



TIDALFLUX 2300 F Quick Start

Electromagnetic flow sensor for partially filled pipes

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

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Warnings and symbols used



DANGER!

This information refers to the immediate danger when working with electricity.



DANGER!

These warnings must be observed without fail. Even partial disregard of this warning can lead to serious health problems and even death. There is also the risk of seriously damaging the device or parts of the operator's plant.



WARNING!

Disregarding this safety warning, even if only in part, poses the risk of serious health problems. There is also the risk of damaging the device or parts of the operator's plant.



CAUTION!

Disregarding these instructions can result in damage to the device or to parts of the operator's plant.



INFORMATION!

These instructions contain important information for the handling of the device.



HANDLING

- This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

➔ **RESULT**

This symbol refers to all important consequences of the previous actions.

Safety instructions for the operator



CAUTION!

Installation, assembly, start-up and maintenance may only be performed by appropriately trained personnel. The regional occupational health and safety directives must always be observed.



LEGAL NOTICE!

The responsibility as to the suitability and intended use of this device rests solely with the user. The supplier assumes no responsibility in the event of improper use by the customer. Improper installation and operation may lead to loss of warranty. In addition, the "Terms and Conditions of Sale" apply which form the basis of the purchase contract.



INFORMATION!

- Further information can be found on the supplied CD-ROM in the manual, on the data sheet, in special manuals, certificates and on the manufacturer's website.
- If you need to return the device to the manufacturer or supplier, please fill out the form contained on the CD-ROM and send it with the device. Unfortunately, the manufacturer cannot repair or inspect the device without the completed form.

2.1 Scope of delivery



Figure 2-1: Scope of delivery

- ① Ordered flowmeter
- ② Product documentation
- ③ Factory calibration report
- ④ CD-ROM with product documentation
- ⑤ Grounding rings (optionally)
- ⑥ Cable

2.2 Device description

This flowmeter can measure the flow of conductive liquids, even in partially filled pipes. To be able to do this, a capacitive height measurement has been integrated into a regular electromagnetic flowmeter. If both the filled fraction and the velocity of the fluid are known, it is easy to calculate the amount of fluid running through the pipe.



INFORMATION!

Product specific information and extensive product specification is available using PICK, the Product Information Center KROHNE web-tool.



PICK can be found via the service menu button on the KROHNE.com website.

2.3 Nameplates



INFORMATION!

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

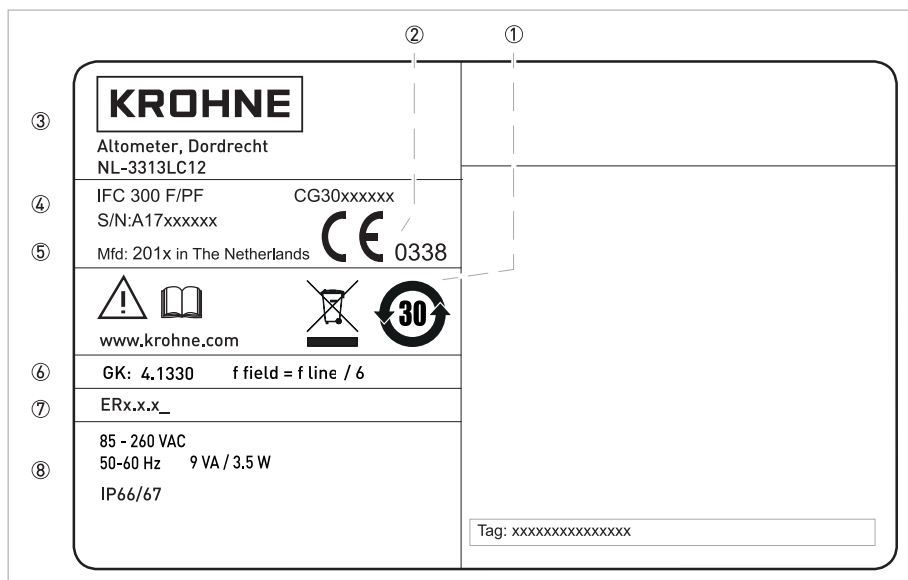
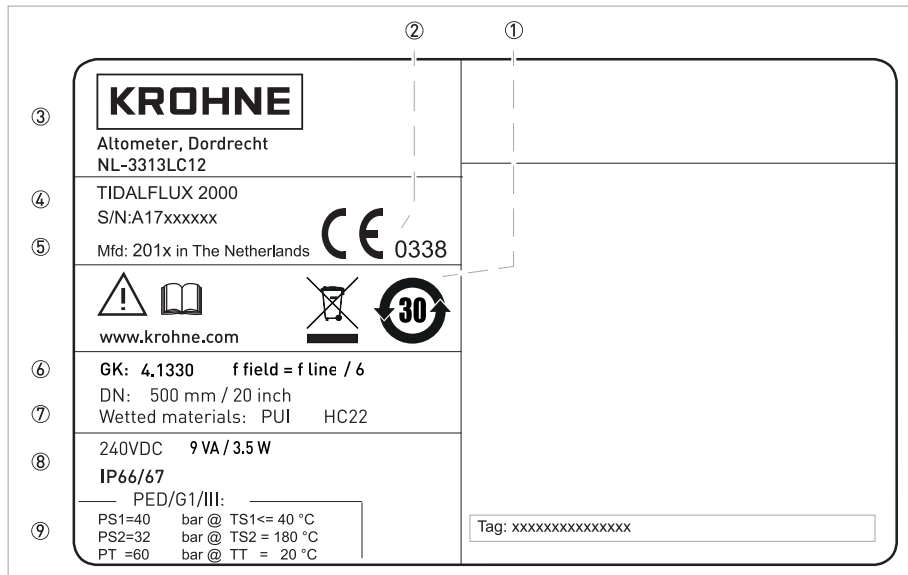


Figure 2-2: Example of nameplate sensor and converter

- ① Additional info, website and recycling logo
- ② CE marking with number(s) of notified body (bodies)
- ③ Name and address of manufacturer
- ④ Type designation with serial / CG number
- ⑤ Manufacturing date and country of origin
- ⑥ GK/GKL values (measuring sensor constants), size (mm/inches), field frequency
- ⑦ Materials of wetted parts or the Electronic Revision number
- ⑧ Electric values and protection category
- ⑨ PED data type I/II/III or SEP

Electrical connection data of inputs/outputs (example of basic version)

① ② ③ ④ ⑤			CG30xxxxxx S/N A17 xxxxx	KROHNE
	D -	P	PULSE OUT / STATUS OUT $I_{max} = 100 \text{ mA}@f \leq 10 \text{ Hz}; = 20 \text{ mA}@f \leq 12 \text{ kHz}$ $V_o = 1.5 \text{ V} @ 10 \text{ mA}; U_{max} = 32 \text{ VDC}$	
	C -	P	STATUS OUT $I_{max} = 100 \text{ mA}; V_{max} = 32 \text{ VDC}$	
	B -	P	STATUS OUT / CONTROL IN $I_{max} = 100 \text{ mA}; V_{on} > 19 \text{ VDC}; V_{off} < 2.5 \text{ VDC}; V_{max} = 32 \text{ VDC}$	
A + A - A	A or P	CURRENT OUT (HART) Active (Terminals C & A+); $R_{Lmax} = 1 \text{ kohm}$ Passive (Terminals A & A-); $U_{max} = 32 \text{ VDC}$		

Figure 2-3: Example of IO sticker

- ① Power supply (AC: L and N, DC: L+ and L-, PE for $\geq 24 \text{ V AC}$, FE for $\leq 24 \text{ V AC}$ and DC)
- ② Connection data of connection terminal D/D-
- ③ Connection data of connection terminal C/C-
- ④ Connection data of connection terminal B/B-
- ⑤ Connection data of connection terminal A/A-, A+ only operable in basic version

- A = active mode; the signal converter supplies the power for connection of the subsequent devices
- P = passive mode; external power supply required for operation of the subsequent devices
- N/C = connection terminals not connected

2.4 Storage

- Store the device in a dry and dust-free location.
- Avoid lasting direct exposure to the sun.
- Store the device in its original packaging.
- Storage temperature: $-50...+70^\circ\text{C}$ / $-58...+158^\circ\text{F}$

2.5 Transport

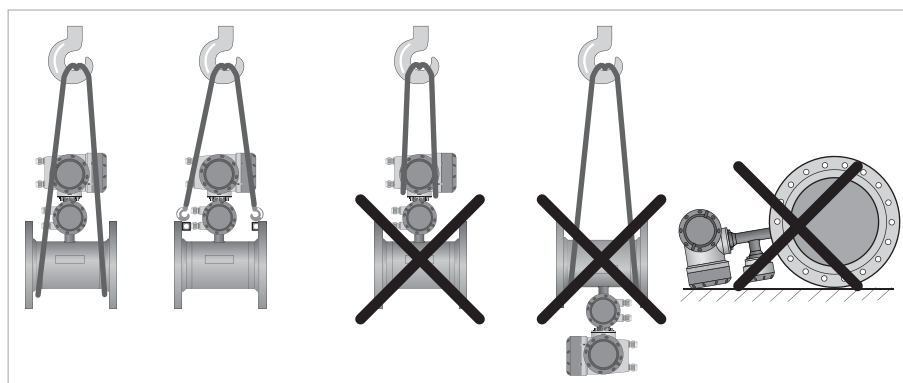


Figure 2-4: Transport

2.6 Pre-installation requirements

Make sure that you have all necessary tools available:

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

2.7 General requirements



INFORMATION!

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 vibration. The flowmeters are tested for a vibration level in accordance with IEC 68-2-64.

2.7.1 Vibration

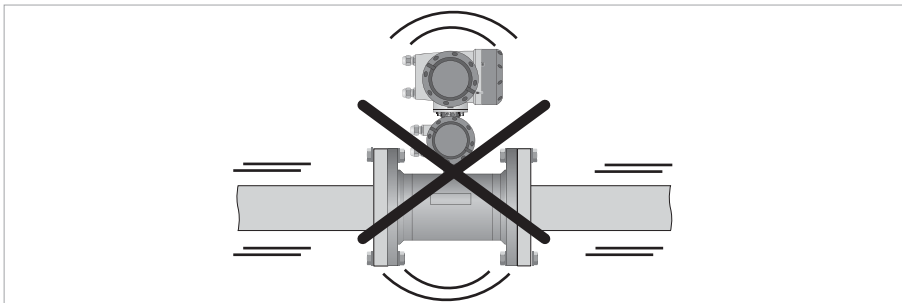


Figure 2-5: Avoid vibrations

2.7.2 Magnetic field

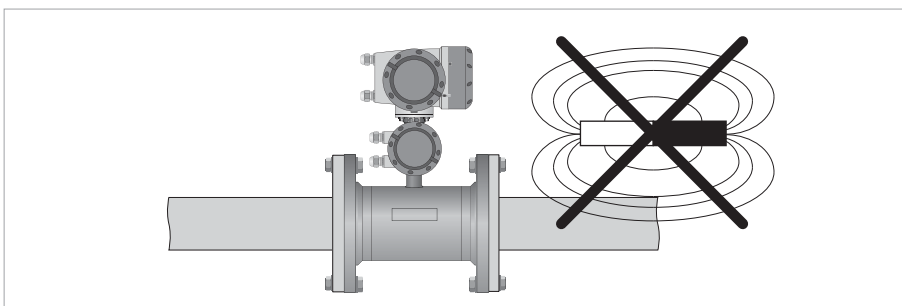


Figure 2-6: Avoid magnetic fields

2.8 Installation conditions

2.8.1 Inlet and outlet

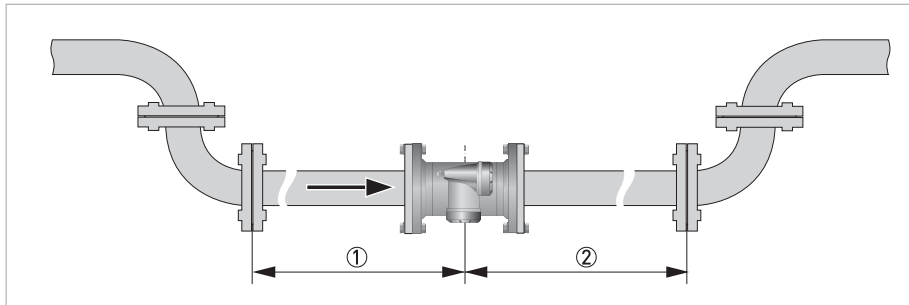


Figure 2-7: Recommended inlet and outlet sections, top view

- ① ≥ 5 DN
- ② ≥ 3 DN

2.8.2 Control valve

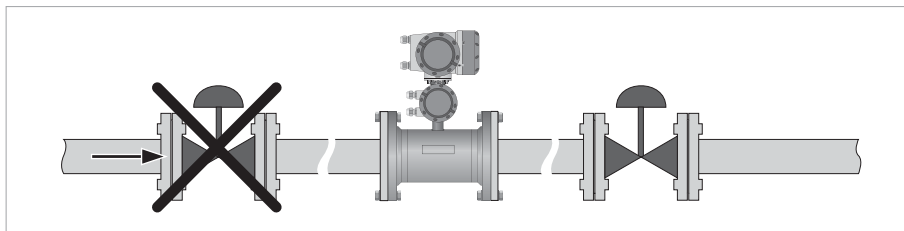


Figure 2-8: Installation before control valve

2.8.3 Slope



CAUTION!

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

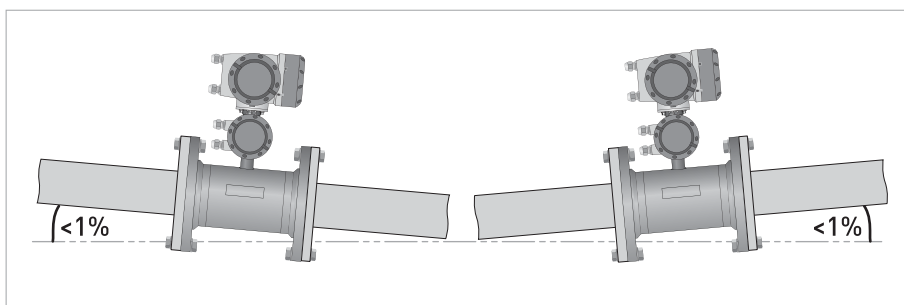


Figure 2-9: Recommended slope

2.8.4 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.

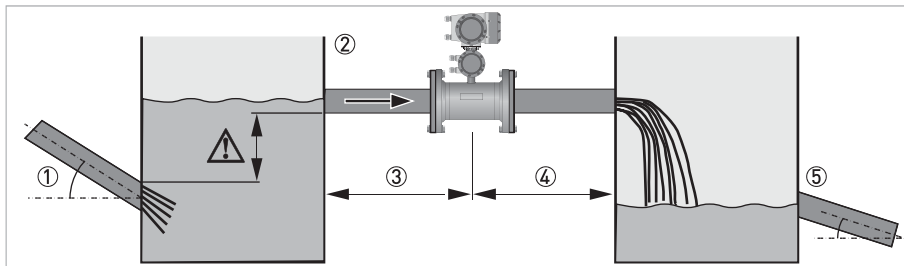


Figure 2-10: Installing in difficult situations

- 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%.



CAUTION!

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.

2.8.5 Open discharge

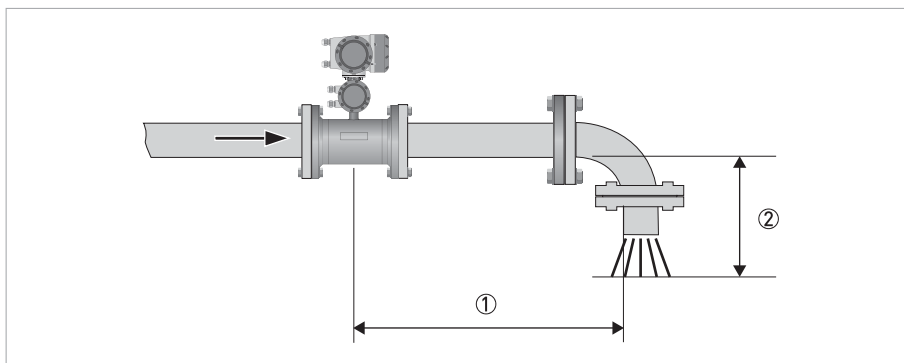


Figure 2-11: Open discharge

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

2.8.6 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.

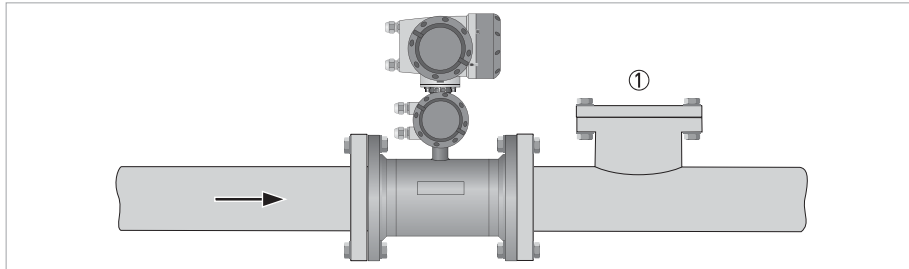


Figure 2-12: Option for cleaning of flow sensor

① Opening for cleaning

2.8.7 Flange deviation



CAUTION!

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

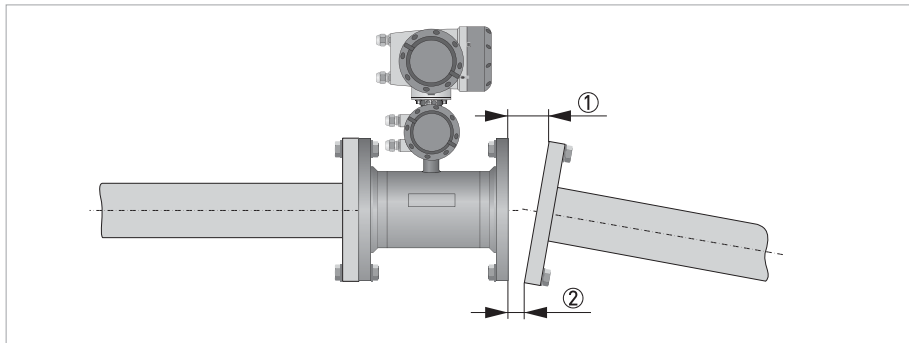


Figure 2-13: Flange deviation

① L_{max}

② L_{min}

2.8.8 Mounting position



CAUTION!

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.

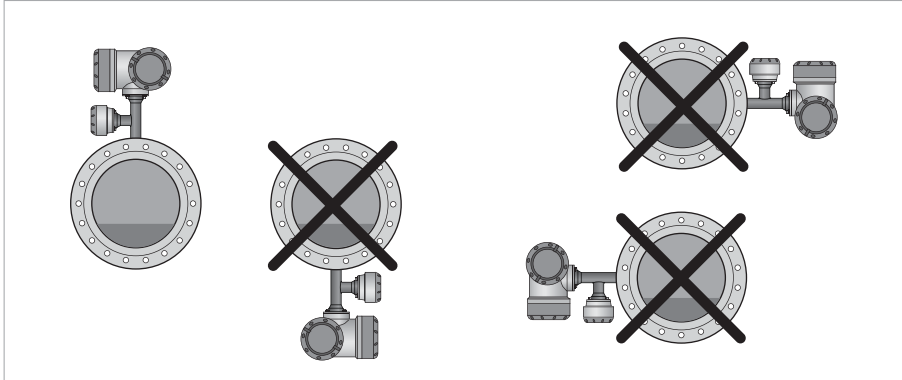


Figure 2-14: Mounting position

2.8.9 Torques and pressures

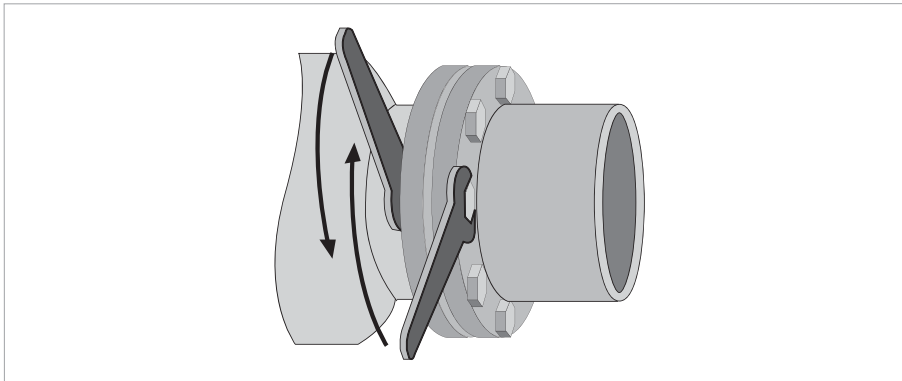


Figure 2-15: Tightening of bolts



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.

**INFORMATION!**

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!**

Information for bigger sizes is available on request.

2.8.10 Temperatures

Temperature range	Process [°C]		Ambient [°C]		Process [°F]		Ambient [°F]	
	min.	max.	min.	max.	min.	max.	min.	max.
All versions	0	60	-40	65	32	140	-40	149

3.1 Safety instructions

**DANGER!**

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

**DANGER!**

Observe the national regulations for electrical installations!

**WARNING!**

Observe without fail the local occupational health and safety regulations. Any work done on the electrical components of the measuring device may only be carried out by properly trained specialists.

**INFORMATION!**

Look at the device nameplate to ensure that the device is delivered according to your order. Check for the correct supply voltage printed on the nameplate.

3.2 Important notes on electrical connection

**DANGER!**

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.

**CAUTION!**

- 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.

**INFORMATION!**

For more information about the grounding of the flowmeter, refer to Grounding on page 25.

3.3 Connection of cables

The illustration shows the different connections and cable entries. View "p" shows (explicit) the bottom entries for signal and field current cables into the connection box on the signal converter.



INFORMATION!

For more detailed information refer to the following electrical diagrams and illustrations in the TIDALFLUX 2300 manual.

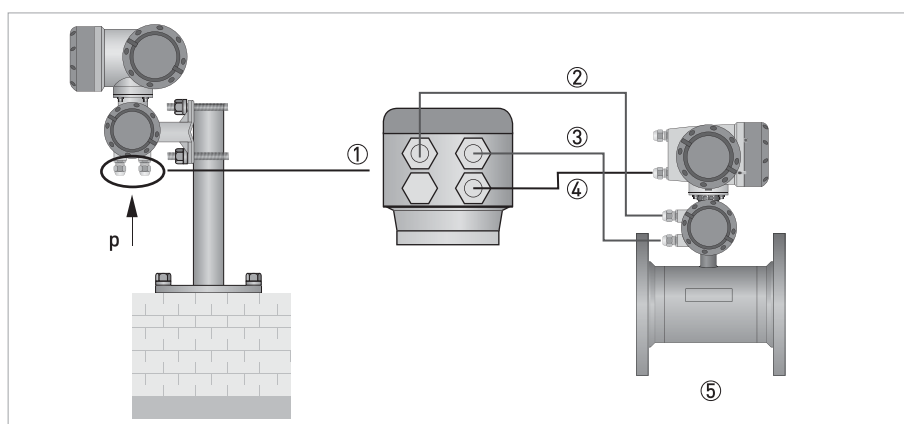


Figure 3-1: Cable entries for electrical connection

- ① View "p" of the connection box of the signal converter
- ② Field current cable
- ③ Signal cable (DS or BTS)
- ④ Interface cable
- ⑤ Flow sensor

3.4 Connection of TIDALFLUX 2000 F

The flow sensor and the signal converter must be incorporated in the equipotential bonding system of the installation. This can be established internally by connection of the protective earth (PE) conductor of the mains supply system to the internal PE clamp, or externally, by connecting a separate equipotential bonding conductor between the two external PE-clamps (size M5). A separate bonding conductor must have a cross-sectional area of at least 4 mm².

Keep the screw-threads free of dirt and well-greased (e.g. with PTFE grease). The grease will help to prevent the threads from locking due to corrosion.

To unscrew the covers, first release the interlocking devices (one at each cover). Therefore unscrew the M4 head screw with an internal hexagon socket set using a HEX or Allen key no. 2.5 until the interlocking device can be turned. After the covers are screwed back onto the housing, make sure that the interlocking devices are properly refitted.



CAUTION!

The TIDALFLUX 2300 sensor and converter need both a separate power supply.

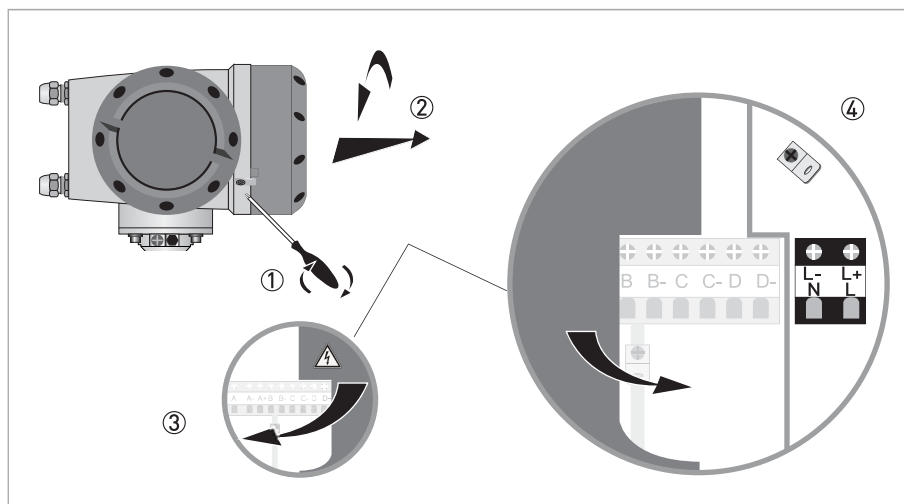


Figure 3-3: Electrical connections

- ① Unscrew interlocking head screw
- ② Turn cover counter-clockwise and remove
- ③ Open / close safety lid of mains supply section
- ④ Mains supply & signal / data terminals

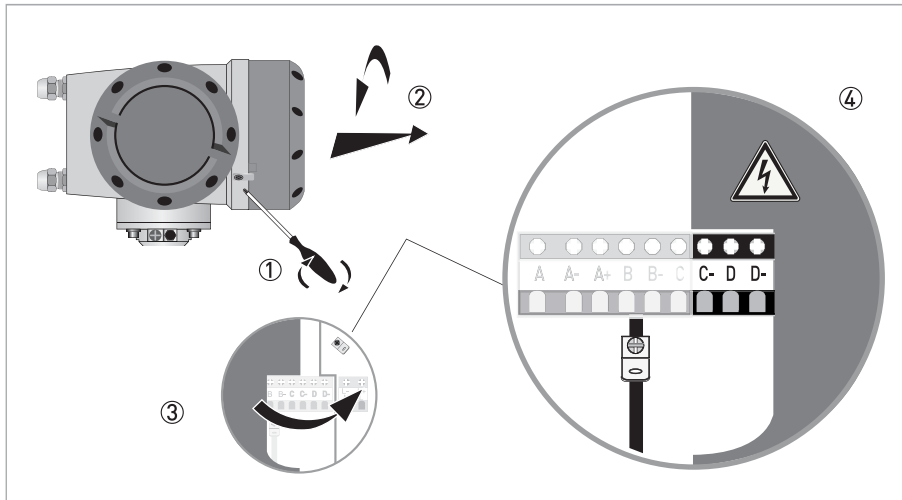


Figure 3-4: Electrical connections

- ① Unscrew interlocking head screw
- ② Turn cover counter-clockwise and remove
- ③ Open / close safety lid of mains supply section
- ④ Mains supply & signal / data terminals

Description of connections

Terminals	Cable wire colour	Function, electrical data
L, N L+, L-		Connections for mains supply, Type of protection Ex e, 100...230 VAC, +10%/-15%, 22 VA 12...24 VDC, +30%/-10% (short-time: -25%), 12 W $U_m = 253 \text{ V}$
C- D D-	black 3 black 1 black 2	Connections for RS 485 circuit, Type of protection Ex ia.

3.5 Cable lengths



CAUTION!

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	
	[m]	[ft]
[$\mu\text{S}/\text{cm}$]		
50	120	394
100	200	656
200	400	1312
≥ 400	600	1968

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

Cross section		Maximum length	
[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

3.6 Signal cable B (type BTS 300), construction

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

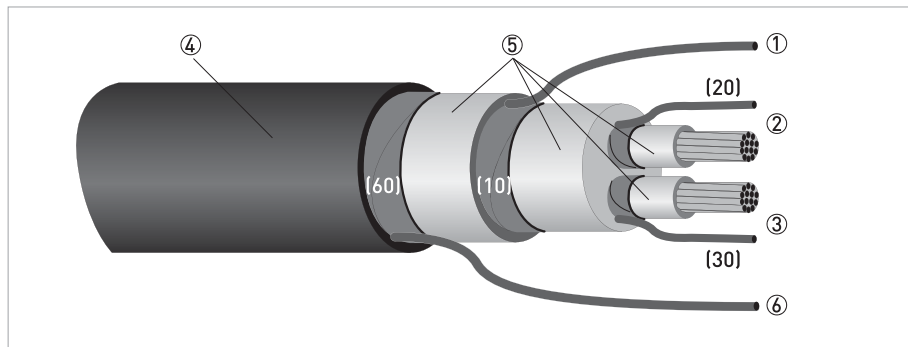


Figure 3-5: Construction of signal cable B

- ① Stranded drain wire 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 with stranded drain wire (20) of shield
- ③ Insulated wire (3), $0.5 \text{ mm}^2 \text{ Cu}$ / AWG 20 with stranded drain wire (30) of shield
- ④ Outer sheath
- ⑤ Insulation layers
- ⑥ Stranded drain wire (6) for the outer shield (60), $0.5 \text{ mm}^2 \text{ Cu}$ / AWG 20 (not insulated, bare)

3.7 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: $\geq 50 \text{ mm} / 2''$

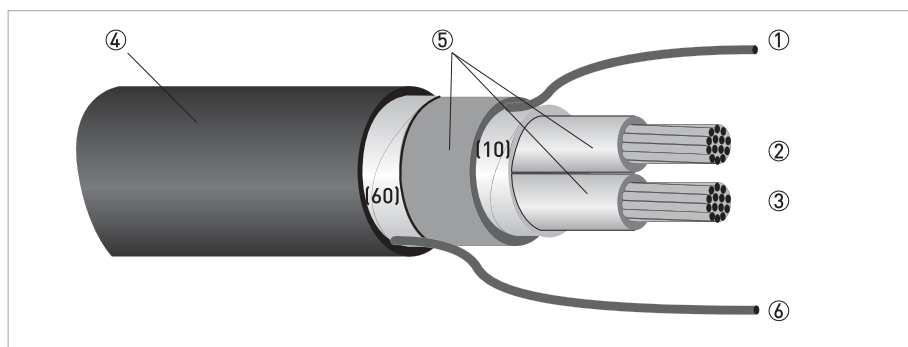


Figure 3-6: Construction of signal cable A

- 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 Outer sheath
- ⑤ Insulation layers
- ⑥ Stranded drain wire (6) for the outer shield (60)

3.8 Preparing signal cable A, connection to flow sensor



INFORMATION!

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

- The outer shield (60) is connected in the terminal compartment of the flow sensor directly via the shield and a clip.
- Bending radius: $\geq 50 \text{ mm} / 2''$

Required materials

- PVC insulating tube, $\varnothing 2.0 \dots 2.5 \text{ mm} / 0.08 \dots 0.1''$
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46228: E 1.5-8 for the stranded drain wire (1)
- 2 wire end ferrules to DIN 46228: E 0.5-8 for the insulated conductors (2, 3)

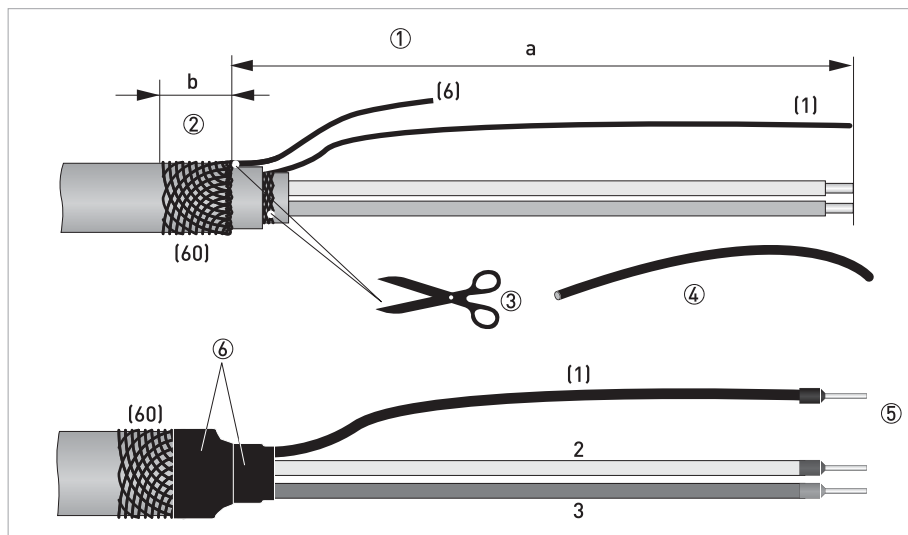


Figure 3-7: Preparing signal cable A, connection to flow sensor

$a = 50 \text{ mm} / 2''$

$b = 10 \text{ mm} / 0.4''$



- ① Strip the conductor to dimension a.
- ② Trim the outer shield (60) to dimension b and pull it over the outer sheath.
- ③ Remove the stranded drain wire (6) of the outer shield and the inner shield. Make sure not to damage the stranded drain wire (1) of the inner shield.
- ④ Slide an insulating tube over the stranded drain wire (1).
- ⑤ Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wire (1).
- ⑥ Pull the heat-shrinkable tubing over the prepared signal cable.

3.9 Preparing signal cable B, connection to flow sensor



INFORMATION!

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

- The outer shield (60) is connected in the terminal compartment of the flow sensor directly via the shield and a clip.
- Bending radius: $\geq 50 \text{ mm} / 2''$

Required materials

- PVC insulating tube, $\varnothing 2.0 \dots 2.5 \text{ mm} / 0.08 \dots 0.1''$
- Heat-shrinkable tubing
- Wire end ferrule to DIN 46228: E 1.5-8 for the stranded drain wire (1)
- 2 wire end ferrules to DIN 46228: E 0.5-8 for the insulated conductors (2, 3)

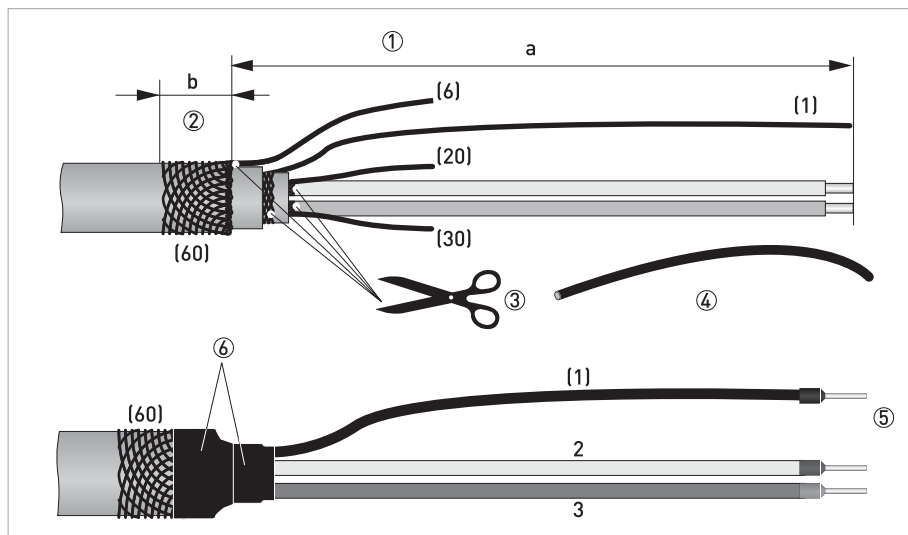


Figure 3-8: Preparing signal cable B, connection to flow sensor

$a = 50 \text{ mm} / 2''$

$b = 10 \text{ mm} / 0.4''$



- ① Strip the conductor to dimension a.
- ② Trim the outer shield (60) to dimension b and pull it over the outer sheath.
- ③ Remove the stranded drain wire (6) of the outer shield and the shields and stranded drain wires of the insulated conductors (2, 3). Remove the inner shield. Be sure not to damage the stranded drain wire (1).
- ④ Slide an insulating tube over the stranded drain wire (1).
- ⑤ Crimp the wire end ferrules onto conductors 2 and 3 and the stranded drain wire (1).
- ⑥ Pull the heat-shrinkable tubing over the prepared signal cable.

3.10 Preparing field current cable C, connection to flow sensor



INFORMATION!

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

- The field current cable is not part of the scope of delivery.
- The shield is connected in the terminal compartment of the signal converter directly via the shield and a clip.
- The shield is connected in the flow sensor via the special cable gland.
- Bending radius: $\geq 50 \text{ mm} / 2''$

Required materials

- Shielded 2-wire insulated copper cable
- Insulating tube, size according to the cable being used
- Heat-shrinkable tubing
- DIN 46 228 wire end ferrules: size according to the cable being used

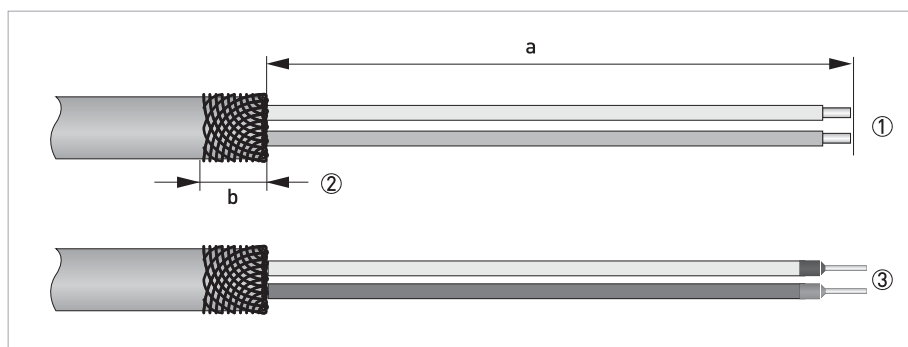


Figure 3-9: Preparation of field current cable C

a = 125 mm / 5"

b = 10 mm / 0.4"



- ① Strip the conductor to dimension a.
- ② Trim the outer shield to dimension b and pull it over the outer sheath.
- ③ Crimp wire end ferrules onto both conductors.

3.11 Interface cable

The data interface cable is a shielded, $3 \times 1.5 \text{ mm}^2$ LIYCY cable.

Preparing the interface cable

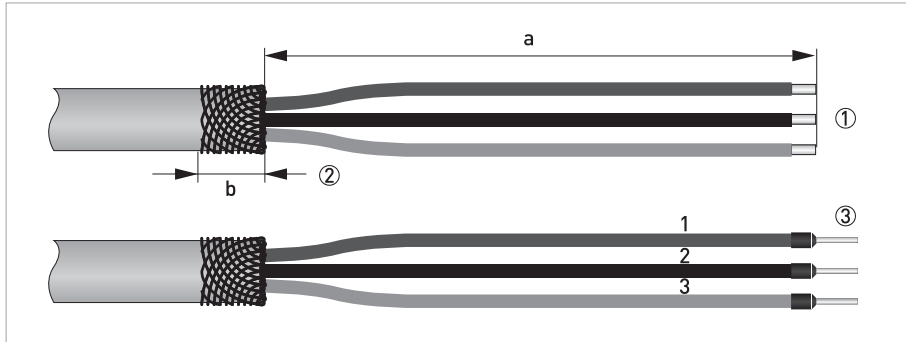


Figure 3-10: Preparing the interface cable

a = 100 mm / 4"

b = 10 mm / 0.4"



- ① Strip the conductor to dimension a.
- ② Trim the outer shield to dimension b and pull it over the outer sheath.
- ③ Crimp the wire end ferrules onto the conductors 1, 2 and 3.

Connect the shielding at both sides of the cable via the special cable gland.

At signal converter side:

Connecting shielding under clamp in connection box of converter

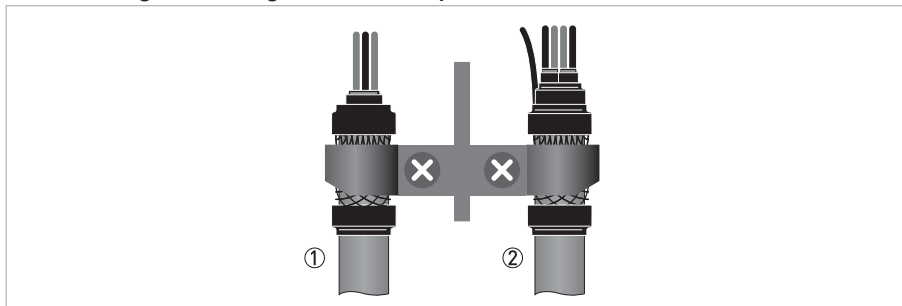


Figure 3-11: Clamping of shields

- ① Field current cable
- ② Signal cable

At flow sensor side:

Connecting shielding via special cable gland

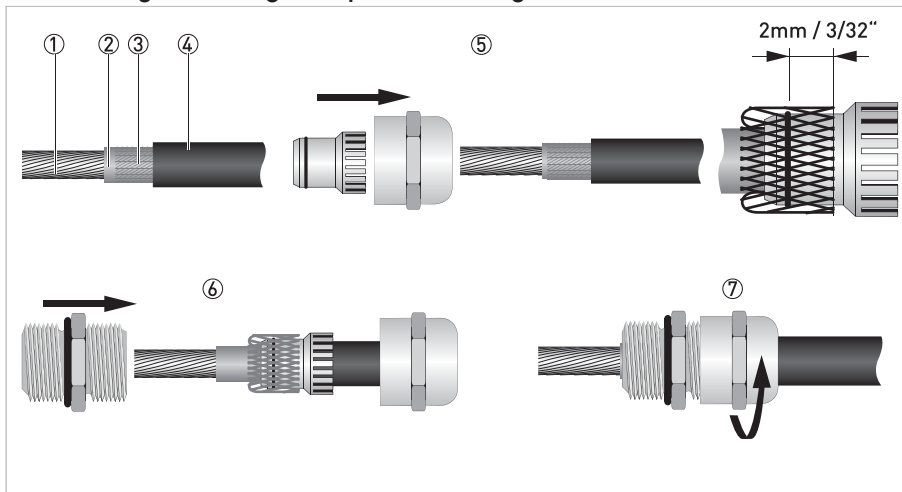


Figure 3-12: Connecting the shield within the cable gland

- ① Wires
- ② Isolation
- ③ Shielding
- ④ Isolation
- ⑤ Feed cable through dome nut and clamping insert and fold shielding over clamping insert. Make sure that the braided shield overlaps the O-ring by 2 mm / 3/32".
- ⑥ Push clamping insert into body.
- ⑦ Tighten the dome nut.

3.12 Grounding



DANGER!

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

3.12.1 Mounting grounding rings



CAUTION!

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.

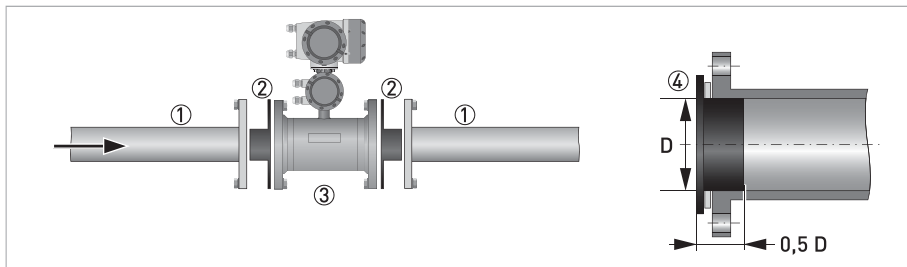


Figure 3-13: Grounding with grounding rings

- 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.



INFORMATION!

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

3.13 Before switching on the power

Before switching on the power, please check that the system has been correctly installed. This includes:

- The device must be mechanically mounted safely in compliance with the regulations.
- The power connections must be in compliance with the regulations.
- Make sure that all electrical connections are made and that the covers of the terminal compartments are closed.
- Check that the electrical operating data of the power supply are correct.



- Switch on the power.

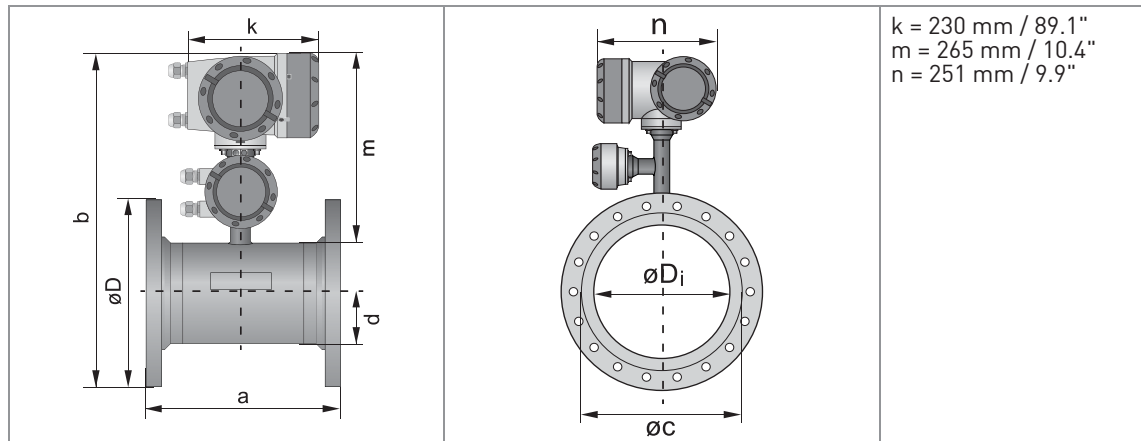


INFORMATION!

The sensor can not be programmed or changed in any way. All settable functions are included in the converter. Please see the relevant documentation of the converter for more information.

4.1 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.



INFORMATION!

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 _i	
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



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