



## TIDALFLUX 2300 F Technical Datasheet

Electromagnetic flow sensor for partially filled pipes

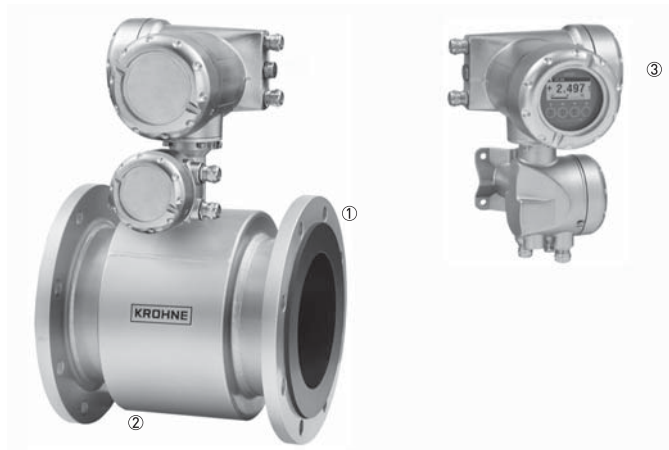
- Measurement in partially filled pipes up to DN1600 / 64"
- Patented, non-contact level measurement
- Measurement possible down to 10% filling of pipe

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

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## 1.1 Solution for partially filled pipes

The **TIDALFLUX 2000** flow sensor with integrated and non-contact capacitive level measuring system provides accurate flow measurement in partially filled pipes. TIDALFLUX is designed to measure reliably between 10% and 100% of the pipe cross-section. The integrated level sensors in the liner are in no contact with the liquid and are therefore insensitive to fat and oil floating on the surface.



- ① Various flange standards
- ② Patented, capacitive and non-contact flow level measuring system integrated in the liner
- ③ Remote converter IFC 300 ( PF)

**Highlights**

- For partially filled pipes in the water and wastewater industry
- Broad diameter range up to DN1600 / 64"
- High abrasion- and chemical resistance
- Measurement possible between 10% and 100% filling
- Electrodes for flow measurement are below 10% filling level, therefore no blind folding by fat and oil floating on the water surface
- Complete factory calibration, no on-site calibration required

**Industries**

- Water
- Wastewater

**Applications**

- For partially filled pipes instead of expensive siphon tube constructions
- Water and wastewater
- Surface water
- Biological and chemical wastewater

## 1.2 Options

The solution for the water and wastewater industry



### Flanged flowsensor

- Robust construction, completely welded
- Various flange standards like DIN, ANSI and JIS
- IP 68
- ATEX / IECEx Zone 1 / Class1 Div 2
- 220/110 V or 24 VDC power supply
- Polyurethane liner



### Remote converter

- IFC 300 F (PF)
- Stainless steel
- ATEX / IECEx Zone 1 / Class1 Div 2
- Extra connector space (for use with NPT)
- Mounting to wall or 2" pipe with clamps
- mA, HART or Modbus

### 1.3 Measuring principle

The TIDALFLUX 2000 is an electromagnetic flow sensor with an integrated capacitive level measurement system, designed for electrically conductive process liquids. The flow rate  $Q(t)$  through the tube is:  $Q(t) = v(t) \times A(t)$ ,

in which

$v(t)$  = flow velocity of liquid product

$A(t)$  = wetted area of tube section.

The flow velocity is determined on basis of the known electromagnetic measurement principle. The two measuring electrodes are located in the lower part of the measuring tube, on a level of approx. 10% of the inner diameter of the pipe in order to get a reliable measurement up from a level of 10%.

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

$D$  = distance between electrodes

The signal voltage  $U$  is picked off by electrodes and is proportional to the mean flow velocity  $v$  and thus the flow rate  $q$ . The signal voltage is quite small (typically 1 mV at  $v = 3 \text{ m/s} / 10 \text{ ft/s}$  and field coil power of 1 W). Finally, a signal converter is used to amplify the signal voltage, filter it (separate from noise) and convert it into signals for totalising, recording and output processing.

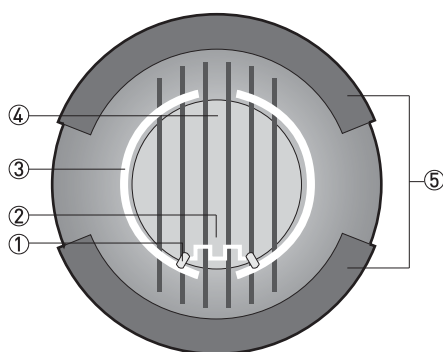


Figure 1-1: Measuring principle TIDALFLUX

- ① Electrodes
- ② Induced voltage [proportional to flow velocity]
- ③ Capacitive plates in liner for height measurement
- ④ Magnetic field
- ⑤ Field coils

The wetted area  $A$  is computed from the known inside diameter of the pipe by the patented capacitive level measurement system that is built into the measuring tube liner. The required electronics unit is accommodated in a compact housing that is mounted on top of the measuring sensor. This electronics is connected to the remote IFC 300 F converter by means of a digital communication line.

## 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
Application range	Electrically conductive fluids
<b>Measured value</b>	
Primary measured value	Flow velocity
	Level
Secondary measured value	Volume flow

### Design

Features	Flange version with full bore flow tube
	Standard as well as higher pressure ratings
	Broad range of nominal sizes
Modular construction	The measurement system consists of a flow sensor and a signal converter. It is available as remote version. More information about the signal converter can be found in the documentation of the signal converter.
Remote version	In field (F) version with IFC 300 signal converter: TIDALFLUX 2300 F.
	Note: Compact versions are not available.
Nominal diameter	DN200...1600 / 8...64"

## Measuring accuracy

Maximum measuring error	Related to volume flow (MV = Measured Value, FS = Full Scale)
	For detailed information on the measuring accuracy, refer to <i>Measuring accuracy</i> on page 11.
	These values are related to the pulse / frequency output
	The additional typical measuring deviation for the current output is $\pm 10 \mu\text{A}$
	<b>Partly filled:</b>
	$v \text{ @ Full Scale} \geq 1 \text{ m/s} / 3.3 \text{ ft/s}: \leq 1\% \text{ of FS}$
	<b>Fully filled:</b>
	$v \geq 1 \text{ m/s} / 3.3 \text{ ft/s}: \leq 1\% \text{ of MV}$
	$v < 1 \text{ m/s} / 3.3 \text{ ft/s}: \leq 0.5\% \text{ of MV} + 5 \text{ mm/s} (0.2 \text{ inch/s})$
	Minimum level: 10% of inner diameter

## Operating conditions

<b>Temperature</b>	
Process temperature	0...+60°C / +32...+140°F
Ambient temperature	Non ATEX: -40...+65°C / -40...+149°F
	ATEX zone 1: -20...+65°C / -4...+149°F
	QPS, Class 1 Div 2: -20...+60°C / -4...+140°F
	Protect electronics against self-heating with 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
Vacuum load (DN200...DN1600 / 8...64")	500 mbar abs. at $T_{\text{process}} = 40^\circ\text{C}$ / 600 mbar abs. at $T_{\text{process}} = 60^\circ\text{C}$
	7.3 psia at $T_{\text{process}} = 104^\circ\text{F}$ / 8.7 psia at $T_{\text{process}} = 140^\circ\text{F}$
<b>Chemical properties</b>	
Physical condition	Conductive liquids
Electrical conductivity	$\geq 50 \mu\text{S/cm}$
Permissible solid content (volume)	$\leq 20\%$
	If process liquid is slurry: density $< 1.15 \text{ kg/dm}^3$ .



**Installation conditions**

Installation	For detailed information, refer to <i>Installation</i> on page 14.
Flow direction	Forward and reverse.
	Arrow on flow sensor indicates positive flow direction.
Inlet run	≥ 5 DN (without disturbing flow, after a single 90° bend)
	≥ 10 DN (after a double bend 2x 90°)
	≥ 10 DN (behind a control valve)
Outlet run	≥ 3 DN
Dimensions and weights	For detailed information, refer to <i>Dimensions and weights</i> on page 12.

**Materials**

Sensor housing	Standard: sheet steel
	Other materials on request
Measuring tube	Austenitic stainless steel
Flange	Standard: carbon steel, polyurethane coated
	Other materials on request.
Liner	Polyurethane
Connection box	IP 67: die-cast aluminium
	IP 68: Stainless steel
Coating	Standard coating: Polysiloxane
	Option: protective coating (off-shore, burial coating)
Measuring electrodes	Hastelloy® C
Grounding rings	Stainless steel
	Tailor made to inner diameter of connecting pipeline.
	Necessary if inner side of connecting pipeline isn't electrically conductive.

**Process connections**

<b>Flange</b>	
EN 1092-1	DN200...1600 in PN 6...40 (others on request)
ASME	8...64" in 150...300 lb RF (others on request)
JIS	DN200...1600 in JIS 10...20 K (others on request)
Design of gasket surface	RF (others on request)

### Electrical connections

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	Standard: 100...230 VAC (-15% / +10%), 50/60 Hz
	Option: 12...24 VDC (-55% / +10%) 12 VDC; -10% is included in the tolerance range
Power consumption	AC: 22 VA
Field current cable	Shielded cable must be used, no part of delivery.
Signal cable	<b>DS 300 (type A)</b> Max. length: 600 m / 1968 ft (dependent on electrical conductivity)
	<b>BTS 300 (type B)</b> Max. length: 600 m / 1968 ft
Data interface cable	For transmission of measured level to IFC 300 F.
	Shielded LIYCY cable, 3 x 0.75 mm <sup>2</sup>
Cable entries	Standard: 2x M20 x 1.5 + 2x M16 x 1.5 EMC type
	Option: ½" NPT

### Approvals and certificates

<b>CE</b>	
This device fulfils the statutory requirements of the EU directives. The manufacturer certifies successful testing of the product by applying the CE mark.	
For full information of the EU directives and standards and the approved certifications, please refer to the EU Declaration of Conformity or the website of the manufacturer.	
<b>Hazardous areas</b>	
ATEX / IECEx	Option: Ex zone 1, IECEx
	DEKRA 12ATEX0235 X
	IECEx DEKRA 12.0079X
QPS	Class 1, Division 2
	LR1338
<b>Other approvals and standards</b>	
Protection category acc. to IEC/EN 60529	Standard: IP 66/67 (NEMA 4/4X/6)
	Option: IP 68 (NEMA 6P)
Vibration resistance	IEC 60068-2-6
Random vibration test	IEC 60068-2-34
Shock test	IEC 60068-2-27

## 2.2 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:  $\geq 10$  DN
- Outlet section:  $\geq 5$  DN

The measuring accuracy for partly filled pipes and completely filled pipes are different. In these graphs it is assumed that the velocity at full scale value is at least 1 m/s (is also the standard value for calibration, since it will result in the most accurate measurements). Additional conditions; slope of pipe line 0%, electrical conductivity medium 50...5000  $\mu\text{S}/\text{cm}$ .

### Partly filled:

- $v @ \text{Full Scale} \geq 1 \text{ m/s} / 3.3 \text{ ft/s} : \leq 1\% \text{ of Full Scale}$

### Fully filled:

- $v \geq 1 \text{ m/s} / 3.3 \text{ ft/s} : \leq 1\% \text{ of MV}$
- $v < 1 \text{ m/s} / 3.3 \text{ ft/s} : \leq 0.5\% \text{ of MV} + 5 \text{ mm/s} / 0.2 \text{ inch/s}$  (see following graph)

### Fully filled pipes

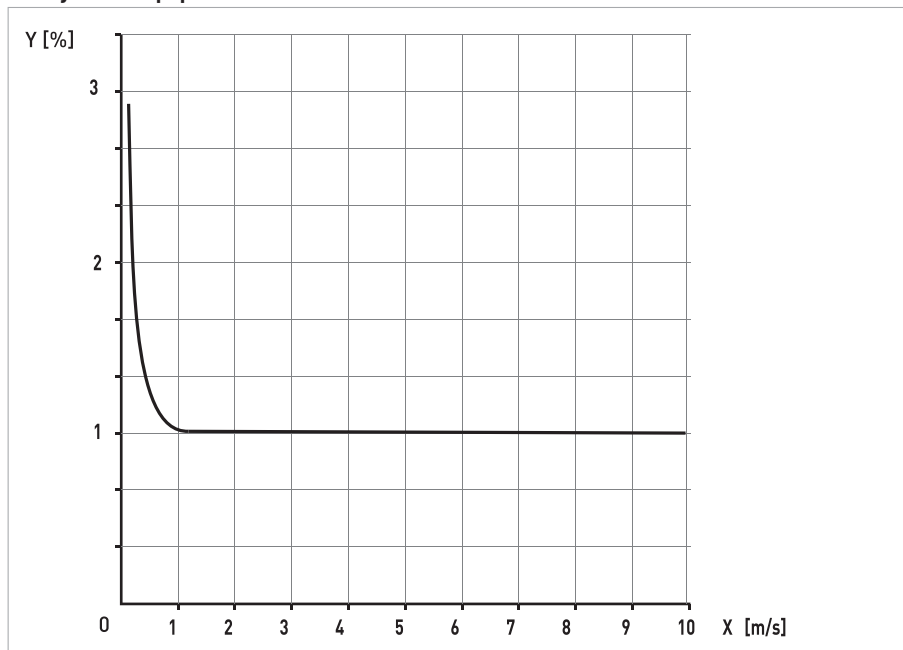
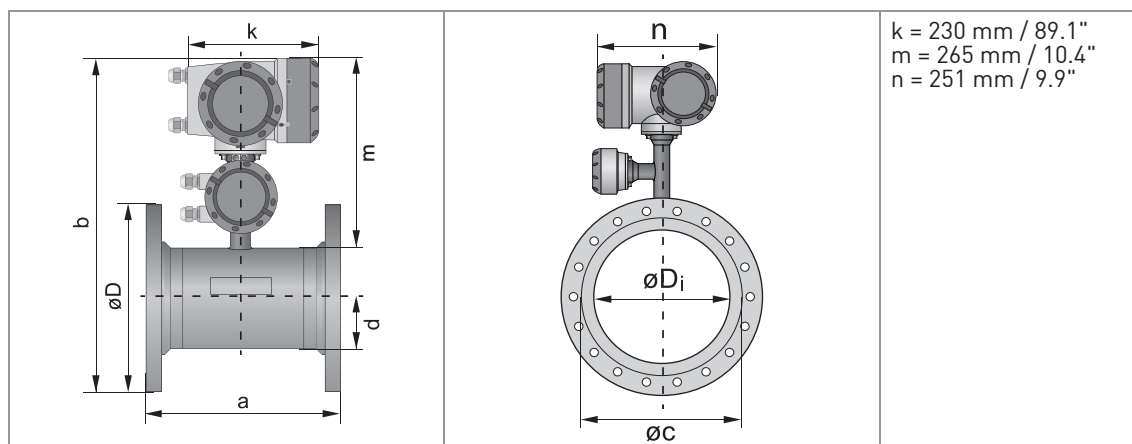


Figure 2-1: Maximum measuring error of measured value (=Y)

## 2.3 Dimensions and weights

The inner pipe diameter should match the inner diameter of the flowmeter. Since the inner diameter is not a standard DN size, choose the inner pipe diameter to be just a little bit bigger than the flowmeter diameter. If a lot of sediment or fat is expected the optimal solution is to use a customized diameter compensation ring on both sides to have smooth transits.



Detailed 2D and 3D drawings are available on the website of the manufacturer.

### EN 1092-1

Nominal size		Dimensions [mm]						Approx. weight [kg]
DN	PN	a	b	øc	d	øD	øDi	
200	10	350	582	291	146	340	189	40
250	10	400	630	331	166	395	231	54
300	10	500	680	381	191	445	281	66
350	10	500	733	428	214	505	316	95
400	10	600	791	483	242	565	365	115
500	10	600	894	585	293	670	467	145
600	10	600	1003	694	347	780	567	180
700	10	700	1120	812	406	895	666	265
800	10	800	1235	922	461	1015	768	350
900	10	900	1356	1064	532	1115	863	425
1000	10	1000	1447	1132	566	1230	965	520
1200	6	1200	1639	1340	670	1405	1169	659
1400	6	1400	1842	1521	761	1630	1367	835
1600	6	1600	2042	1721	861	1830	1549	1659

## 150 lb flanges

Nominal size		Dimensions [inches]						Approx. weight [lb]
ASME ①	PN [psi]	a	b	Øc	d	ØD	ØD <sub>i</sub>	
8	284	13.78	22.93	11.46	5.75	13.5	7.44	90
10	284	15.75	24.80	13.03	6.54	16.0	9.09	120
12	284	19.69	26.76	15	7.52	19.0	11.06	145
14	284	27.56	30.22	16.85	9.8	21.0	12.44	210
16	284	31.5	31.13	19.02	9.53	23.5	14.37	255
20	284	31.5	35.21	23.03	11.54	27.5	18.39	320
24	284	31.5	39.50	27.32	13.66	32.0	22.32	400
28	Class D	35.43	44.71	31.97	15.98	36.5	26.22	692
32	Class D	39.37	49.51	36.3	18.15	41.8	30.24	1031
36	Class D	43.31	54.42	41.89	20.94	46.0	33.98	1267
40	Class D	47.24	58.14	44.57	22.28	50.8	37.99	1554
48	Class D	55.12	66.61	52.76	26.38	59.5	46.02	2242

① Nominal size ≤ 24": ASME; > 24": AWWA

### 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.*

### 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 Vibration

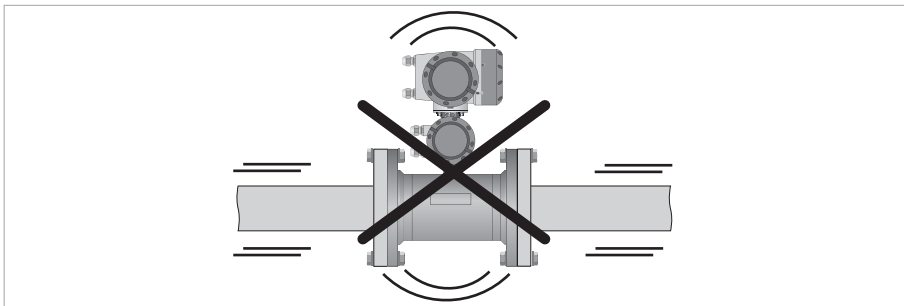


Figure 3-1: Avoid vibrations

#### 3.2.2 Magnetic field

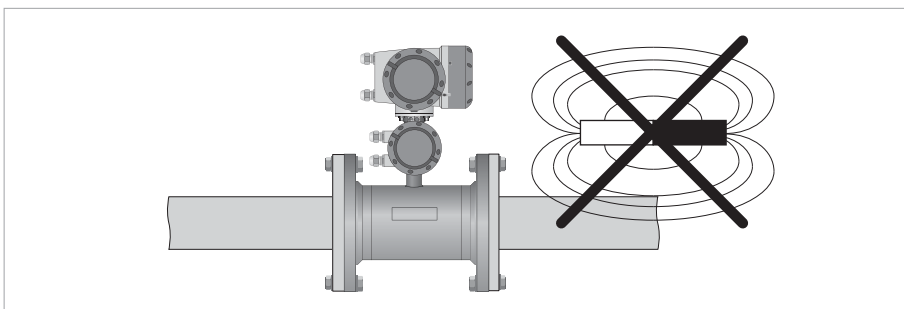


Figure 3-2: Avoid magnetic fields

### 3.3 Installation conditions

#### 3.3.1 Inlet and outlet

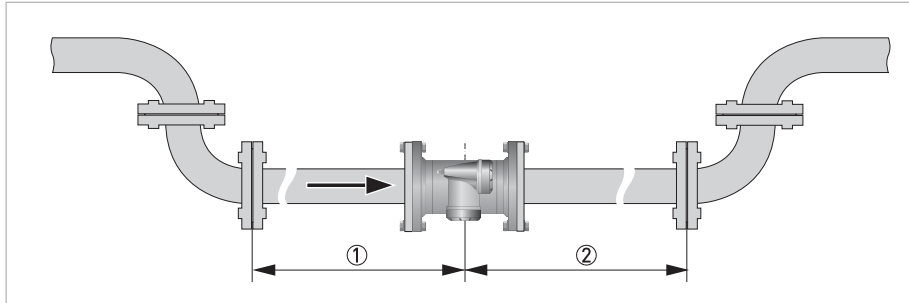


Figure 3-3: Recommended inlet and outlet sections, top view

- ①  $\geq 5$  DN
- ②  $\geq 3$  DN

#### 3.3.2 Control valve

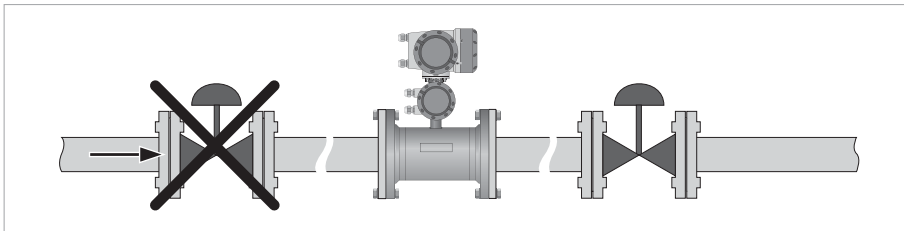


Figure 3-4: Installation before control valve

#### 3.3.3 Slope

*The accuracy is influenced by the slope. Stay within  $\pm 1\%$  to get the most accurate measurements!*

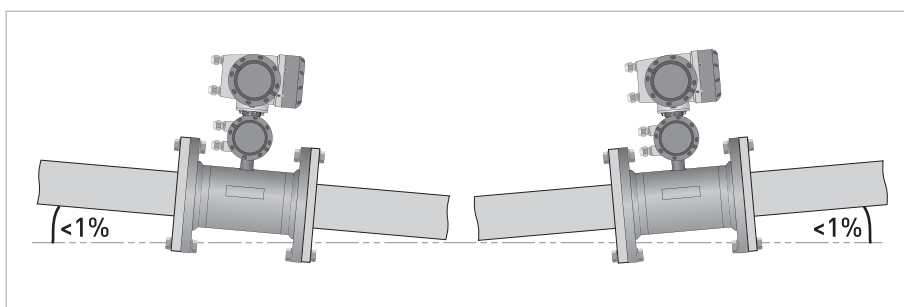


Figure 3-5: Recommended slope

### 3.3.4 Mounting advice for difficult situations

If you can not meet the installation conditions install the flowmeter between two containers. The inlet to the flowmeter must be higher than the outlet of the fluid. In this way you will have a calm flow into the flowmeter, resulting in a highly accurate measurement. The sizes of the containers must be proportional to the size of the flowmeter.

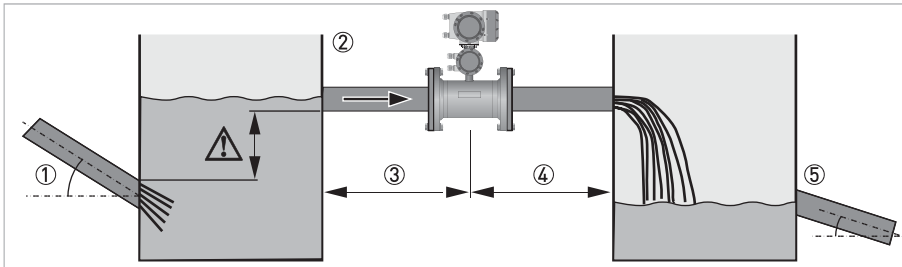


Figure 3-6: Installing in difficult situations

- ① Use a container ② if the Inlet pipe has a slope > 1%. Make sure that the outlet level of this pipe is below the inlet to the flowmeter.
- ② Inlet container
- ③ Inlet section of 10 DN
- ④ Outlet section of 5 DN
- ⑤ Outlet container advisable if outlet pipe has a slope > 1%.

*Always use a free exit pipe to prevent backflow in the flow sensor and to keep the velocity at the maximum flow at least at 1 m/s.*

### 3.3.5 Open discharge

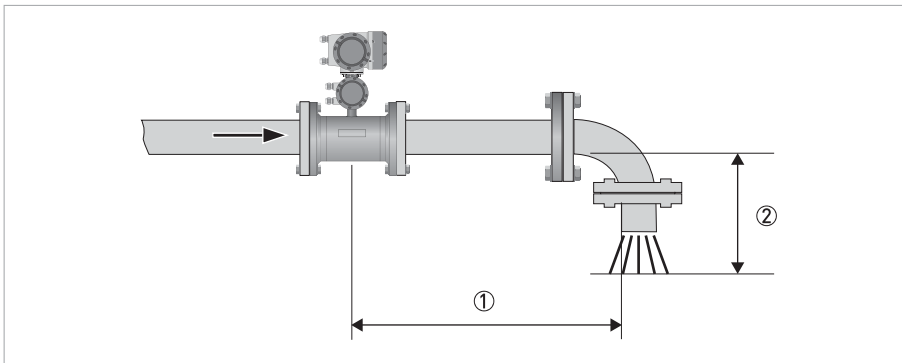


Figure 3-7: Open discharge

- ①  $\geq 5$  DN
- ② Make sure that the water level stays below the pipe outlet.



### 3.3.6 Cleaning of flow sensor

The flow sensor is highly resistant against dirt and the measurement will rarely be influenced by anything. However, it is advisable to create a possibility for cleaning just in front or behind the sensor.

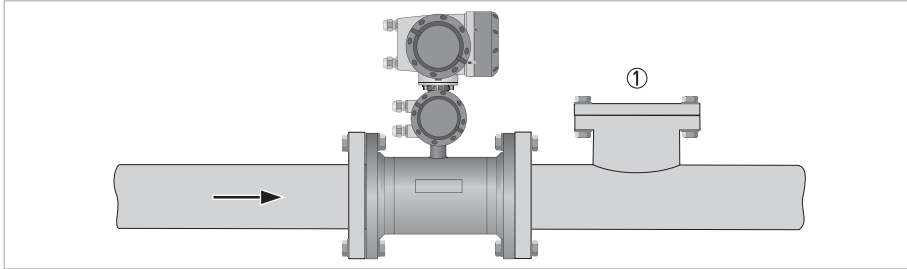


Figure 3-8: Option for cleaning of flow sensor

① Opening for cleaning

### 3.3.7 Flange deviation

*Max. permissible deviation of pipe flange faces:*

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

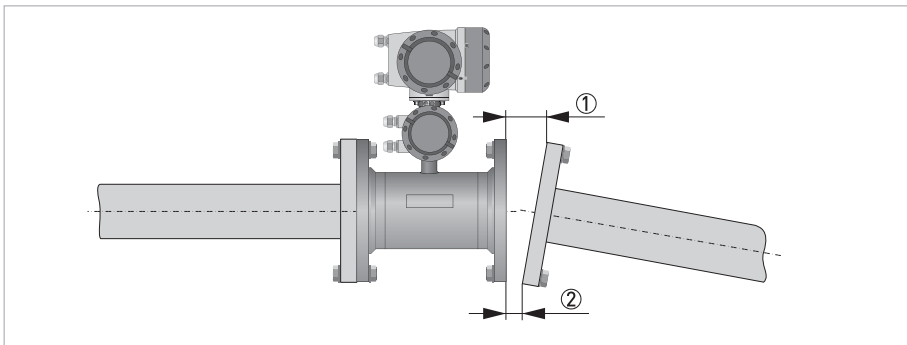


Figure 3-9: Flange deviation

①  $L_{max}$

②  $L_{min}$

### 3.3.8 Mounting position

Only install the flow sensor in the shown position to keep the electrodes under water. Limit the rotation to  $\pm 2^\circ$  to maintain the accuracy.

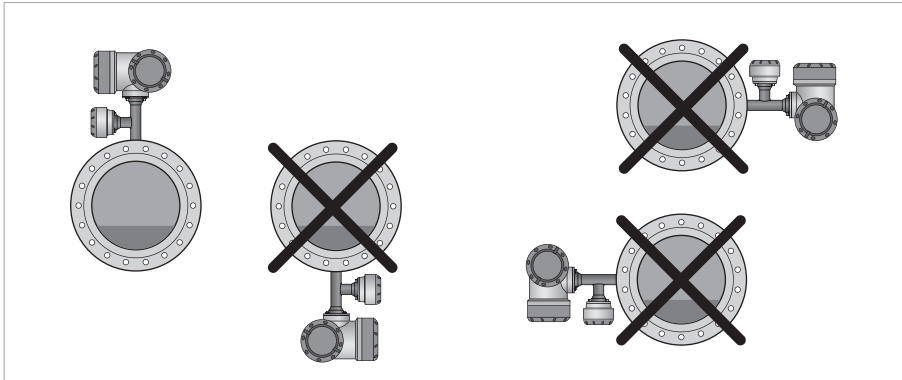


Figure 3-10: Mounting position

### 3.3.9 Torques and pressures

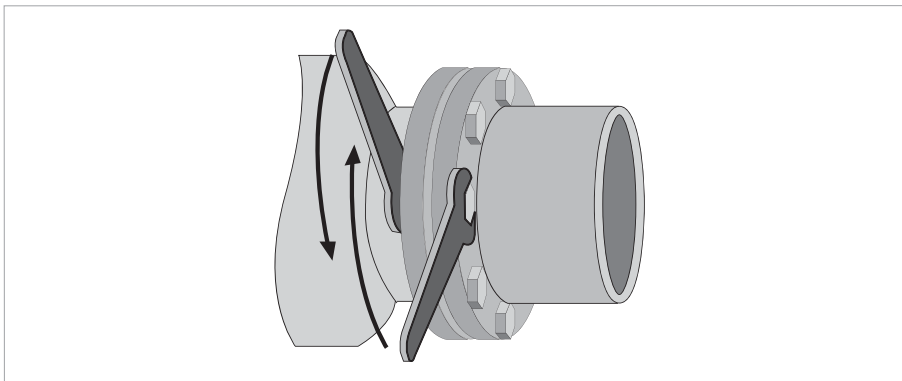


Figure 3-11: Tightening of bolts

#### 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.

*Tighten the bolts uniformly in diagonally opposite sequence.*

Nominal size DN [mm]	Pressure rating	Bolts	Max. torque [Nm]
200	PN 10	8 x M 20	68
250	PN 10	12 x M 20	65
300	PN 10	12 x M 20	76
350	PN 10	16 x M 20	75
400	PN 10	16 x M 24	104
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
1200	PN 6	32 x M30	252

Nominal size [inch]	Flange class [lb]	Bolts	Max. torque [Nm]
8	150	8 x 3/4"	69
10	150	12 x 7/8"	79
12	150	12 x 7/8"	104
14	150	12 x 1"	93
16	150	16 x 1"	91
18	150	16 x 1 1/8"	143
20	150	20 x 1 1/8"	127
24	150	20 x 1 1/4"	180
28	150	28 x 1 1/4"	161
32	150	28 x 1 1/2"	259
36	150	32 x 1 1/2"	269
40	150	36 x 1 1/2"	269

*Information for bigger sizes is available on request.*

## 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!*

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

*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 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.*

- *Use suitable cable entries for the various electrical cables.*
- *The sensor and converter are configured together in the factory. For this reason, please connect the devices in pairs. Ensure that the sensor constant GK (see nameplates) are identically set.*
- *The TIDALFLUX 2300 sensor and converter need both a separate power supply.*

*For more information about the grounding of the flowmeter, refer to Grounding on page 22.*

### 4.3 Cable lengths

*The maximum allowed distance between the flow sensor and the converter is determined by the shortest cable length.*

**Interface cable:** maximum length is 600 m / 1968 ft.

**Type B (BTS) signal cable:** maximum length is 600 m / 1968 ft.

**Type A (DS) signal cable:** maximum length depends on the conductivity of the fluid:

Electrical conductivity	Maximum length	
[ $\mu\text{S}/\text{cm}$ ]	[m]	[ft]
50	120	394
100	200	656
200	400	1312
$\geq 400$	600	1968

**Field current cable:** The cross section of the cable determines the maximum length:

Cross section		Maximum length	
[ $\text{mm}^2$ ]	[AWG]	[m]	[ft]
2 x 0.75	2 x 18	150	492
2 x 1.5	2 x 16	300	984
2 x 2.5	2 x 14	600	1968

## 4.4 Grounding

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

### 4.4.1 Mounting grounding rings

*In order to get a reliable height measurement it is **absolutely necessary** that the inner side of the connecting pipeline is electrically conductive and connected to ground. If not, tailor-made grounding rings with a cylindrical part can be delivered. Please contact your local agency in case of doubt.*

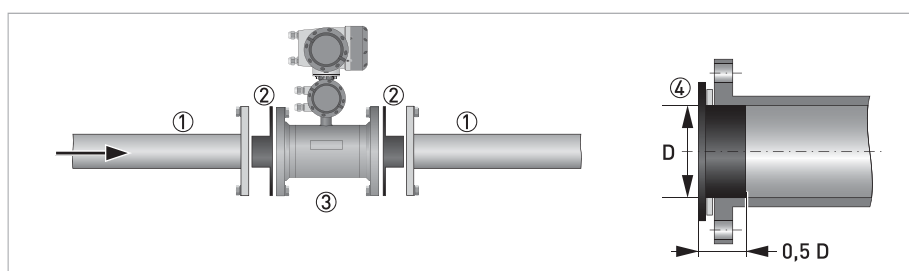


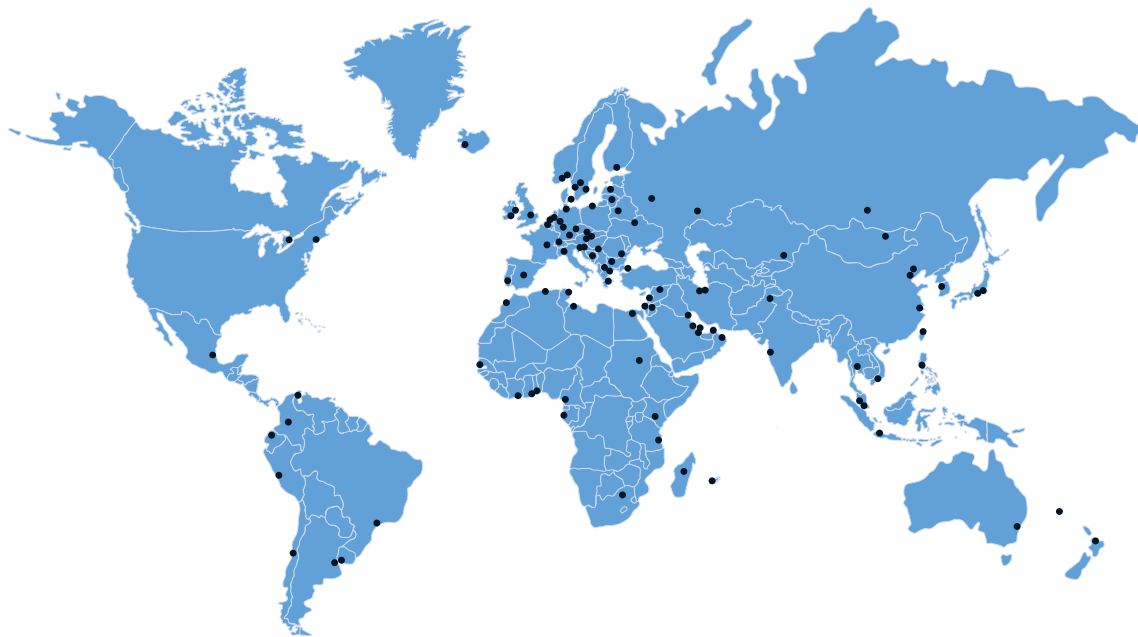
Figure 4-1: Grounding with grounding rings

- ① Existing pipeline
- ② Grounding rings, custom made to inner diameter of pipeline
- ③ TIDALFLUX
- ④ Insert the cylindrical part of the grounding ring into the pipeline. Use an appropriate gasket between the grounding ring and the flange.

*Sizes of the grounding rings are diameter dependent and available on request.*

*For the connection diagrams and more information on connection of the sensor, please refer to the manual of the TIDALFLUX 2300 and the applicable signal converter.*





## KROHNE – Process instrumentation and measurement solutions

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

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