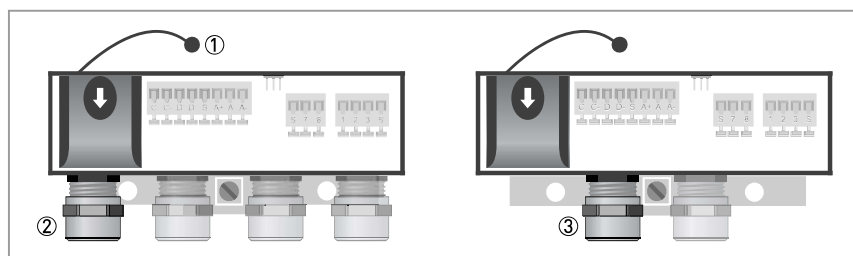


Figure 4-5: Terminal compartment for power supply

- ① Retaining band of the cover
- ② Cable entry for power supply, remote version
- ③ Cable entry for power supply, compact version

Version	Non-Ex	Ex
100...230 VAC	Standard	Optional
24 VDC	Standard	-
24 VAC/DC	Standard	Optional

Table 4-2: Version overview

- Open the cover of the electrical terminal compartment by pressing down and pulling forwards at the same time.

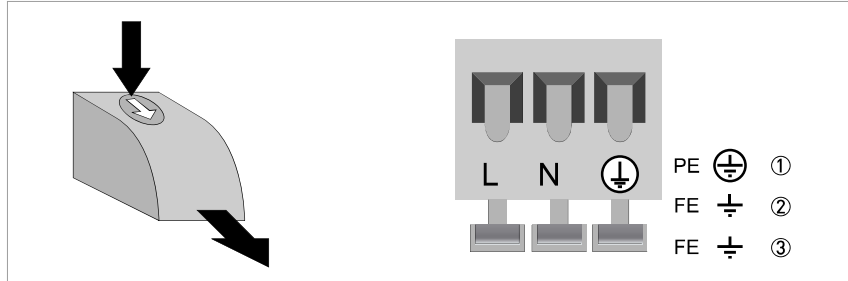


Figure 4-6: Power supply connection

- ① 100...230 VAC (-15% / +10%), 8 VA
- ② 24 VDC (-55% / +30%), 4 W
- ③ 24 VAC/DC (AC: -15% / +10%; DC: -25% / +30%), 7 VA or 4 W

- Close the cover after the power has been connected.

100...230 VAC (tolerance range for 100 VAC: -15% / +10%)

- Note the power supply voltage and frequency (50...60 Hz) on the nameplate.

240 VAC + 5% is included in the tolerance range.

24 VDC (tolerance range: -55% / +30%)

- Note the data on the nameplate!

12 VDC - 10% is included in the tolerance range.

24 VAC/DC (tolerance range: AC: -15% / +10%; DC: -25% / +30%)

- AC: Note the power supply voltage and frequency (50...60 Hz) on the nameplate.

*12 V is **not** included in the tolerance range.*

4.4 Inputs and outputs, overview

4.4.1 Description of the CG number

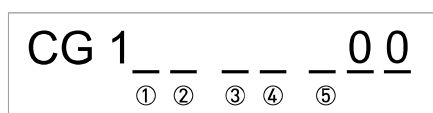


Figure 4-7: Marking (CG number) of the electronics module and output variants

- ① ID number: 0
- ② ID number: 0 = standard; 9 = special
- ③ Power supply
- ④ Display (language versions)
- ⑤ Input/output version (I/O)

4.4.2 Fixed, non-alterable input/output versions

This signal converter is available with various input/output combinations.

- The grey boxes in the tables denote unassigned or unused connection terminals.
- In the table, only the final digits of the CG number are depicted.

CG no.	Connection terminals							
	C	C-	D	D-	S	A+	A	A-
1 0 0	S _p / C _p ①		P _p / S _p passive ①		②		I _p + HART® passive ③	
						I _a + HART® active ③		

Table 4-3: Fixed, non-alterable input/output versions

- ① Function change by software
- ② Shielding
- ③ Function changed by reconnecting

I _a	I _p	Current output active or passive
P _p		Pulse/frequency output passive
S _p		Status output / limit switch passive
C _p		Control input passive

Table 4-4: Description of used abbreviations

4.5 Laying electrical cables correctly

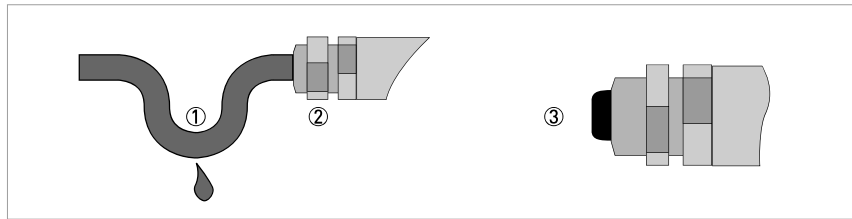


Figure 4-8: Protect housing from dust and water

- ① For compact versions with nearly horizontally-oriented cable entries, lay the necessary electric cables with a drip loop as shown in the illustration.
- ② Tighten the screw connection of the cable entry securely.
- ③ Seal cable entries that are not needed with a plug.

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