



OPTIFLUX 2000 Technical Datasheet

Electromagnetic flow sensor

- For all water and wastewater applications
- Wide range of approvals for potable water
- Robust, fully welded construction with full bore pipe



KTW



kiwa

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

| | | |
|----------|--|-----------|
| 1 | Product features | 3 |
| 1.1 | Reliable solution for the water and wastewater industry | 3 |
| 1.2 | Options..... | 5 |
| 1.3 | Measuring principle..... | 7 |
| 2 | Technical data | 8 |
| 2.1 | Technical data..... | 8 |
| 2.2 | Legal metrology..... | 16 |
| 2.2.1 | OIML R49 | 16 |
| 2.2.2 | MID Annex III (MI-001)..... | 18 |
| 2.3 | Measuring accuracy | 20 |
| 2.4 | Pressure derating..... | 21 |
| 2.5 | Vacuum load | 23 |
| 2.6 | Dimensions and weights | 24 |
| 3 | Installation | 31 |
| 3.1 | Intended use | 31 |
| 3.2 | General notes on installation | 31 |
| 3.2.1 | Vibrations | 31 |
| 3.2.2 | Magnetic field..... | 31 |
| 3.3 | Installation conditions | 32 |
| 3.3.1 | Inlet and outlet | 32 |
| 3.3.2 | Bends in 2 or 3 dimensions..... | 32 |
| 3.3.3 | Bends | 33 |
| 3.3.4 | T-section | 34 |
| 3.3.5 | Open discharge | 34 |
| 3.3.6 | Control valve | 35 |
| 3.3.7 | Pump | 35 |
| 3.3.8 | Air venting and vacuum forces | 36 |
| 3.3.9 | Flange deviation | 37 |
| 3.3.10 | Mounting position..... | 37 |
| 3.4 | Installation in a metering pit and subsurface applications | 38 |
| 3.5 | Mounting | 39 |
| 3.5.1 | Torques and pressures | 39 |
| 4 | Electrical connections | 43 |
| 4.1 | Safety instructions..... | 43 |
| 4.2 | Grounding | 43 |
| 4.3 | Virtual reference option | 45 |
| 4.4 | Connection diagrams | 45 |
| 5 | Notes | 46 |

1.1 Reliable solution for the water and wastewater industry

The **OPTIFLUX 2000** is designed to meet the demands for all water and waste water applications including groundwater, potable water, waste water, sludge and sewage, industry water and salt water.

The OPTIFLUX 2000 has a field proven and unsurpassed lifetime. This is assured by the fully welded construction, full bore pipe, absence of moving parts and wear resistant liner materials. The flow sensor has the widest diameter range available in the market: from DN25 up to DN3000.



- ① Robust fully welded construction
- ② Diameter range: DN25...DN3000
- ③ Polypropylene and hard rubber liners

Highlights

- Rugged liners suitable for any water and wastewater application
- Proven and unsurpassed lifetime, huge installed base
- Tamper proof, fully welded construction, also available in customer specific constructions
- Drinking water approvals including KTW, ACS, NSF, WRAS, KIWA, DVGW
- Suitable for subsoil installation and constant flooding (IP68)
- Bi-directional flow metering
- Compliant with requirements for custody transfer (MID MI-001, OIML R49, ISO 4064, EN 14154)
- Standard in house wet calibration of flow sensors up to diameter DN3000
- Easy installation and commissioning
- No grounding rings with virtual reference option on IFC 300 and IFC 400
- In-situ verification with OPTICHECK
- Extensive diagnostic capabilities
- Maintenance-free

Industries

- Water
- Wastewater
- Pulp & Paper
- Minerals & Mining
- Iron, Steel & Metals
- Power

Applications

- Water abstraction
- Water purification and desalination
- Drinking water distribution networks
- Revenue metering or billing
- Leakage detection
- Irrigation
- Industry water
- Cooling water
- Wastewater
- Sewage and sludge
- Sea water

1.2 Options

The reliable solution for the water and wastewater industry



From standard to customized

For easy ordering the standard range of the OPTIFLUX 2000 covers all popular sizes, flange materials and connections (ASME, EN, JIS, AWWA). But KROHNE does not stop here. Our extensive engineering department is dedicated to provide solutions for all specifications not covered by our standard range. Requests for special sizes, flange connections, pressure ratings, building lengths, and materials, will always get a serious review. Whenever possible we will engineer a flow meter that fits your application.



Easy installation

Fitting the OPTIFLUX 2000 is easy with the flanged design and standard ISO insertion lengths. To further ease the operation, the OPTIFLUX 2000 can be installed without filters and straighteners. Even grounding rings are not required with the patented **"Virtual Reference"** option on the IFC 300 and IFC 400 signal converter.



IP68

Installation in measurement chambers subject to (constant) flooding is possible with the IP68 rated version. The chambers can even be completely surpassed if the IP68 version is combined with our special subsoil coating, allowing the OPTIFLUX 2000 to be installed directly in the ground.

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.

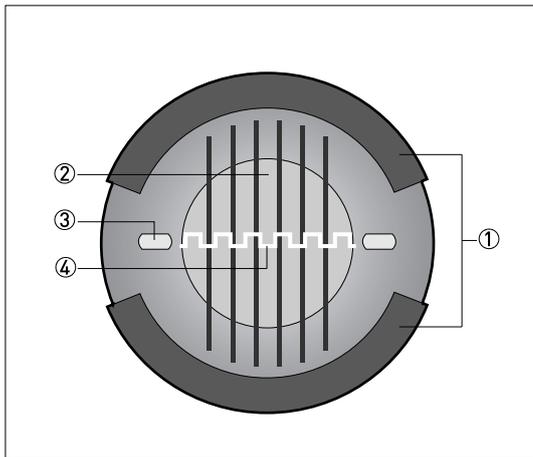


Figure 1-1: Measuring principle

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

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 | Fully welded maintenance-free flow sensor. |
| | Large diameter range DN25...3000 |
| | Rugged liners approved for drinking water. |
| | Large standard range but also available in customer specific diameter, length and pressure rating. |
| Modular construction | The measurement system consists of a flow sensor and a signal converter. It is available as compact and as separate version. Additional information can be found in the documentation of the signal converter. |
| Compact version | With signal converter IFC 050: OPTIFLUX 2050 C |
| | With signal converter IFC 100: OPTIFLUX 2100 C |
| | With signal converter IFC 300: OPTIFLUX 2300 C |
| | With signal converter IFC 400: OPTIFLUX 2400 C |
| Remote version | In wall (W) mount version with signal converter IFC 050: OPTIFLUX 2050 W |
| | In wall (W) mount version with signal converter IFC 100: OPTIFLUX 2100 W |
| | In field (F), wall (W) or rack (R) mount version with signal converter IFC 300: OPTIFLUX 2300 F, W or R |
| | In field (F), wall (W) or rack (R) mount version with signal converter IFC 400: OPTIFLUX 2400 F, W or R |
| Nominal diameter | With signal converter IFC 050: DN25...1200 / 1...48" |
| | With signal converter IFC 100: DN25...1200 / 1...48" |
| | With signal converter IFC 300 and IFC 400: DN25...3000 / 1...120" |

Measuring accuracy

| | | |
|--|---|----------------------|
| Maximum measuring error | IFC 050: down to 0.5% of the measured value \pm 1 mm/s | |
| | IFC 100: down to 0.3% of the measured value \pm 1 mm/s | |
| | IFC 300 and IFC 400: down to 0.2% of the measured value \pm 1 mm/s | |
| | Optionally: optimised accuracy for IFC 050 and IFC 100. For more details on optimised accuracy, see the concerning signal converter documentation. | |
| | The maximum measuring error depends on the installation conditions. | |
| | For detailed information refer to <i>Measuring accuracy</i> on page 20. | |
| Repeatability | \pm 0.1% of the measured value, minimum 1 mm/s | |
| Calibration / Verification | Standard: | |
| | 2 point calibration by a direct volume comparison. | |
| | Optional: | |
| | Verification to Measurement Instrument Directive (MID), Annex MI-001. Standard: Verification at Ratio (Q3/Q1) = 80, Q3 \geq 2 m/s Optional: Verification at Ratio (Q3/Q1) > 80 on request (up to Ratio 400) | |
| MID Annex III (MI-001) (Directive 2014/32/EU / Regulation 2016 No. 1153) | EC-Type examination certificate to MID Annex MI-001 | |
| | Only in combination with the signal converter IFC 300. | |
| | Diameter range: DN25...1800 | |
| | Forward and reverse (bi-directional) flow | |
| | 0DN / 0DN (0 x DN upstream and 0 x DN downstream) | |
| | Liquid temperature range: +0.1°C / +50°C | |
| | For detailed information refer to <i>Legal metrology</i> on page 16. | |
| OIML R49 | Certificate of conformity to OIML R49 | |
| | Only in combination with the signal converter IFC 300. | |
| | Diameter range | Class 1: DN50...1800 |
| | | Class 2: DN25...40 |
| | Forward and reverse (bi-directional) flow | |
| | 0DN / 0DN (0 x DN upstream and 0 x DN downstream) | |
| | Liquid temperature range: +0.1°C / +50°C | |
| | For detailed information refer to <i>Legal metrology</i> on page 16. | |

Operating conditions

| | |
|--|--|
| Temperature | |
| For detailed information in pressure / temperature refer to <i>Pressure derating</i> on page 21. | |
| For Ex versions different temperatures are valid. Please refer to the relevant Ex documentation for details. | |
| Process temperature | Hard rubber liner: -5...+80°C / +23...+176°F |
| | Polypropylene liner: -5...+90°C / +23...+194°F |
| Ambient temperature | Standard (with aluminum signal converter housing): carbon steel flanges -20...+65°C / -4...+149°F |
| | Option (with aluminum signal converter housing): low temperature carbon steel flanges or stainless steel flanges -40...+65°C / -40...+149°F |
| | Option (with stainless steel signal converter housing): low temperature carbon steel flanges or stainless steel flanges -40...+55°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 |
| Measuring range | -12...+12 m/s / -40...+40 ft/s |

| Pressure | |
|--|---|
| For detailed information in pressure / temperature refer to <i>Pressure derating</i> on page 21. | |
| EN 1092-1 | DN2200...3000: PN 2.5 |
| | DN1200...2000: PN 6 |
| | DN200...1000: PN 10 |
| | DN65 and DN100...150: PN 16 |
| | DN25...50 and DN80: PN 40 |
| | Other pressures on request |
| ASME B16.5 | 1...24": 150 & 300 lb RF |
| | Other pressures on request |
| JIS | DN50...1000 / 2...40": 10 K |
| | DN25...40 / 1...1½": 20 K |
| | Other pressures on request |
| AWWA class B or D FF (on request) | Option: |
| | DN700...1000 / 28...40": ≤ 10 bar / 145 psi (class D) |
| | DN1200...2000 / 48...80": ≤ 6 bar / 87 psi (class B) |
| DIN | PN 16 - 6 bar rated; DN700...2000 |
| | PN 10 - 6 bar rated; DN700...2000 |
| | PN 6 - 2 bar rated; DN700...2000 |
| Vacuum load | For detailed information refer to <i>Vacuum load</i> on page 23. |
| Pressure loss | Negligible |
| Chemical properties | |
| Physical condition | Electrically conductive liquids |
| Electrical conductivity | Standard measurement |
| | For detailed information refer to the relevant signal converter document. |
| Permissible gas content (volume) | IFC 050: ≤ 3% |
| | IFC 100: ≤ 3% |
| | IFC 300 and IFC 400: ≤ 5% |
| Permissible solid content (volume) | IFC 050: ≤ 10% |
| | IFC 100: ≤ 10% |
| | IFC 300 and IFC 400: ≤ 70% |

Installation conditions

| | |
|------------------------|---|
| Installation | Assure that the flow sensor is always fully filled. |
| | For detailed information refer to <i>Installation</i> on page 31. |
| Flow direction | Forward and reverse |
| | Arrow on flow sensor indicates flow direction. |
| Inlet run | ≥ 5 DN |
| Outlet run | ≥ 2 DN |
| Dimensions and weights | For detailed information refer to <i>Dimensions and weights</i> on page 24. |

Materials

| | |
|--------------------------------|--|
| Flow sensor housing | Sheet steel |
| | Other materials on request |
| Measuring tube | Austenitic stainless steel |
| Flanges | Carbon steel |
| | Other materials on request |
| Liner | Standard: |
| | DN25...150 / 1...6": polypropylene |
| | DN200...3000 / 8...120": hard rubber |
| | Option: |
| | DN25...150 / 1...6": hard rubber |
| Protective coating | On exterior of the meter: flanges, housing, signal converter (compact version) and / or connection box (field version) |
| | Standard coating |
| | Option: subsoil coating, offshore coating |
| Connection box | Only for remote versions |
| | Standard: die-cast aluminum |
| | Option: stainless steel |
| Measuring electrodes | Standard: Hastelloy® C |
| | Option: stainless steel, titanium |
| | Other materials on request |
| Grounding rings | Standard: stainless steel |
| | Option: Hastelloy® C, titanium, tantalum |
| | Grounding rings can be omitted with virtual reference option for the signal converter IFC 300 and IFC 400. |
| Reference electrode (optional) | Standard: Hastelloy® C |
| | Option: stainless steel, titanium |
| | Other materials on request |

Process connections

| Flange | |
|--------------------------|--|
| EN 1092-1 | DN25...3000 in PN 2.5...40 |
| ASME | 1...24" in 150 & 300 lb RF |
| JIS | DN25...1000 in 10...20 K |
| AWWA | DN700...2000 in 6...10 bar |
| Design of gasket surface | RF |
| | Other sizes or pressure ratings on request |

Electrical connections

| | |
|--|---|
| For full detail refer to the relevant documentation of the signal converter. | |
| Signal cable (remote versions only) | |
| Type A (DS) | In combination with the signal converter IFC 050, IFC 100, IFC 300 and IFC 400 Standard cable, double shielded. Max. length: 600 m / 1968 ft (depends on electrical conductivity and flow sensor) |
| Type B (BTS) | Only in combination with the signal converter IFC 300 and IFC 400 Optional cable, triple shielded. Max. length: 600 m / 1968 ft (depends on electrical conductivity and flow sensor) |
| 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 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. |
| Hazardous area | |
| ATEX | Please check the relevant Ex documentation for details. |
| | OPTIFLUX 2000 F; FTZU 13 ATEX 0175 X |
| | II 2G Ex eb ia q IIC T5...T3 Gb (DN25...150); non-PFA |
| | II 2G Ex eb ia q IIC T6...T3 Gb (DN200...300) |
| | II 2G Ex eb ia IIC T6...T3 Gb (DN350...3000) |
| IECEX | OPTIFLUX 2000 F; IECEX FTZU 14.0001 X |
| | II 2G Ex eb ia q IIC T5...T3 Gb (DN25...150); non-PFA |
| | II 2G Ex eb ia q IIC T6...T3 Gb (DN200...300) |
| | II 2G Ex eb ia IIC T6...T3 Gb (DN350...3000) |
| | II 2D Ex tb IIIC T85°C...T180°C Db (DN25...3000) |
| NEPSI (China) | OPTIFLUX 2000 F; GYJ20.1342X |
| | Ex e ia q IIC T3-T5 Gb (DN25...150); non-PFA |
| | Ex e ia q IIC T3-T6 Gb (DN200...300) |
| | Ex e ia IIC T3-T6 Gb (DN350...3000) |
| | Ex tD A21 IP6X T85°C-T150°C Db (DN2.5...3000) |
| DNV (Brazil) | OPTIFLUX 2000 F; DNV 20.0072 X |
| | Ex eb ia q IIC T5...T3 Gb (DN25...150); non-PFA |
| | Ex eb ia q IIC T6...T3 Gb (DN200...300) |
| | Ex eb ia IIC T6...T3 Gb (DN350...3000) |
| | Ex tb IIIC T180°C Db; IP66/IP67 (DN25...3000) |
| FM (USA) | OPTIFLUX 2000-DIV2; FM 17 US 0301X; (with IFC 100 W signal converter) |
| | OPTIFLUX 2000-DIV2; FM 16 US 0329X; (with IFC 300 F signal converter) |
| | Class I, Division 2; Groups ABCD; T6 |
| | Class II, Division 2; Groups FG |
| FM, CSA (Canada) | Class III, Division 2; T6...T3 |
| | OPTIFLUX 2000-DIV2; FM 17 CA 0153X; (with IFC 100 W signal converter) |
| | Class I, Division 2; Groups ABCD |
| | Class II, Division 2; Groups FG |
| | Class III, Division 2; T6...T3 |
| | OPTIFLUX 2000-DIV2; CSA 1665151; (with IFC 300 F signal converter) |
| | Class I, Division 2; Groups ABCD |
| Class II, Division 2; Groups FG; T6 | |
| KCS Korea) | OPTIFLUX 2000 |
| | 14-AV4B0-0743X : Ex qe ia IIC T3...T6 (DN25...150); non-PFA |
| | 14-AV4B0-0743X : Ex qe ia IIC T3...T6 (DN200...300) |
| | 14-AV4B0-0741X : Ex e ia IIC T3...T6 (DN350...3000) |

| Other approvals and standards | |
|---------------------------------------|--|
| Custody transfer | Only in combination with the IFC 300 signal converter |
| | MID Annex MI-001 type examination certificate |
| | OIML R49 certificate of conformity |
| | Conformity with ISO 4064 and EN 14154 |
| Drinking water approvals | Hard rubber liner: NSF / ANSI / CAN standard 61 / ACS, KTW (<60°C), DVGW-W270, WRAS, KIWA . |
| | Polypropylene liner: ACS, KIWA/ATA, KTW, NSF / ANSI / CAN standard 61, WRAS, DVGW-W270, DM 174 |
| VdS Fire Extinguishing Systems | Only with OPTIFLUX 2100 C, W |
| | Use in fire and safety equipment |
| | Available for nominal diameters: DN25...50: 25 bar/ DN65...200: 16 bar/ DN250...300: 10 an 16 bar |
| Protection category acc. to IEC 60529 | Standard: |
| | IP66/67, NEMA 4/4X/6 |
| | Option: |
| | IP68, NEMA 6P |
| | IP68 is only available for separate design and with a stainless steel connection box. |
| Protective coating | Standard, ISO 12944-2: C3 medium / C4 high Off shore coating; ISO 12944-2: C5I high / C5M high |
| Random vibration test | IEC 60068-2-64: 20...2000 Hz, ASD 1.0 (m/s ²) 2/Hz, RMS a = 4.5 g |
| | IEC 60068-2-64 / IEC 60721-3-4 Class 4M11: 5...200 Hz, ASD 0.01 (m/s ²) 2/Hz |
| Sinus vibration test | IEC 60068-2-6 / IEC 61298-3 |
| | 10...58 Hz: 0.15 mm / 58...1000 Hz, a = 2 g |
| Shock test | IEC 60068-2-27 / IEC 60721-3-4 |
| | Half sine wave, Class 4M12, 2 g, pulse duration 6 ms |

2.2 Legal metrology

*OIML R49 and MID Annex MI-001 is **only** available in combination with the IFC 300 signal converter!*

2.2.1 OIML R49

The OPTIFLUX 2300 has a certificate of conformity with the international recommendation OIML R49-1. The certificate has been issued by NMi (Dutch board of weight and measures).

The OIML R49 -1 concerns water meters intended for the metering of cold potable and hot water. The measuring range of the flowmeter is determined by Q3 (nominal flow rate) and R (ratio).

The OPTIFLUX 2300 meets the requirements for water meters of accuracy class 1 and 2.

The following accuracy can be met in all installation orientations (horizontal, vertical or diagonal) and with flow profile sensitivity class 0DN / 0DN (0 x DN upstream and 0 x DN downstream).

- For accuracy class 1, the maximum permissible error for water meters is $\pm 1\%$ for the upper flow rate zone and $\pm 3\%$ for the lower flow rate zones.
- For accuracy class 2, the maximum permissible error for water meters is $\pm 2\%$ for the upper flow rate zone and $\pm 5\%$ for the lower flow rate zones.

$$Q1 = Q3 / R$$

$$Q2 = Q1 * 1.6$$

$$Q3 = Q1 * R$$

$$Q4 = Q3 * 1.25$$

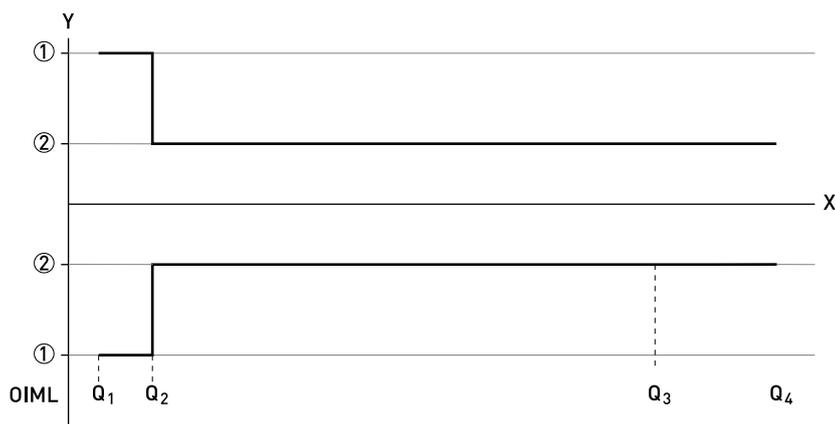


Figure 2-1: ISO flow rates added to figure as comparison towards OIML

X: Flow rate

Y [%]: Maximum measuring error

① $\pm 3\%$ for class 1, $\pm 5\%$ for class 2 devices

② $\pm 1\%$ for class 1, $\pm 2\%$ for class 2 devices

OIML R49 Class 1

| DN | Span (R) | Flow rate [m ³ /h] | | | |
|------|----------|-------------------------------|-----------------|--------------|-------------|
| | | Minimum Q1 | Transitional Q2 | Permanent Q3 | Overload Q4 |
| 50 | 400 | 0.10 | 0.16 | 40 | 50 |
| 65 | 630 | 0.1587 | 0.254 | 100 | 125 |
| 80 | 630 | 0.254 | 0.4063 | 160 | 200 |
| 100 | 630 | 0.3968 | 0.6349 | 250 | 312.5 |
| 125 | 630 | 0.6349 | 1.0159 | 400 | 500 |
| 150 | 630 | 0.6349 | 1.0159 | 400 | 500 |
| 200 | 1000 | 1.0 | 1.6 | 1000 | 1250 |
| 250 | 1000 | 1.6 | 2.56 | 1600 | 2000 |
| 300 | 1000 | 2.5 | 4.0 | 2500 | 3125 |
| 350 | 500 | 5.0 | 8.0 | 2500 | 3125 |
| 400 | 500 | 8.0 | 12.8 | 4000 | 5000 |
| 450 | 500 | 8.0 | 12.8 | 4000 | 5000 |
| 500 | 500 | 12.6 | 20.16 | 6300 | 7875 |
| 600 | 160 | 39.375 | 63 | 6300 | 7875 |
| 700 | 80 | 125 | 200 | 10000 | 12500 |
| 800 | 80 | 125 | 200 | 10000 | 12500 |
| 900 | 80 | 200 | 320 | 16000 | 20000 |
| 1000 | 80 | 200 | 320 | 16000 | 20000 |
| 1100 | 80 | 200 | 320 | 16000 | 20000 |
| 1200 | 80 | 200 | 320 | 16000 | 20000 |
| 1300 | 80 | 312.5 | 500 | 25000 | 31250 |
| 1400 | 80 | 312.5 | 500 | 25000 | 31250 |
| 1500 | 80 | 312.5 | 500 | 25000 | 31250 |
| 1600 | 80 | 312.5 | 500 | 25000 | 31250 |
| 1800 | 50 | 500 | 800 | 25000 | 31250 |

OIML R49 Class 2

| DN | Span (R) | Flow rate [m ³ /h] | | | |
|----|----------|-------------------------------|-----------------|--------------|-------------|
| | | Minimum Q1 | Transitional Q2 | Permanent Q3 | Overload Q4 |
| 25 | 400 | 0.040 | 0.064 | 16 | 20 |
| 32 | 400 | 0.0625 | 0.10 | 25 | 31.25 |
| 40 | 400 | 0.0625 | 0.10 | 25 | 31.25 |

Standard factory Span (R) =80. Other Span up to Ratio = 400 on request.

2.2.2 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 Regulation 2016 No. 1153 Annex III (MI-001).

Annex MI-001 of the MID applies to water meters intended for the measurement of 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 OPTIFLUX 2300 has a type examination certificate and can be verified to the MID Annex III (MI-001) for water meters with diameter DN25...DN1800.

The conformity assessment procedure followed for OPTIFLUX 2300 is Module B (Type Examination) and Module D (Quality Assurance of the Production Process).

The following accuracy can be met in all installation orientations (horizontal, vertical or diagonal) and with flow profile sensitivity class 0DN / 0DN (0 x DN upstream and 0 x DN downstream).

- 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 $\pm 5\%$.

$$Q1 = Q3 / R$$

$$Q2 = Q1 * 1.6$$

$$Q3 = Q1 * R$$

$$Q4 = Q3 * 1.25$$

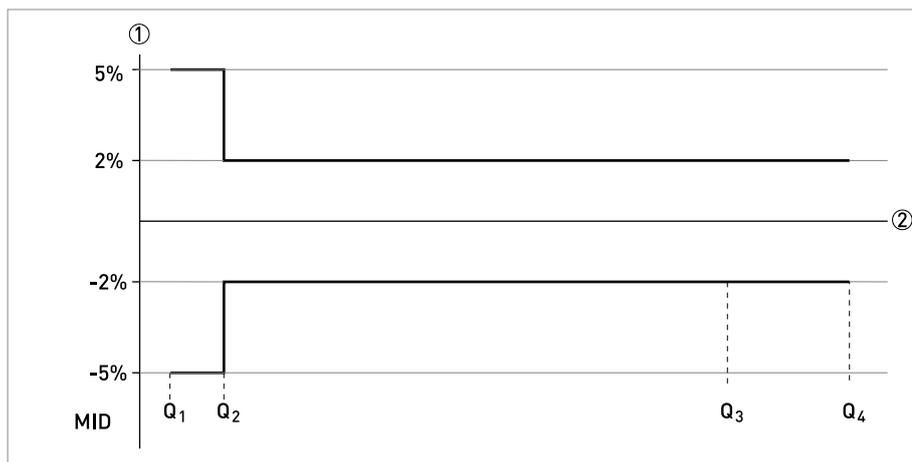


Figure 2-2: ISO flow rates added to figure as comparison towards MID

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 | 400 | 0.04 | 0.064 | 16 | 20 |
| 32 | 400 | 0.0625 | 0.10 | 25 | 31.25 |
| 40 | 400 | 0.0625 | 0.10 | 25 | 31.25 |
| 50 | 400 | 0.10 | 0.16 | 40 | 50 |
| 65 | 625 | 0.1587 | 0.254 | 100 | 125 |
| 80 | 640 | 0.254 | 0.4063 | 160 | 200 |
| 100 | 625 | 0.3968 | 0.6349 | 250 | 312.5 |
| 125 | 667 | 0.6349 | 1.0159 | 400 | 500 |
| 150 | 667 | 0.6349 | 1.0159 | 400 | 500 |
| 200 | 1000 | 1.0 | 1.6 | 1000 | 1250 |
| 250 | 1000 | 1.6 | 2.56 | 1600 | 2000 |
| 300 | 1000 | 2.5 | 4.0 | 2500 | 3125 |
| 350 | 500 | 5.0 | 8.0 | 2500 | 3125 |
| 400 | 500 | 8.0 | 12.8 | 4000 | 5000 |
| 450 | 500 | 8.0 | 12.8 | 4000 | 5000 |
| 500 | 500 | 12.6 | 20.16 | 6300 | 7875 |
| 600 | 160 | 39.375 | 63 | 6300 | 7875 |
| 700 | 80 | 125 | 200 | 10000 | 12500 |
| 800 | 80 | 125 | 200 | 10000 | 12500 |
| 900 | 80 | 200 | 320 | 16000 | 20000 |
| 1000 | 80 | 200 | 320 | 16000 | 20000 |
| 1100 | 80 | 200 | 320 | 16000 | 20000 |
| 1200 | 80 | 200 | 320 | 16000 | 20000 |
| 1300 | 80 | 312.5 | 500 | 25000 | 31250 |
| 1400 | 80 | 312.5 | 500 | 25000 | 31250 |
| 1500 | 80 | 312.5 | 500 | 25000 | 31250 |
| 1600 | 80 | 312.5 | 500 | 25000 | 31250 |
| 1800 | 59 | 500 | 800 | 25000 | 31250 |

2.3 Measuring 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: ≥ 5 DN
- Outlet section: ≥ 2 DN

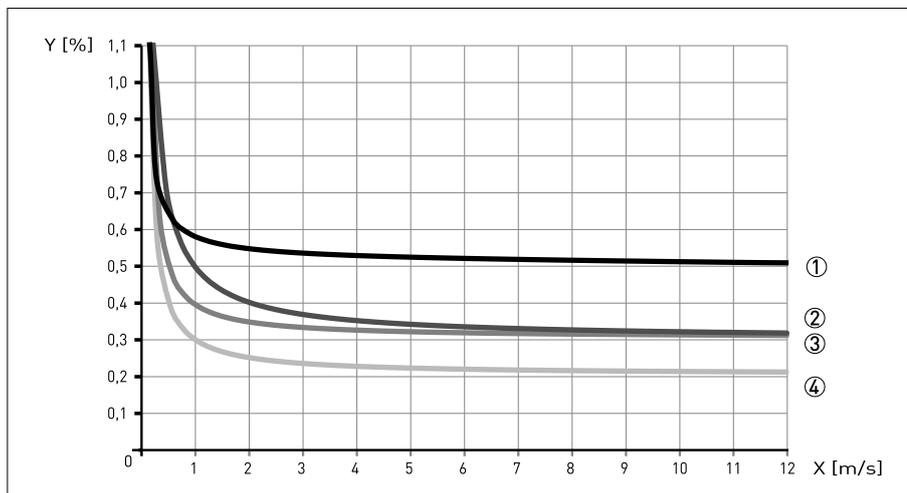


Figure 2-3: Flow velocity vs. accuracy
 X [m/s] : flow velocity
 Y [%]: deviation from the actual measured value (mv)

Accuracy

| Flow sensor diameter | Signal converter type | Accuracy | Curve |
|-----------------------|-----------------------|---------------------|-------|
| DN25...1200 / 1...48" | IFC 050 | 0.5% of mv + 1 mm/s | ① |
| DN25...1200 / 1...48" | IFC 100 | 0.3% of mv + 1 mm/s | ③ |
| DN25...1600 / 1...64" | IFC 300/ IFC 400 | 0.2% of mv + 1 mm/s | ④ |
| DN1800...3000 / > 64" | IFC 300/ IFC 400 | 0.3% of mv + 2 mm/s | ② |

Optionally for IFC 050 and IFC 100; extended calibration at 2 points for optimised accuracy. For more details on optimised accuracy, see the concerning signal converter documentation.

2.4 Pressure derating

The graphs below refer to the maximum pressure as a function of the temperature for the flanges of the flowmeter (per specified flange material).

Please note that the specified values only refer to the flanges. The maximum value for the flowmeter can further be limited by the maximum value for other materials (i.e. the liner)

For A = Carbon steel A 105 & B = Stainless steel 316L

X/Y axes in all graphs; X = Temperature in [°C] / Y = Pressure in [bar]
x/y axes in all graphs; x = Temperature in [°F] / y = Pressure in [psi]

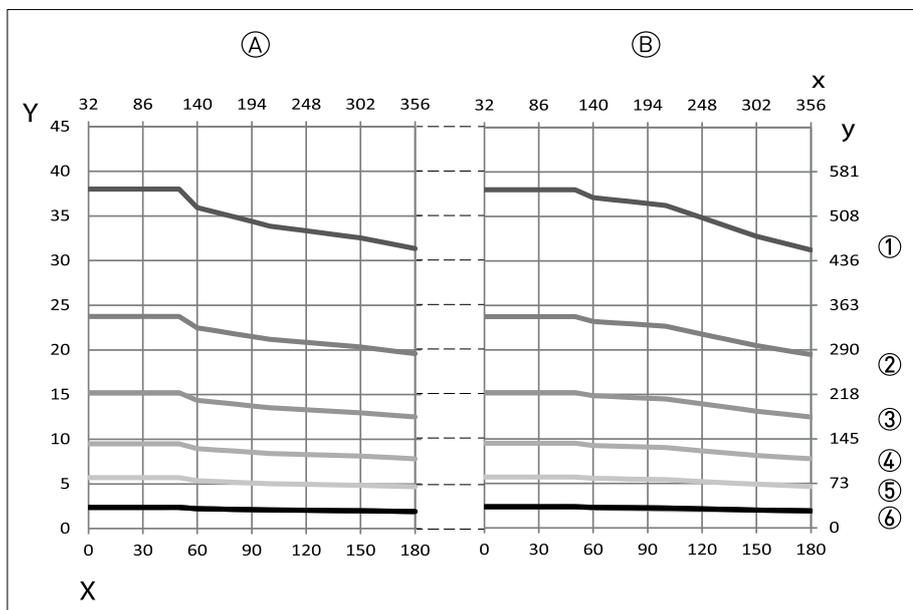


Figure 2-4: Pressure derating; EN 1092-1

- ① PN 40
- ② PN 25
- ③ PN 16
- ④ PN 10
- ⑤ PN 6
- ⑥ PN 2.5

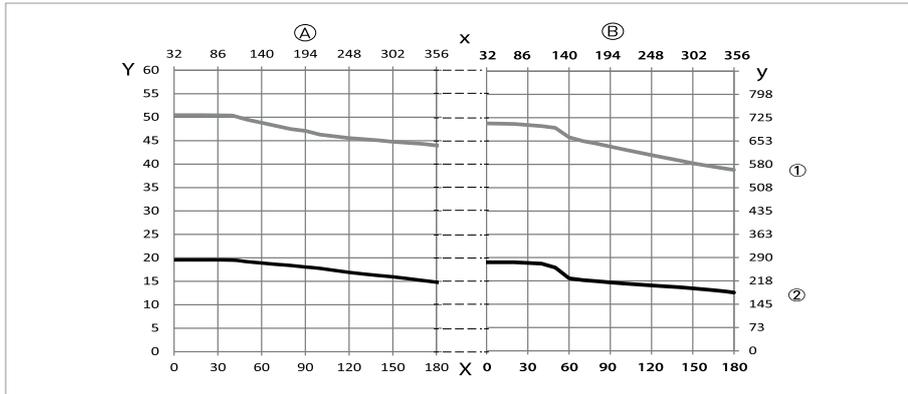


Figure 2-5: Pressure derating; ANSI B16.5

- ① 300 lbs
- ② 150 lbs

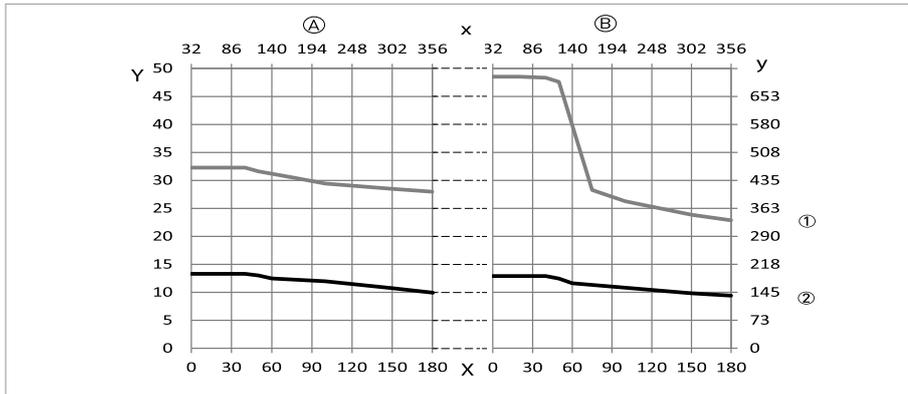


Figure 2-6: Pressure derating; JIS B2220

- ① 20K
- ② 10K

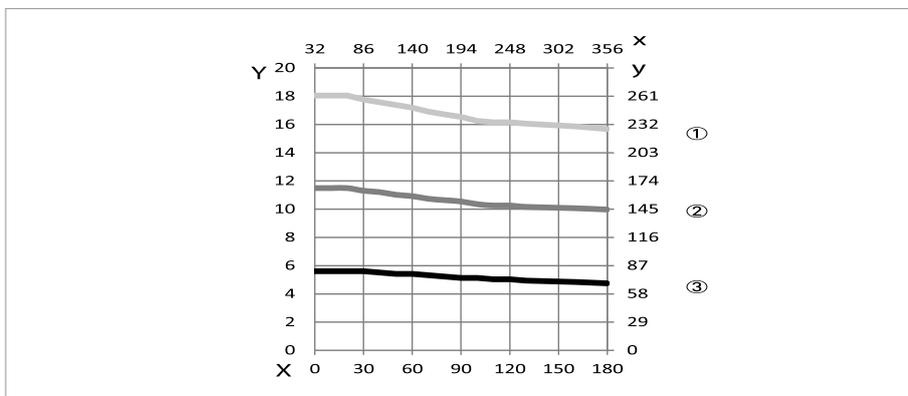


Figure 2-7: Pressure derating; AWWA C207

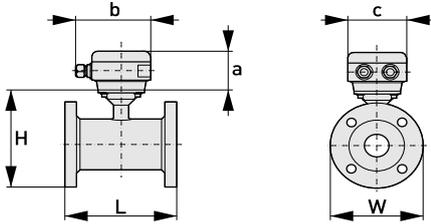
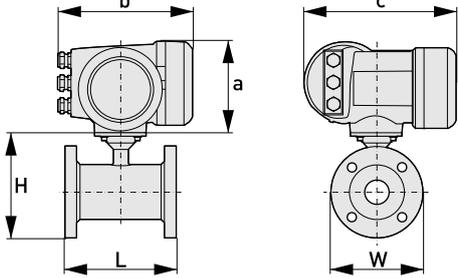
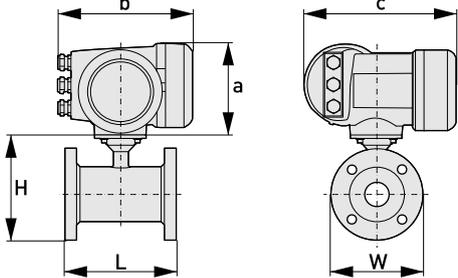
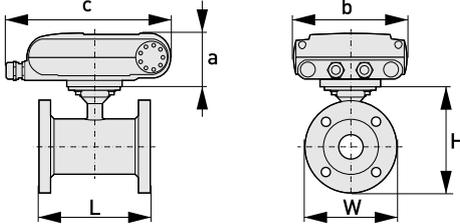
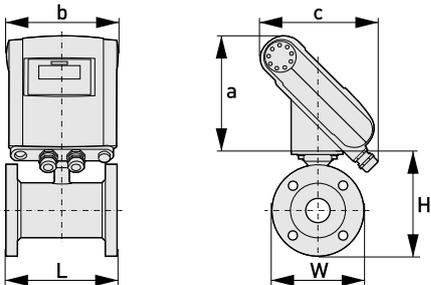
- ① Class D1 [4...12"]
- ② Class D2 [>12"]
- ③ Class B

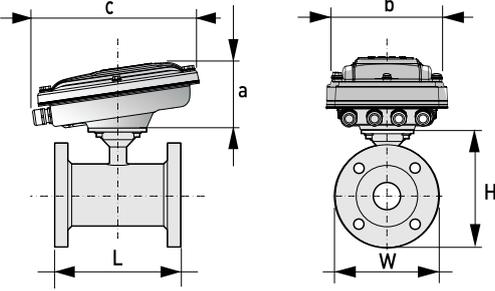
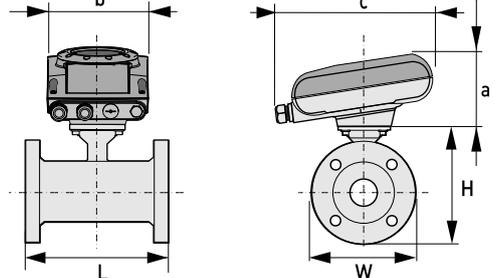
2.5 Vacuum load

| Diameter | Vacuum load in mbar abs. at a process temperature of | | | |
|----------------------|--|------|------|------|
| [mm] | 20°C | 40°C | 60°C | 80°C |
| Hard rubber | | | | |
| DN200...300 | 250 | 250 | 400 | 400 |
| DN350...1000 | 500 | 500 | 600 | 600 |
| DN1200...3000 | 600 | 600 | 750 | 750 |
| Polypropylene | | | | |
| DN25...150 | 250 | 250 | 400 | 400 |

| Diameter | Vacuum load in psia at process temperature of | | | |
|----------------------|---|-------|-------|-------|
| [inch] | 68°F | 104°F | 140°F | 176°F |
| Hard rubber | | | | |
| 8...12 | 3.6 | 3.6 | 5.8 | 5.8 |
| 14...40 | 7.3 | 7.3 | 8.7 | 8.7 |
| 48...120 | 8.7 | 8.7 | 10.9 | 10.9 |
| Polypropylene | | | | |
| 1...6 | 3.6 | 3.6 | 5.8 | 5.8 |

2.6 Dimensions and weights

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

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

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 ② [kg] |
|-------------------------|--------------------|----------------------------|---|---|------|------|-----------------------------|
| | Standard length | ISO Insertion length | Standard length ① ATEX with HR liner | Standard length ① ATEX with HR liner | H | W | |
| 25 | 150 | 200 | 200 | 200 | 140 | 115 | 5 |
| 32 | 150 | 200 | 200 | 200 | 157 | 140 | 6 |
| 40 | 150 | 200 | 200 | 200 | 166 | 150 | 7 |
| 50 | 200 | 200 | 250 | n.a | 186 | 165 | 11 |
| 65 | 200 | 200 | 250 | n.a | 200 | 185 | 9 |
| 80 | 200 | 200 | 250 | n.a | 209 | 200 | 14 |
| 100 | 250 | 250 | 250 | 250 | 237 | 220 | 15 |
| 125 | 250 | 250 | 300 | n.a | 266 | 250 | 19 |
| 150 | 300 | 300 | 300 | 300 | 300 | 285 | 27 |
| 200 | 350 | 350 | 350 | 350 | 361 | 340 | 34 |
| 250 | 400 | 450 | 400 | 400 | 408 | 395 | 48 |
| 300 | 500 | 500 | 500 | 500 | 458 | 445 | 58 |
| 350 | 500 | 550 | 500 | 550 | 510 | 505 | 78 |
| 400 | 600 | 600 | 600 | 600 | 568 | 565 | 101 |
| 450 | 600 | - | 600 | | 618 | 615 | 111 |
| 500 | 600 | - | 600 | | 671 | 670 | 130 |
| 600 | 600 | - | 600 | | 781 | 780 | 165 |
| 700 | 700 | - | 700 | | 898 | 895 | 248 |
| 800 | 800 | - | 800 | | 1012 | 1015 | 331 |
| 900 | 900 | - | 900 | | 1114 | 1115 | 430 |
| 1000 | 1000 | - | 1000 | | 1225 | 1230 | 507 |
| 1200 | 1200 | - | 1200 | | 1417 | 1405 | 555 |
| 1400 | 1400 | - | 1400 | | 1619 | 1630 | 765 |
| 1600 | 1600 | - | 1600 | | 1819 | 1830 | 1035 |
| 1800 | 1800 | - | 1800 | | 2027 | 2045 | 1470 |
| 2000 | 2000 | - | 2000 | | 2259 | 2265 | 1860 |

① Only ATEX version with Hard Rubber liner (and Potable water certified HR).

② Extra options like material, pressure rating and Ex will increase weight.

ASME B16.5 / 150 lb flanges

| Nominal size [inch] | Dimensions [inch] | | | | Approx. weight [lb] ② |
|------------------------|-------------------|------------------------------|-------|-------|-----------------------------|
| | L | L ① ATEX with HR liner | H | W | |
| 1" | 5.91 | 7.87 | 5.39 | 4.25 | 9 |
| 1 1/4" | 5.91 | 7.87 | 5.75 | 4.63 | 13 |
| 1 1/2" | 5.91 | 7.87 | 6.10 | 5.00 | 15 |
| 2" | 7.87 | 9.84 | 7.05 | 5.98 | 18 |
| 2 1/2" | 7.87 | 9.84 | 7.72 | 7 | 22 |
| 3" | 7.87 | 9.84 | 8.03 | 7.50 | 26 |
| 4" | 9.84 | 9.84 | 9.49 | 9.00 | 44 |
| 5" | 9.84 | 11.81 | 10.55 | 10.00 | 49 |
| 6" | 11.81 | 11.81 | 11.69 | 11.00 | 64 |
| 8" | 13.78 | 13.78 | 14.25 | 13.50 | 95 |
| 10" | 15.75 | 15.75 | 16.30 | 16.00 | 143 |
| 12" | 19.69 | 19.69 | 18.78 | 19.00 | 207 |
| 14" | 27.56 | 27.56 | 20.67 | 21.00 | 284 |
| 16" | 31.50 | 31.50 | 22.95 | 23.50 | 364 |
| 18" | 31.50 | 31.50 | 24.72 | 25.00 | 410 |
| 20" | 31.50 | 31.50 | 26.97 | 27.50 | 492 |
| 24" | 31.50 | 31.50 | 31.38 | 32.00 | 675 |

① Only ATEX version with Hard Rubber liner (and Potable water certified HR).

② Extra options like material, pressure rating and Ex will increase weight.

- Pressures at 20°C / 68°F.
- For higher temperatures, the pressure and temperature ratings are as per ASME B16.5.

ASME B16.5 / 300 lb flanges

| Nominal size [inch] | Dimensions [inch] | | | | Approx. weight [lb] ② |
|------------------------|-------------------|-------|-------|-------|-----------------------------|
| | L | L ① | H | W | |
| 1" | 5.91 | 7.87 | 5.71 | 4.87 | 11 |
| 1 1/4" | 7.87 | 9.84 | 6.30 | 5.25 | 17 |
| 1 1/2" | 7.87 | 9.84 | 6.65 | 6.13 | 20 |
| 2" | 9.84 | 9.84 | 7.32 | 6.50 | 22 |
| 2 1/2" | 9.84 | 9.84 | 7.95 | 7.5 | 25 |
| 3" | 9.84 | 11.81 | 8.43 | 8.25 | 31 |
| 4" | 11.81 | 11.81 | 10.00 | 10.00 | 44 |
| 5" | 11.81 | 13.78 | 11.26 | 11.26 | 58 |
| 6" | 12.60 | 13.78 | 12.44 | 12.50 | 73 |
| 8" | 15.75 | 15.75 | 15.04 | 15.00 | 157 |
| 10" | 19.69 | 19.69 | 17.05 | 17.50 | 247 |
| 12" | 23.62 | 23.62 | 20.00 | 20.50 | 375 |
| 14" | 27.56 | 27.56 | 21.65 | 23.00 | 474 |
| 16" | 31.50 | 31.50 | 23.98 | 25.50 | 639 |
| 18" | 31.50 | 31.50 | 25.65 | 27.95 | 790 |
| 20" | 31.50 | 31.50 | 28.46 | 30.50 | 937 |
| 24" | 31.50 | 31.50 | 33.39 | 36.00 | 1345 |

① Only ATEX version with Hard Rubber liner (and Potable water certified HR).

② Extra options like material, pressure rating and Ex will increase weight.

- Pressures at 20°C / 68°F.
- For higher temperatures, the pressure and temperature ratings are as per ASME B16.5.

AWWA (D), class D, FF flanges

| Nominal size | | Dimensions (approximately) ① | | | Approx. weight [kg] |
|--------------|--------|------------------------------|------|--------|---------------------|
| DN | [inch] | L [mm] | H | W [mm] | |
| 400 | 18" | 600 | 600 | 635 | 120 |
| 600 | 24" | 800 | 810- | 813 | 210 |
| 650 | 26" | 700 | 865 | 870 | 270 |
| 700 | 28" | 700 | 914 | 927 | 290 |
| 750 | 30" | 750 | 971 | 984 | 340 |
| 800 | 32" | 800 | 1035 | 1060 | 420 |
| 900 | 36" | 900 | 1160 | 1168 | 540 |
| 1000 | 40" | 1000 | 1254 | 1289 | 680 |
| 1050 | 42" | 1100 | 1314 | 1346 | 720 |
| 1100 | 44" | 1100 | 1366 | 1403 | 810 |
| 1200 | 48" | 1200 | 1470 | 1511 | 940 |
| 1300 | 52" | 1300 | 1608 | 1626 | 1175 |
| 1350 | 54" | 1400 | 1641 | 1683 | 1310 |
| 1500 | 60" | 1500 | 1793 | 1854 | 1580 |
| 1700 | 66" | 1800 | 2023 | 2032 | 2250 |
| 1800 | 72" | 1800 | 2106 | 2197 | 2550 |
| 1950 | 78" | 2000 | 2243 | 2362 | 3200 |
| 2400 | 96" | 2400 | 2688 | 2877 | 5450 |

Table 2-1: Dimensions in [mm], ① Exact dimensions on request

AWWA (D), class D, FF flanges

| Nominal size | | Dimensions (approximately) ① | | | Approx. weight [lb] |
|--------------|--------|------------------------------|-------|----------|---------------------|
| DN | [inch] | L [inch] | H | W [inch] | |
| 400 | 18" | 23.6 | 23.6 | 25.0 | 265 |
| 600 | 24" | 31.5 | 31.9 | 32.0 | 463 |
| 650 | 26" | 27.6 | 34.1 | 34.3 | 595 |
| 700 | 28" | 27.6 | 36 | 36.5 | 639 |
| 750 | 30" | 29.5 | 38.2 | 38.7 | 750 |
| 800 | 32" | 31.5 | 40.7 | 41.7 | 926 |
| 900 | 36" | 35.4 | 45.7 | 46.0 | 1191 |
| 1000 | 40" | 39.4 | 49.4 | 50.7 | 1499 |
| 1050 | 42" | 43.3 | 51.7 | 53.0 | 1588 |
| 1100 | 44" | 43.3 | 53.8 | 55.2 | 1786 |
| 1200 | 48" | 47.2 | 57.9 | 59.5 | 2073 |
| 1300 | 52" | 51.2 | 62.9 | 64.0 | 2591 |
| 1350 | 54" | 55.1 | 64.6 | 66.3 | 2889 |
| 1500 | 60" | 59.1 | 70.6 | 73.0 | 3484 |
| 1700 | 66" | 70.9 | 79.6 | 80.0 | 4961 |
| 1800 | 72" | 70.9 | 82.9 | 86.5 | 5623 |
| 1950 | 78" | 78.7 | 88.3 | 93.0 | 7056 |
| 2400 | 96" | 94.5 | 105.8 | 113.3 | 12017 |

Table 2-2: Dimensions in inch, ① Exact dimensions on request

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.

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

The OPTIFLUX 2000 electromagnetic flowmeter is designed exclusively to measure the flow of electrically conductive, liquid media.

3.2 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.

3.2.1 Vibrations

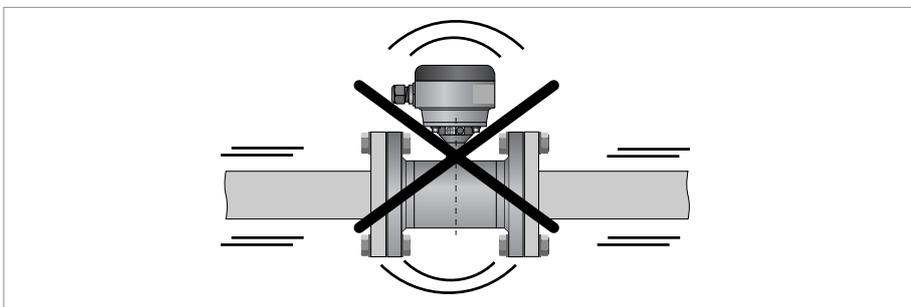


Figure 3-1: Avoid vibrations

3.2.2 Magnetic field

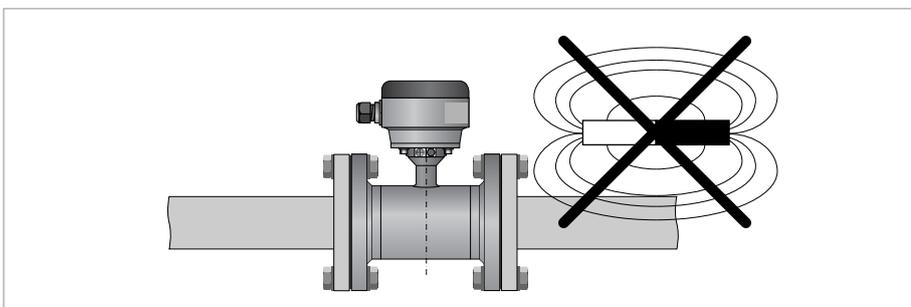


Figure 3-2: Avoid magnetic field

Keep at least 5 DN distance between electromagnetic flow sensors.

3.3 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). For installation conditions and accuracies see section OIML and MID in this manual and the OIML R49 /MID MI-001 certificates at the manufacturer's website.

3.3.1 Inlet and outlet

Use straight inlet and outlet pipe sections to prevent flow distortion or swirl, caused by bends and T- sections.

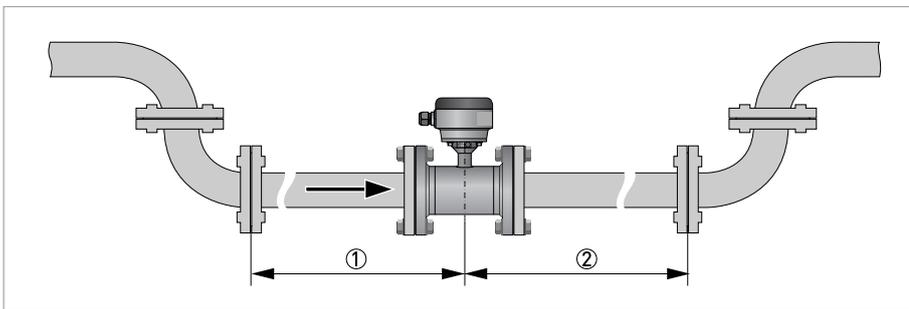


Figure 3-3: Recommended inlet and outlet section

- ① Refer to chapter "Bends in 2 or 3 dimensions"
- ② ≥ 2 DN

3.3.2 Bends in 2 or 3 dimensions

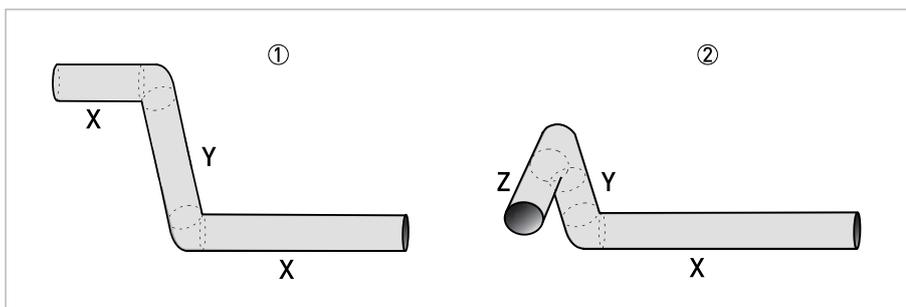


Figure 3-4: 2 and/or 3 dimensional bends upstream of the flowmeter

- ① 2 dimensions = X/Y
- ② 3 dimensions = X/Y/Z

Inlet length: using bends in 2 dimensions: ≥ 5 DN; when having bends in 3 dimensions: ≥ 10 DN

*2 dimensional bends occur in a vertical **or** horizontal plane (X/Y) only, while 3 dimensional bends occur in both vertical **and** horizontal plane (X/Y/Z).*

3.3.3 Bends

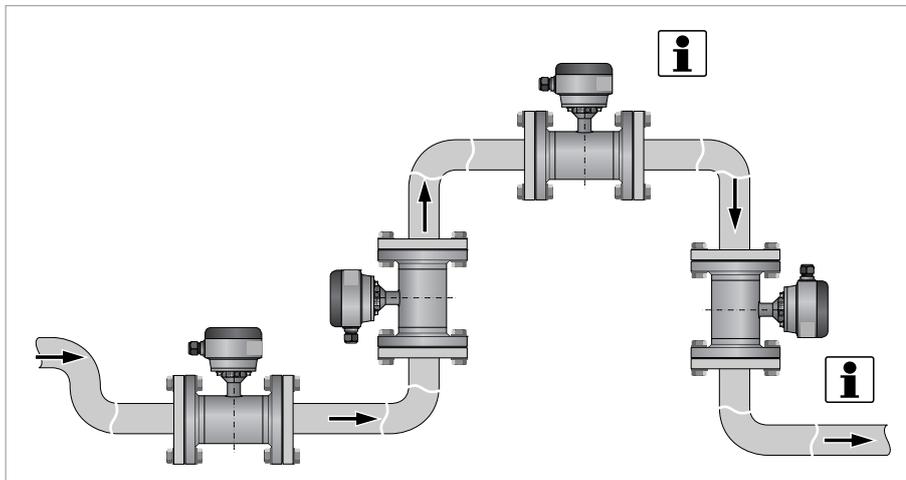


Figure 3-5: Installation in bending pipes (90°)

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.

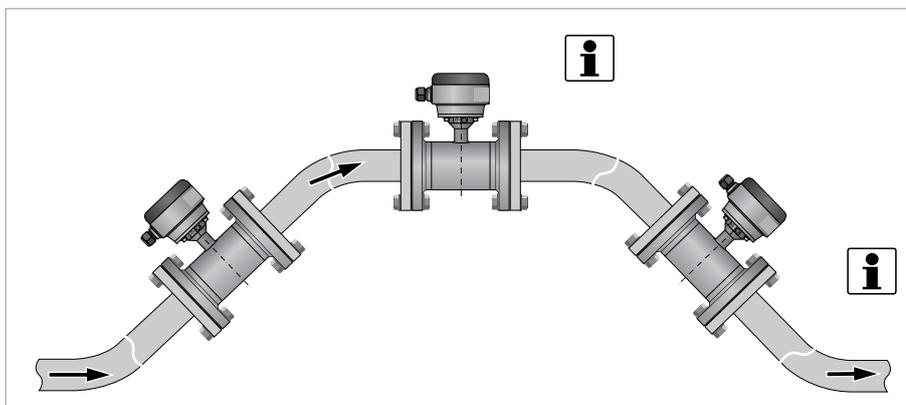


Figure 3-6: Installation in bending pipes (45°)

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.

3.3.4 T-section

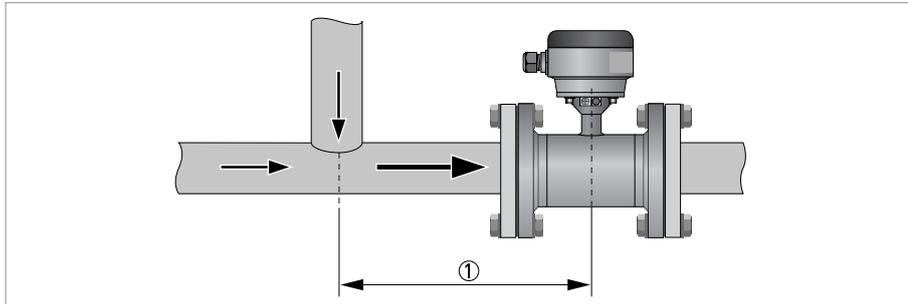


Figure 3-7: Distance behind a T-section

① $\geq 10 \text{ DN}$

3.3.5 Open discharge

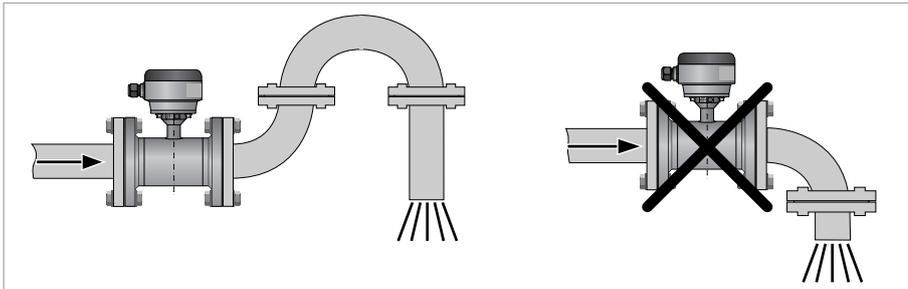


Figure 3-8: Installation in front of an open discharge

3.3.6 Control valve

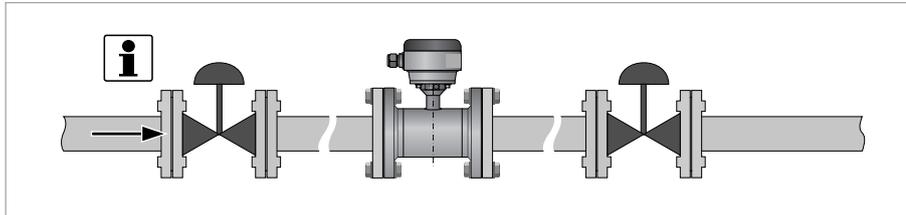


Figure 3-9: Installation in front of a control valve

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).

3.3.7 Pump

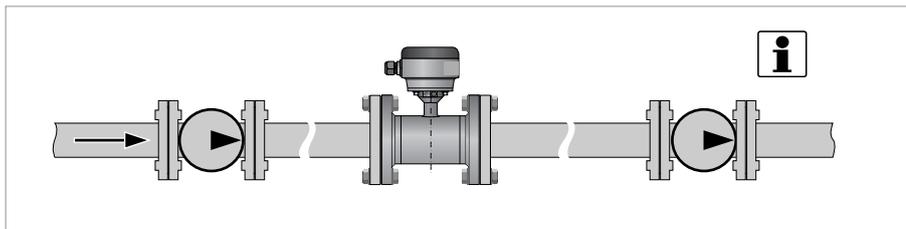


Figure 3-10: Installation behind a pump

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.

3.3.8 Air venting and vacuum forces

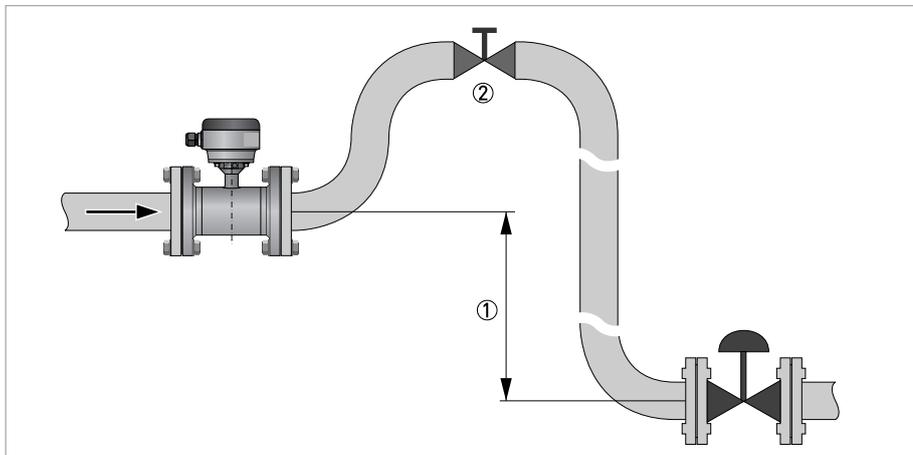


Figure 3-11: Air venting

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

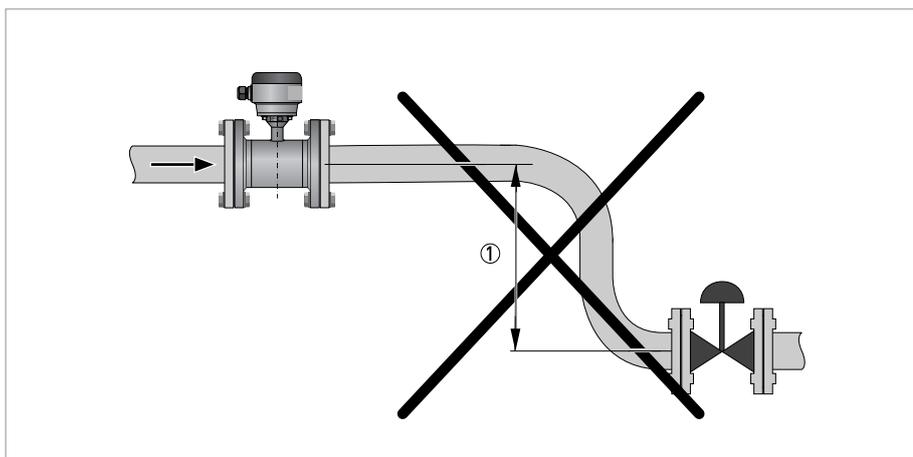


Figure 3-12: Vacuum

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

3.3.9 Flange deviation

Max. permissible deviation of pipe flange faces:
 $L_{max} - L_{min} \leq 0.5 \text{ mm} / 0.02''$

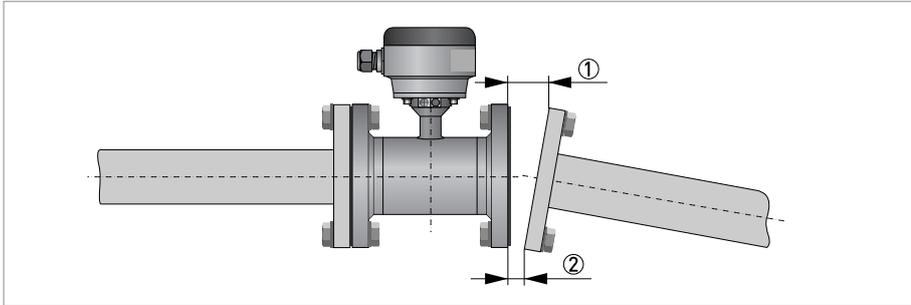


Figure 3-13: Flange deviation

- ① L_{max}
- ② L_{min}

3.3.10 Mounting position

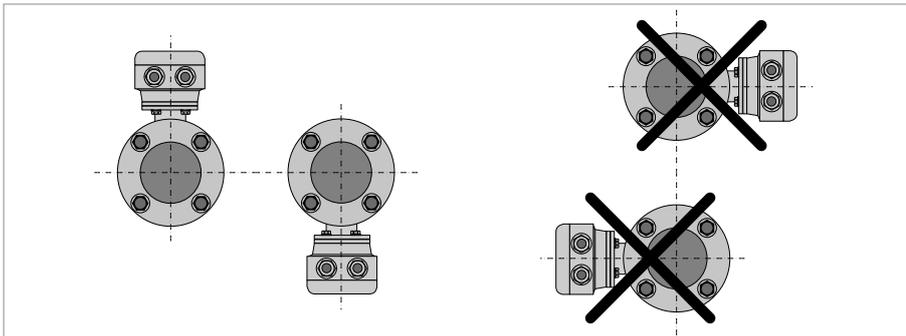


Figure 3-14: Mounting position

- 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.

3.4 Installation in a metering pit and subsurface applications

The OPTIFLUX 2000 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).

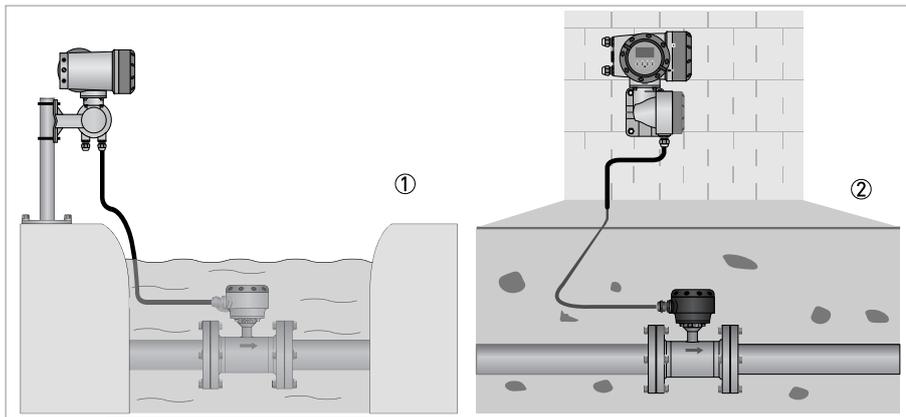


Figure 3-15: Examples of flooded and buried application

- 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

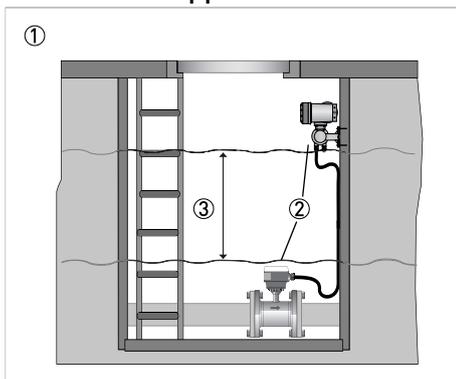


Figure 3-16: Examples of installation in measuring pit

- ① Continuous submersion
- ② Remote version
- ③ Maximum water column 10 meter / 33 ft

It is recommended to place the cables in a protective tube. The standard IP 68 field version is available for special (customer installed) applications. Customer specified cables can be applied by the installer and connected according to IP68 with the separate delivered two-component resin.

3.5 Mounting

Please take care to use the proper gasket to prevent damaging the liner of the flowmeter. In general, the use of spiral wound gaskets is not advised, as it could severely damage the liner of the flowmeter.

3.5.1 Torques and pressures

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

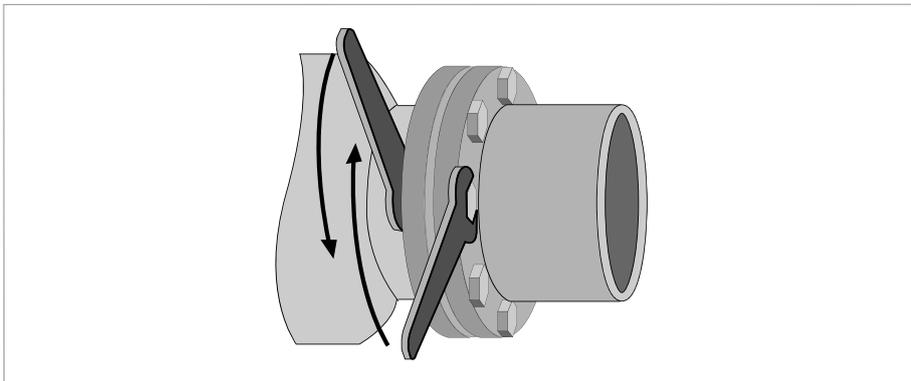


Figure 3-17: Tightening of bolts

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 | |
|-------------------------|--------------------|-----------|-------------------------------|-------------|
| | | | Polypropylene | Hard rubber |
| 25 | PN 40 | 4 x M 12 | 22 | 11 |
| 32 | PN 40 | 4 x M 16 | 37 | 19 |
| 40 | PN 40 | 4 x M 16 | 43 | 25 |
| 50 | PN 40 | 4 x M 16 | 55 | 31 |
| 65 | PN 16 | ② x M 16 | 51 | 42 |
| 65 | PN 40 | 8 x M 16 | 38 | 21 |
| 80 | PN 40 | 8 x M 16 | 47 | 25 |
| 100 | PN 16 | 8 x M 16 | 39 | 30 |
| 125 | PN 16 | 8 x M 16 | 53 | 40 |
| 150 | PN 16 | 8 x M 20 | 68 | 47 |
| 200 | PN 10 | 8 x M 20 | - | 68 |
| 200 | PN 16 | 12 x M 20 | - | 45 |
| 250 | PN 10 | 12 x M 20 | - | 65 |
| 250 | PN 16 | 12 x M 24 | - | 78 |
| 300 | PN 10 | 12 x M 20 | - | 76 |
| 300 | PN 16 | 12 x M 24 | - | 105 |
| 350 | PN 10 | 16 x M 20 | - | 75 |
| 400 | PN 10 | 16 x M 24 | - | 104 |
| 450 | PN 10 | 20 x M 24 | - | 93 |
| 500 | PN 10 | 20 x M 24 | - | 107 |
| 600 | PN 10 | 20 x M 27 | - | 138 |
| 700 | PN 10 | 24 x M 27 | - | 163 |
| 800 | PN 10 | 24 x M 30 | - | 219 |
| 900 | PN 10 | 28 x M 30 | - | 205 |
| 1000 | PN 10 | 28 x M 33 | - | 261 |

① The specified torque values are dependent on variables (temperature, bolt material, gasket material, lubricants, etc.) which are not within the control of the manufacturer. Therefore the values should be regarded as indicative only.

② DN65 / PN16 is available with standard 8 bolt holes. On request 4 bolt holes is optional.

Other sizes / pressure ratings on request.

| Nominal size [inch] | Flange class [lb] | Bolts | Max. torque [lbf.ft] ① | |
|------------------------|----------------------|-------------|------------------------|-------------|
| | | | Polypropylene | Hard rubber |
| 1 | 150 | 4 x 1/2" | 6.7 | 3.2 |
| 1 1/2 | 150 | 4 x 1/2" | 13 | 9 |
| 2 | 150 | 4 x 5/8" | 24 | 17 |
| 3 | 150 | 4 x 5/8" | 43 | 29 |
| 4 | 150 | 8 x 5/8" | 34 | 23 |
| 6 | 150 | 8 x 3/4" | 61 | 38 |
| 8 | 150 | 8 x 3/4" | - | 51 |
| 10 | 150 | 12 x 7/8" | - | 58 |
| 12 | 150 | 12 x 7/8" | - | 77 |
| 14 | 150 | 12 x 1" | - | 69 |
| 16 | 150 | 16 x 1" | - | 67 |
| 18 | 150 | 16 x 1 1/8" | - | 105 |
| 20 | 150 | 20 x 1 1/8" | - | 94 |
| 24 | 150 | 20 x 1 1/4" | - | 133 |
| 28 | 150 | 28 x 1 1/4" | - | 119 |
| 32 | 150 | 28 x 1 1/2" | - | 191 |
| 36 | 150 | 32 x 1 1/2" | - | 198 |
| 40 | 150 | 36 x 1 1/2" | - | 198 |

① The specified torque values are dependent on variables (temperature, bolt material, gasket material, lubricants, etc.) which are not within the control of the manufacturer. Therefore the values should be regarded as indicative only.

| Nominal size [inch] | Flange class [lb] | Bolts | Max. torque [lbf.ft] ① | |
|------------------------|----------------------|-------------|------------------------|-------------|
| | | | Polypropylene | Hard rubber |
| 1 | 300 | 4 x 5/8" | 11 | 5 |
| 1 1/2 | 300 | 4 x 3/4" | 29 | 20 |
| 2 | 300 | 8 x 5/8" | 18 | 13 |
| 3 | 300 | 8 x 3/4" | 44 | 30 |
| 4 | 300 | 8 x 3/4" | 69 | 47 |
| 6 | 300 | 12 x 3/4" | 62 | 38 |
| 8 | 300 | 12 x 7/8" | - | 60 |
| 10 | 300 | 16 x 1" | - | 75 |
| 12 | 300 | 16 x 1 1/8" | - | 113 |
| 14 | 300 | 20 x 1 1/4" | - | 71 |
| 16 | 300 | 20 x 1 1/4" | - | 92 |
| 18 | 300 | 24 x 1 1/4" | - | 108 |
| 20 | 300 | 24 x 1 1/4" | - | 121 |
| 24 | 300 | 24 x 1 1/2" | - | 189 |

① The specified torque values are dependent on variables (temperature, bolt material, gasket material, lubricants, etc.) which are not within the control of the manufacturer. Therefore the values should be regarded as indicative only.

Other sizes / pressure ratings on request.

- *Pressures are applicable at 20°C / 68°F.*
- *For higher temperatures, the pressure ratings are as per ASME B16.5.*

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.*

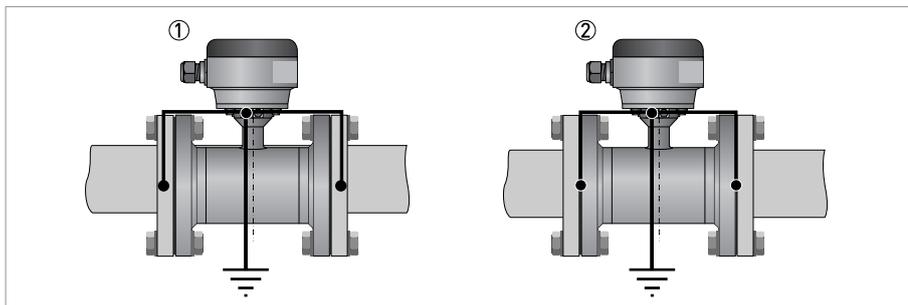


Figure 4-1: Grounding

- ① Metal pipelines, not internally coated. Grounding without grounding rings!
- ② Metal pipelines with internal coating and non-conductive pipelines. Grounding with grounding rings!

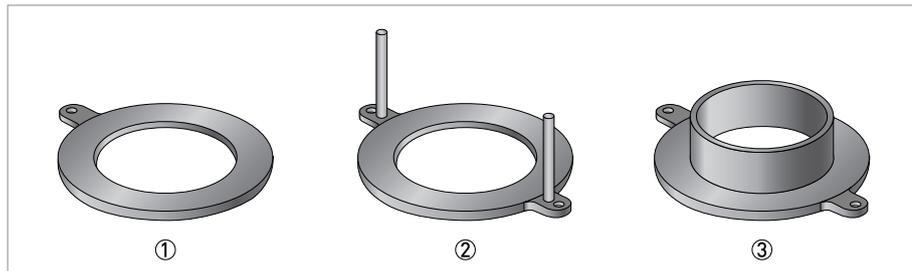


Figure 4-2: Different types of grounding rings

- ① Grounding ring number 1
- ② Grounding ring number 2
- ③ Grounding ring number 3

Grounding ring number 1:

- \leq DN300 / 12": 3 mm / 0.12"
- \geq DN350 / 14": 4 mm / 0.16"
(tantalum: 0.5 mm / 0.02")

Grounding ring number 2:

- \leq DN300 / 12": 3 mm / 0.12"
- \geq DN350 / 14": 4 mm / 0.16"
- Prevents damage to the flanges during transport and installation

Grounding ring number 3:

- \leq DN300 / 12": 3 mm / 0.12"
- \geq DN350 / 14": 4 mm / 0.16"
- With cylindrical neck (length 30 mm / 1.25" for DN25...150 / 1...6")
- Offers liner protection against abrasive fluids

4.3 Virtual reference option

Only in combination with the IFC 300 and IFC 400 signal converter (C, W and F version)

Benefits of virtual reference:

- Grounding rings or grounding electrodes can be omitted.
- Safety increases by reducing the number of potential leakage points.
- The installation of the flowmeters is much easier.
- Compliant with OIML-R49 and MID MI-001 certification (IFC 300).

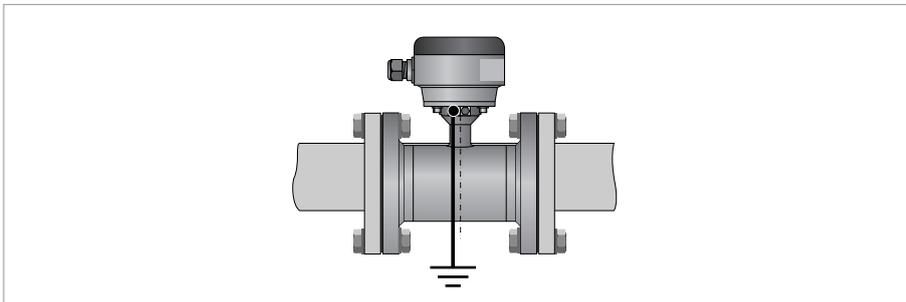


Figure 4-3: Virtual reference

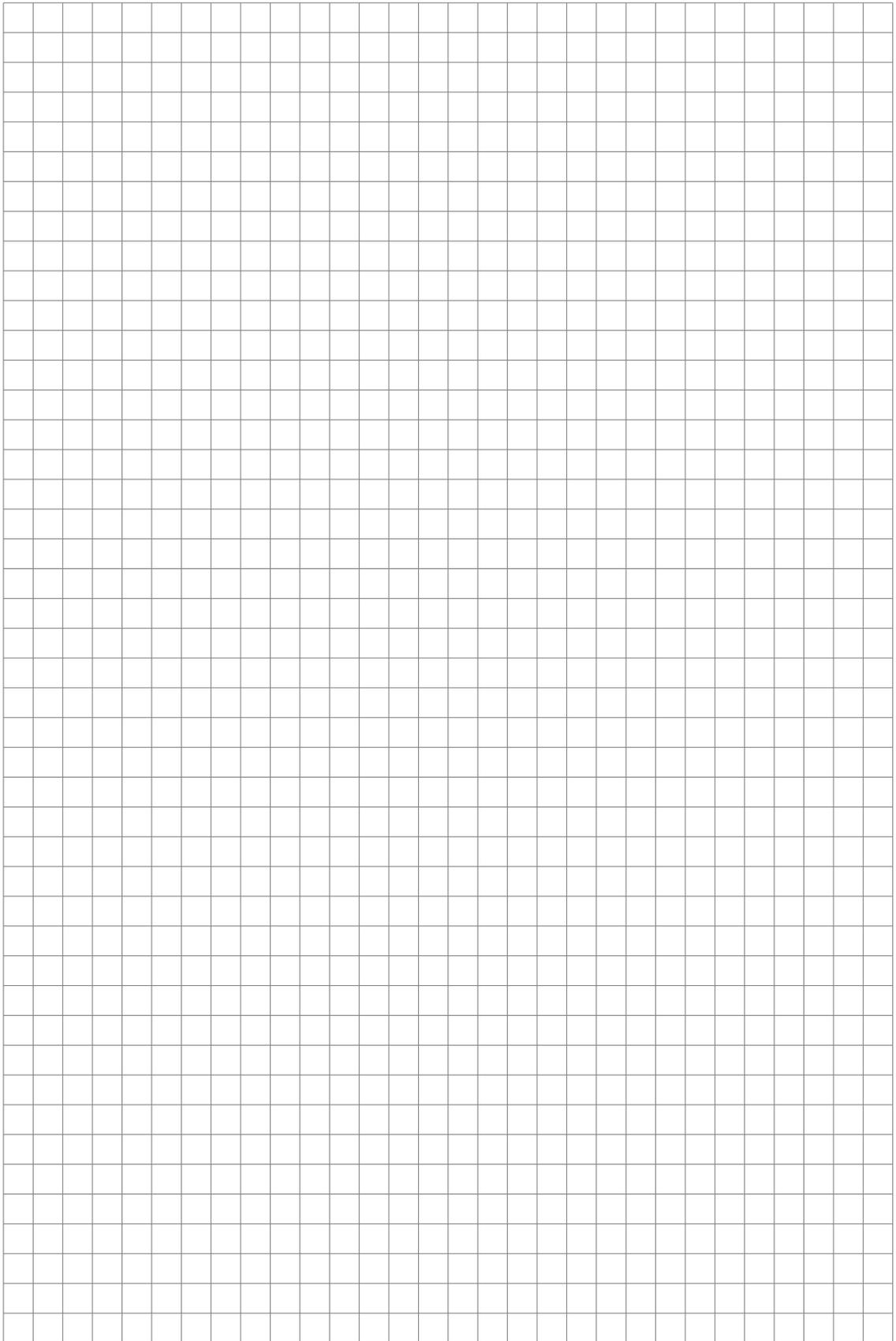
Minimum requirements:

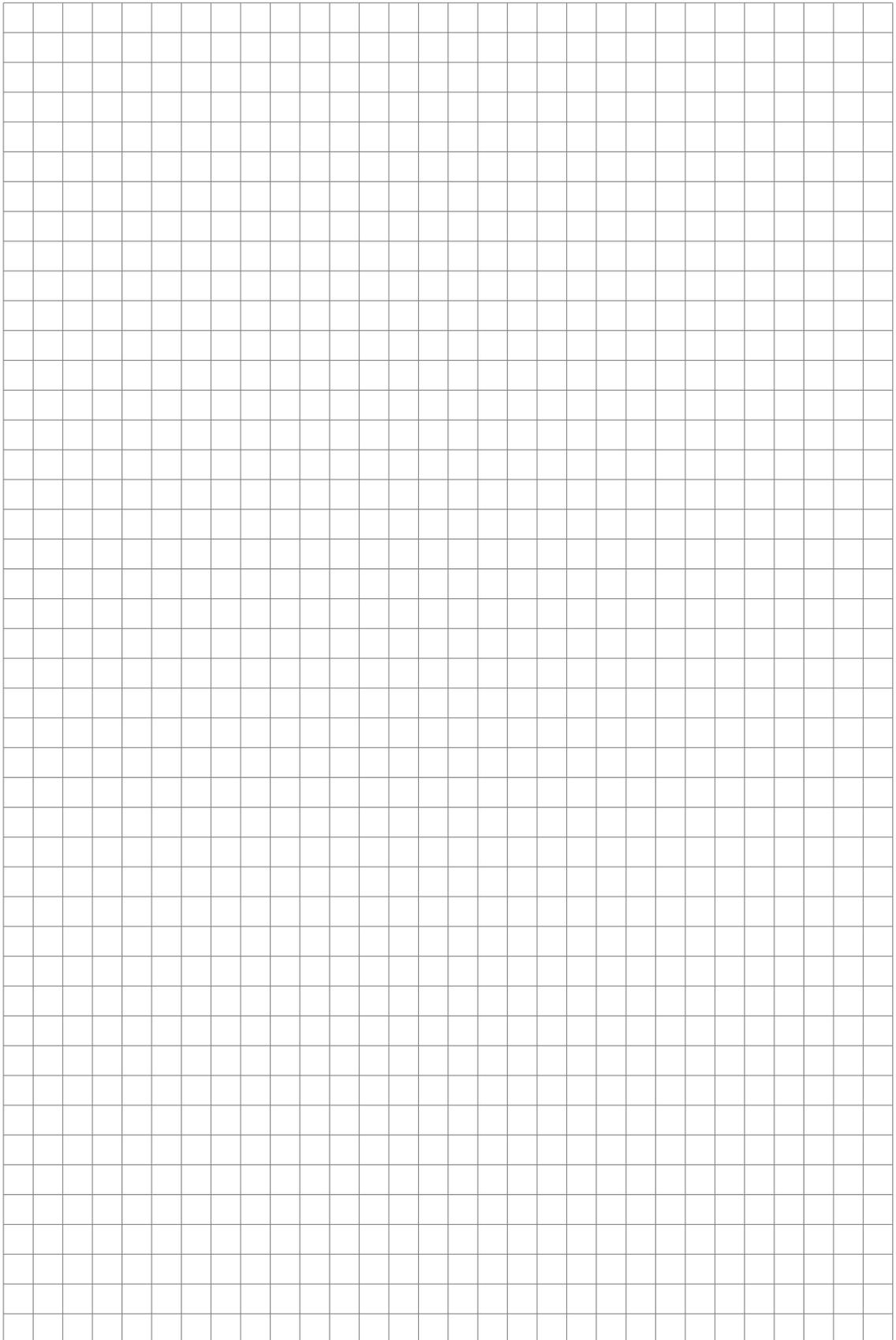
- Electrical conductivity: $\geq 200 \mu\text{S}/\text{cm}$
- Signal cable: max. 50 m / 164 ft, type DS

Virtual reference cannot be activated when the IFC 400 is in the SIL mode.

4.4 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
- Engineering, commissioning, calibration, maintenance and training services

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

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

