OPTIFLUX 1000 Handbook

Electromagnetic flow sensor in sandwich version

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

KROHNE

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1.1 Intended use

The **OPTIFLUX 1000** flowmeter measures the volumetric flow rate of electrically conductive liquids, acids, alkaline solutions, pastes and slurries, also with very high solid contents.

1.2 Certification

CE

The device fulfils the statutory requirements of the following EC directives:

- EMC Directive 2004/108/EC in conjunction with EN 61326-1: 2006
- Low Voltage Directive 2006/95/EC in conjunction with EN 61010-1: 2001
- Pressure Equipment Directive 97/23/EC

The manufacturer certifies successful testing of the product by applying the CE marking.

1.3 Safety instructions from the manufacturer

1.3.1 Copyright and data protection

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1.3.2 Disclaimer

The manufacturer will not be liable for any damage of any kind by using its product, including, but not limited to direct, indirect or incidental and consequential damages.

This disclaimer does not apply in case the manufacturer has acted on purpose or with gross negligence. In the event any applicable law does not allow such limitations on implied warranties or the exclusion of limitation of certain damages, you may, if such law applies to you, not be subject to some or all of the above disclaimer, exclusions or limitations.

Any product purchased from the manufacturer is warranted in accordance with the relevant product documentation and our Terms and Conditions of Sale.

The manufacturer reserves the right to alter the content of its documents, including this disclaimer in any way, at any time, for any reason, without prior notification, and will not be liable in any way for possible consequences of such changes.

1.3.3 Product liability and warranty

The operator shall bear responsibility for the suitability of the device for the specific purpose. The manufacturer accepts no liability for the consequences of misuse by the operator. Improper installation and operation of the devices (systems) will cause the warranty to be void. The respective "Standard Terms and Conditions" which form the basis for the sales contract shall also apply.

1.3.4 Information concerning the documentation

To prevent any injury to the user or damage to the device it is essential that you read the information in this document and observe applicable national standards, safety requirements and accident prevention regulations.

If this document is not in your native language and if you have any problems understanding the text, we advise you to contact your local office for assistance. The manufacturer can not accept responsibility for any damage or injury caused by misunderstanding of the information in this document.

This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device. Special considerations and precautions are also described in the document, which appear in the form of underneath icons.

1.3.5 Warnings and symbols used

Safety warnings are indicated by the following symbols.

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

DANGER!
This warning refers to the immediate danger of burns caused by heat or hot surfaces.

DANGER!
This warning refers to the immediate danger when using this device in a hazardous atmosphere.

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.

LEGAL NOTICE!
This note contains information on statutory directives and standards.

- 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.

1.4 Safety instructions for the operator

WARNING!
In general, devices from the manufacturer may only be installed, commissioned, operated and maintained by properly trained and authorized personnel.
This document is provided to help you establish operating conditions, which will permit safe and efficient use of this device.

2.1 Scope of delivery

INFORMATION!
Check the packing list to check if you received completely all that you ordered.

INFORMATION!
Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
The device will arrive in two cartons. One carton contains the converter and one carton contains the sensor.

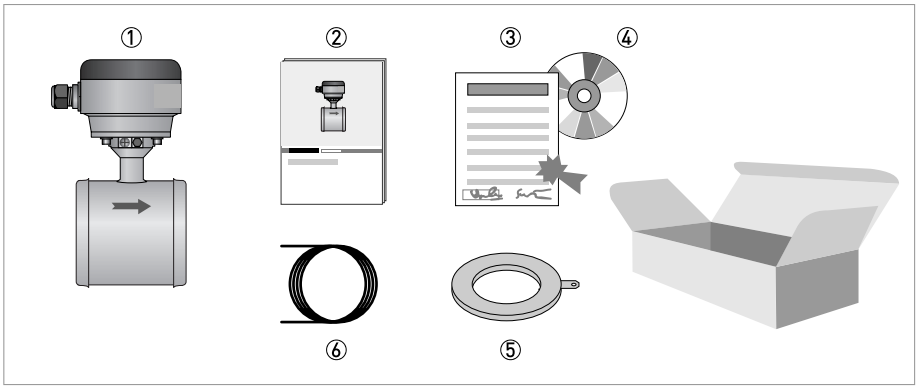


Figure 2-1: Scope of delivery

① Ordered flowmeter
② Product documentation
③ Factory calibration report
④ CD-ROM with product documentation
⑤ Grounding rings (optionally)
⑥ Signal cable (optionally, remote versions only)

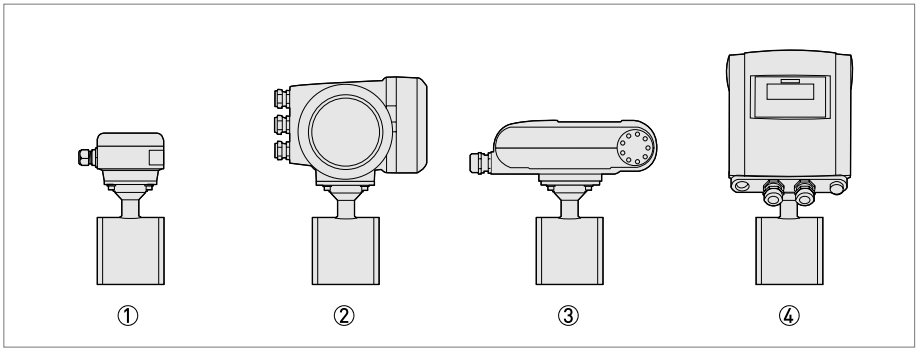
INFORMATION!
Assembly materials and tools are not part of the delivery. Use the assembly materials and tools in compliance with the applicable occupational health and safety directives.

2.2 Device description

Your measuring device is supplied ready for operation. The factory settings for the operating data have been made in accordance with your order specifications.

The following versions are available:

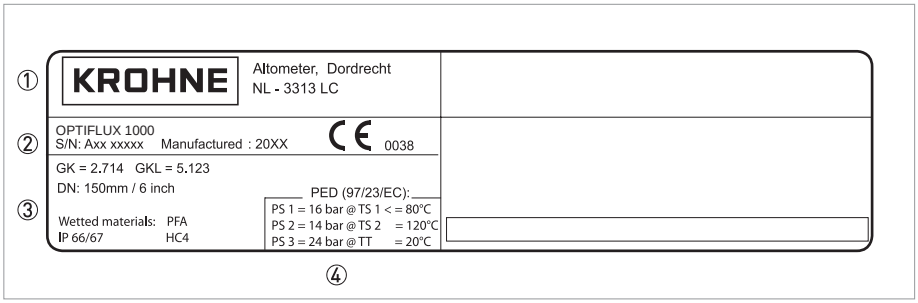
- Compact version (the signal converter is mounted directly on the measuring sensor)
- Remote version (electrical connection to the measuring sensor via field current and signal cable)



① Remote version
② Compact version with IFC 300 signal converter
③ Compact version with IFC 100 (0°) signal converter
④ Compact version with IFC 100 (45°) signal converter

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.



① Name and address of the manufacturer
② Type designation of the flowmeter and CE sign with number(s) of notified body / bodies
③ Calibration data
④ PED data

3.1 Notes on installation

INFORMATION!
Inspect the cartons carefully for damage or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

INFORMATION!
Check the packing list to check if you received completely all that you ordered.

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 Storage

- Store the device in a dry and dust-free location.
- Avoid lasting direct exposure to the sun.
- Store the device in its original packing.

3.3 Transport

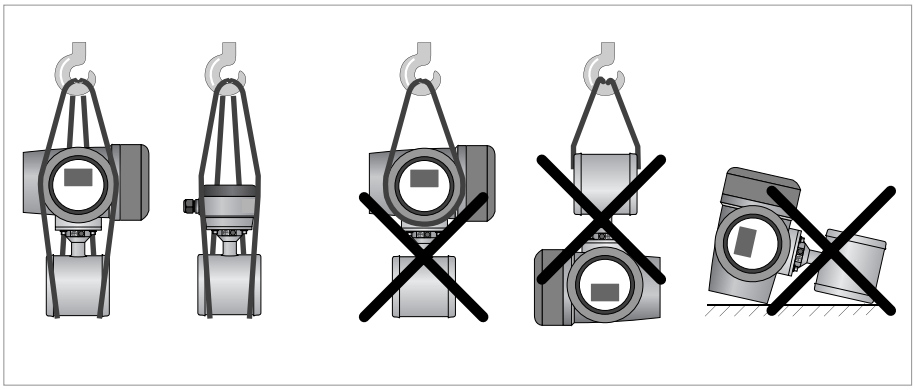


Figure 3-1: Transport

3.4 Installation conditions

3.4.1 Inlet and outlet

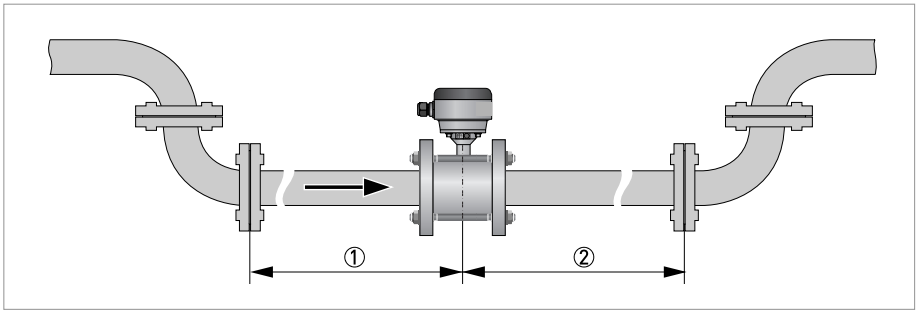


Figure 3-2: Recommended inlet and outlet

① ≥ 5 DN
② ≥ 2 DN

3.4.2 Mounting position

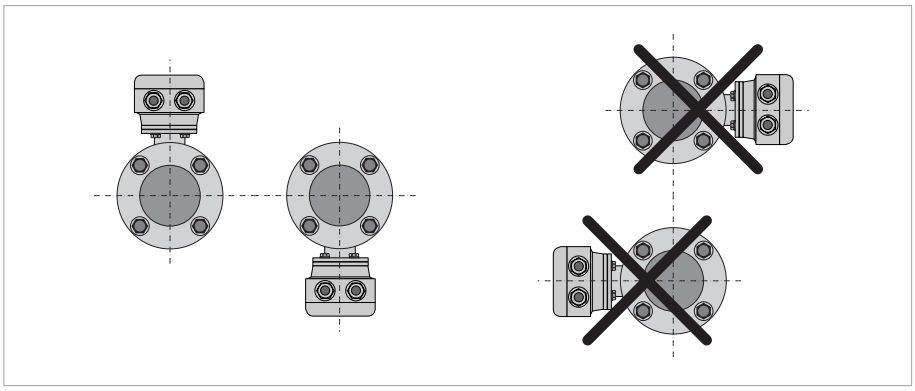


Figure 3-3: Mounting position

3.4.3 Flange deviation

CAUTION!
Max. permissible deviation of pipe flange faces:
$L_{max} - L_{min} \leq 0.5$ *mm / 0.02"*

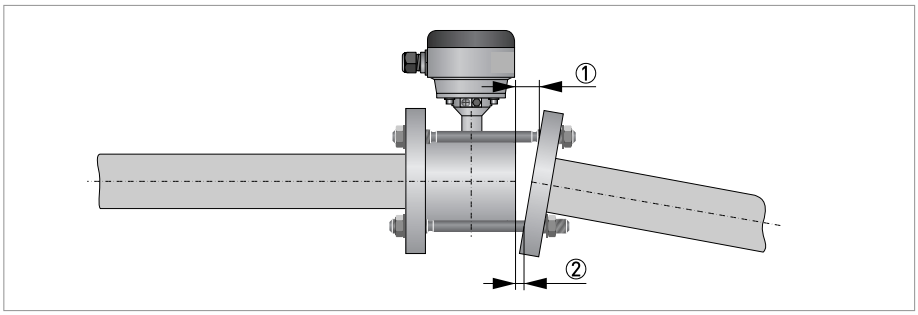


Figure 3-4: Flange deviation

① L_{max}
② L_{min}

3.4.4 T-section

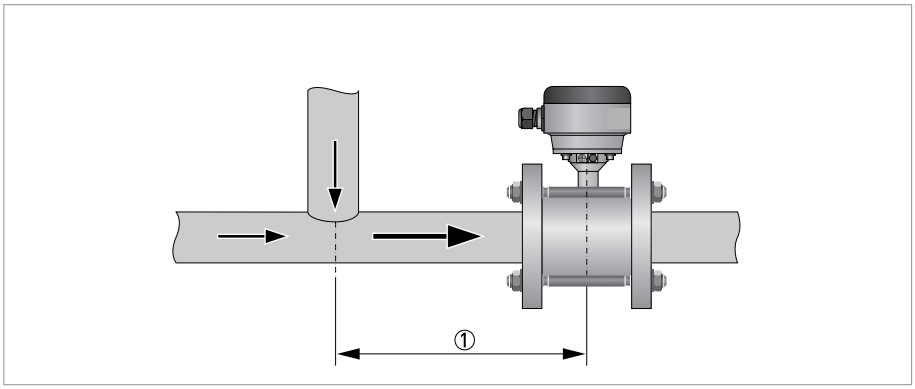


Figure 3-5: Distance after T-sections

① ≥ 10 DN

3.4.5 Vibration

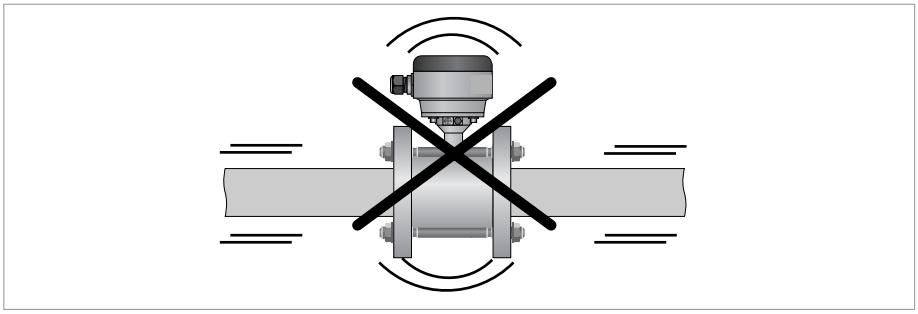


Figure 3-6: Avoid vibrations

3.4.6 Magnetic field

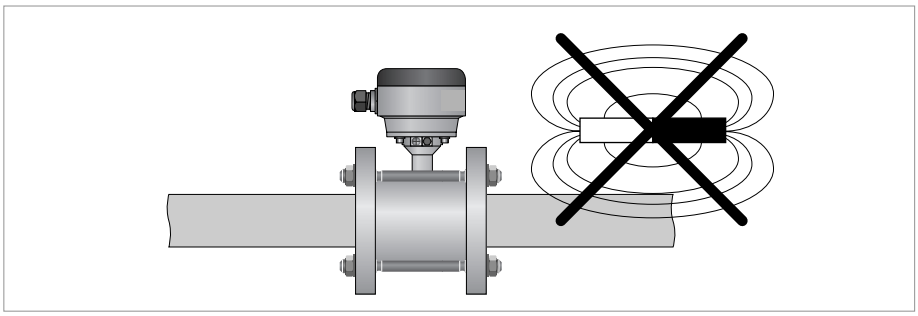


Figure 3-7: Avoid magnetic fields

3.4.7 Bends

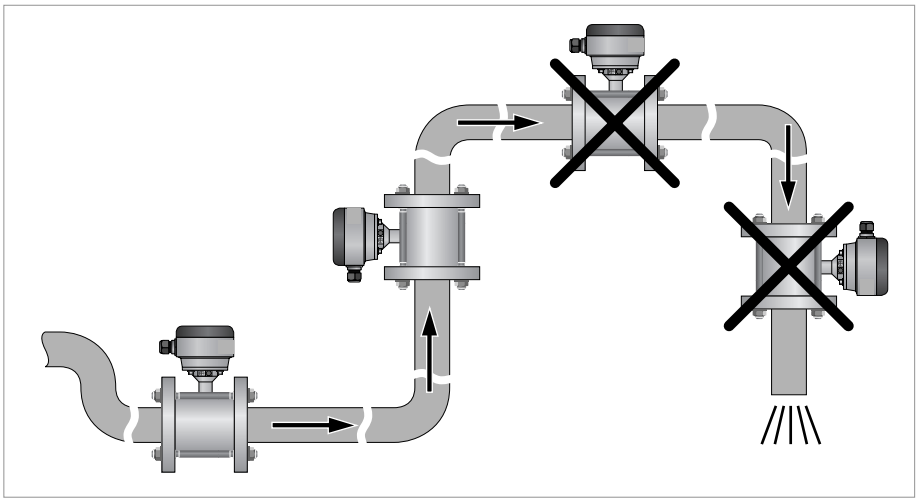


Figure 3-8: Installation in bending pipes

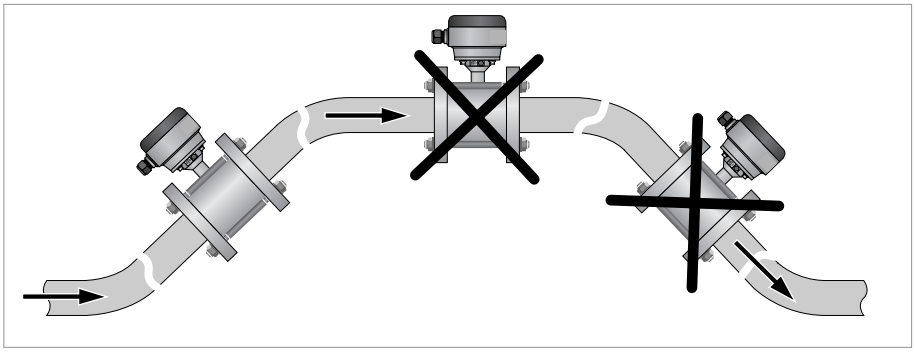


Figure 3-9: Installation in bending pipes

3.4.8 Open discharge

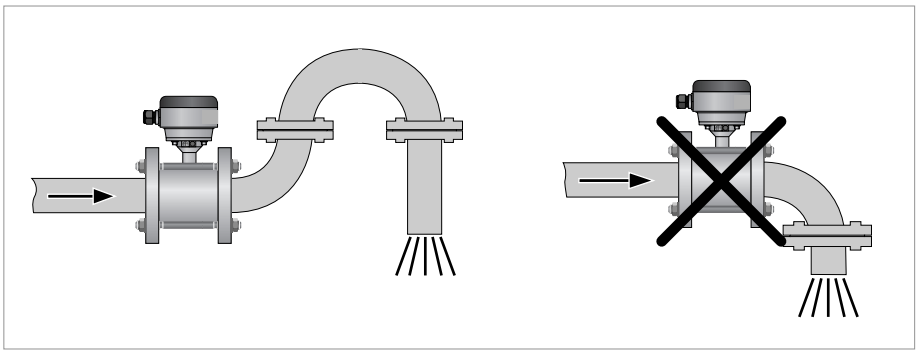


Figure 3-10: Installation before an open discharge

3.4.9 Control valve

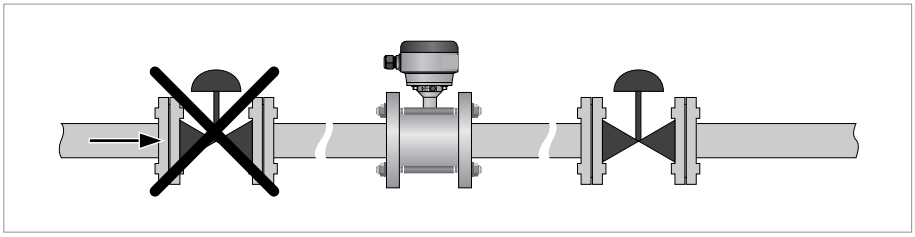


Figure 3-11: Installation before control valve

3.4.10 Air venting

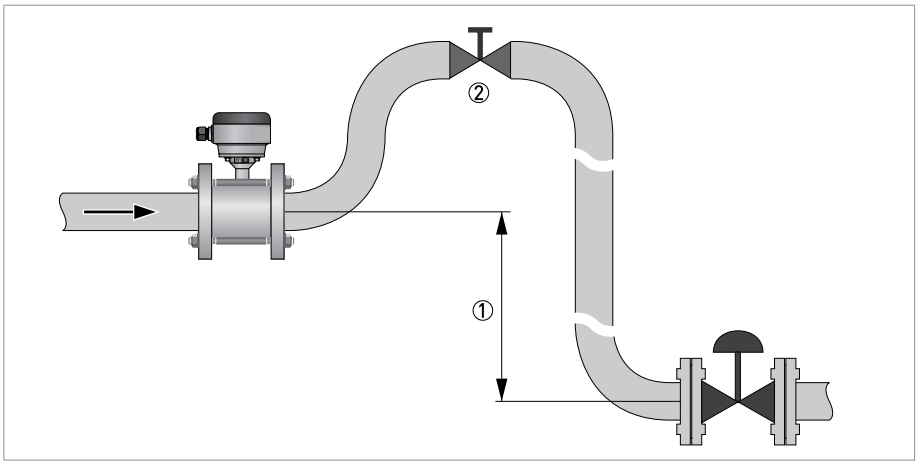


Figure 3-12: Air venting

① ≥ 5 m
② Air ventilation point

3.4.11 Pump

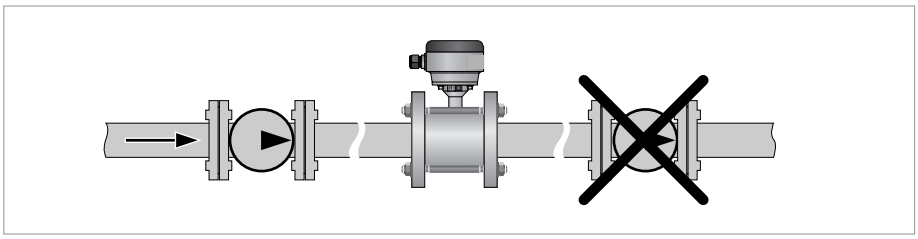


Figure 3-13: Installation after pump

3.4.12 Temperatures

CAUTION!
Protect the device from direct sunlight.

Temperature range	Process [°C]		Ambient [°C]		Process [°F]		Ambient [°F]	
	min.	max.	min.	max.	min.	max.	min.	max.
Separate flow sensor	-25	120	-25	65	-13	248	-13	149
Compact + IFC 300 C	-25	120	-25	65	-13	248	-13	149
Compact + IFC 100 C	-25	120	-25	65	-13	248	-13	149

3.5 Mounting

3.5.1 Torques and pressures

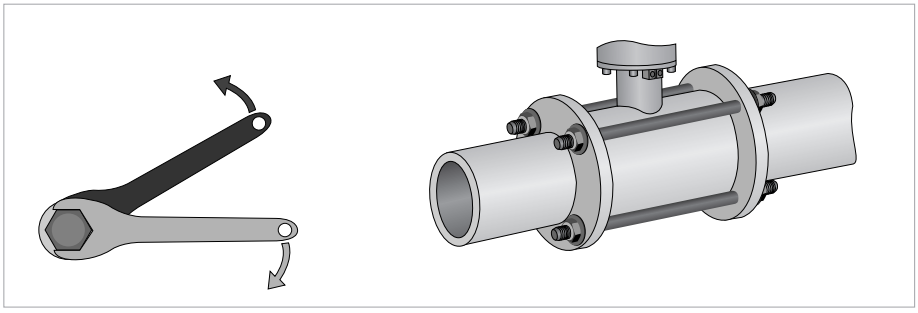


Figure 3-14: Tightening of bolts

Tightening of bolts

① Step 1: Apply approx. 50% of max. torque given in table.
② Step 2: Apply approx. 80% of max. torque given in table.
③ Step 3: Apply 100% of max. torque given in table.

EN 1092-1

Nominal size	Pipe flanges		Pressure rating [bar]	Max. torque [Nm]
	Flange size	Pressure rating		
DN10	DN15	PN 16/40	16	16
DN15	DN15	PN 16/40	16	16
DN25	DN25	PN 16/40	16	16
DN40	DN40	PN 16/40	16	25
DN50	DN50	PN 16/40	16	45
DN80	DN80	PN 16/40	16	25
DN100	DN100	PN 16/40	16	33
DN150	DN150	PN 16/40	16	82

ASME B 16.5

Nominal size	Pipe flanges		Pressure rating [psig]	Max. torque [Nm]
	Flange size	Pressure rating		
3/8"	1/2"	150/300 lb	230	16
1/2"	1/2"	150/300 lb	230	16
1"	1"	150/300 lb	230	15
1 1/2"	1 1/2"	150/300 lb	230	25
2"	2"	150/300 lb	230	45
3"	3"	150 lb	230	56
3"	3"	300 lb	230	28
4"	4"	150/300 lb	230	36
6"	6"	150 lb	230	100
6"	6"	300 lb	230	66

4.1 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.

4.2 Grounding

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

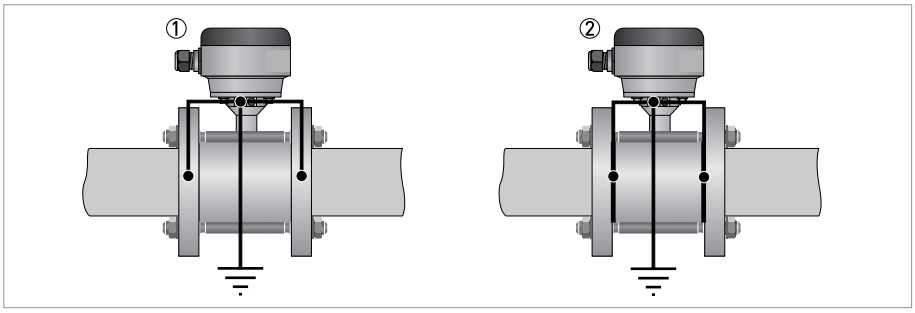


Figure 4-1: Grounding

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: Grounding ring number 1

Grounding ring number 1 (Optional for DN25...100):

- 3 mm / 0.1" thick (tantalum: 0.5 mm / 0.1")

4.3 Virtual reference for IFC 300 (C, W and F version)

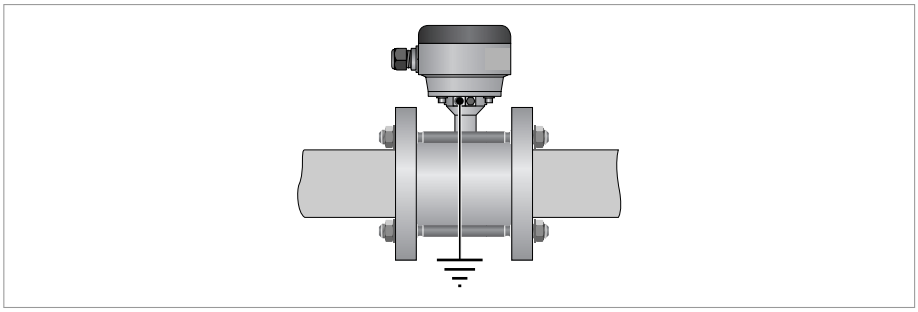


Figure 4-3: Virtual reference

Possible if:

- ≥ DN10
- Electrical conductivity ≥ 200 µS/cm
- Electrode cable max. 50m., type DS

4.4 Connection diagrams

INFORMATION!
For the connection diagrams please refer to the documentation of the applicable converter.

5.1 Spare parts availability

The manufacturer adheres to the basic principle that functionally adequate spare parts for each device or each important accessory part will be kept available for a period of 3 years after delivery of the last production run for the device.

This regulation only applies to spare parts which are subject to wear and tear under normal operating conditions.

5.2 Availability of services

The manufacturer offers a range of services to support the customer after expiration of the warranty. These include repair, maintenance, technical support and training.

INFORMATION!
For more precise information, please contact your local representative.

5.3 Returning the device to the manufacturer

5.3.1 General information

This device has been carefully manufactured and tested. If installed and operated in accordance with these operating instructions, it will rarely present any problems.

CAUTION!
Should you nevertheless need to return a device for inspection or repair, please pay strict attention to the following points:

- *Due to statutory regulations on environmental protection and safeguarding the health and safety of our personnel, manufacturer may only handle, test and repair returned devices that have been in contact with products without risk to personnel and environment.*
- *This means that the manufacturer can only service this device if it is accompanied by the following certificate (see next section) confirming that the device is safe to handle.*

CAUTION!
If the device has been operated with toxic, caustic, flammable or water-endangering products, you are kindly requested:

- *to check and ensure, if necessary by rinsing or neutralizing, that all cavities are free from such dangerous substances,*
- *to enclose a certificate with the device confirming that is safe to handle and stating the product used.*

5.3.2 Form (for copying) to accompany a returned device

Company:		Address:
Department:		Name:
Tel. no.:		Fax no.:
Manufacturer's order no. or serial no.:		
The device has been operated with the following medium:		
This medium is:		water-hazardous
		toxic
		caustic
		flammable
		We checked that all cavities in the device are free from such substances.
		We have flushed out and neutralized all cavities in the device.
We hereby confirm that there is no risk to persons or the environment through any residual media contained in the device when it is returned.		
Date:		Signature:
Stamp:		

5.4 Disposal

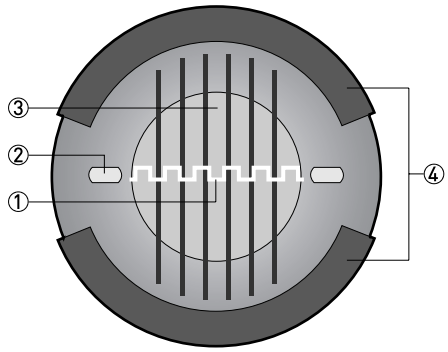
CAUTION!
Disposal must be carried out in accordance with legislation applicable in your country.

6.1 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 flow meter

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 totalising, recording and output processing.



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

6.2 Technical data

INFORMATION!

- *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 representative.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Download Center).*

Measuring system

Measuring principle	Faraday's law of induction
Application range	Electrically conductive fluids
Measured value	
Primary measured value	Flow velocity
Secondary measured value	Volume flow, mass flow, electrical conductivity, coil temperature

Design

Features	Sandwich version
Modular construction	The measurement system consists of a flow sensor and a signal converter. It is available as compact and as separate version. More information about the signal converter can be found in the documentation of the signal converter.
Compact version	With IFC 100 converter: OPTIFLUX 1100 C
	With IFC 300 converter: OPTIFLUX 1300 C
Remote version	In wall (W) mount version with IFC 100 converter: OPTIFLUX 1100 W
	In field (F), wall (W) or rack (R) mount version with IFC 300 converter: OPTIFLUX 1300 F, W or R
Nominal diameter	DN10...150 / 3/8...6"
Measurement range	-12...+12 m/s / -40...+40 ft/s

Measuring accuracy

Reference conditions	Flow condition simular to EN 29104
	Medium: Water
	Electrical conductivity: ≥ 300 µS/cm
	Temperature: +10...+30°C / +50...+86°F
	Flow velocity: > 1 m/s / > 3 ft/s
	Operating pressure: 1 bar / 14.5 psig
	Wet calibrated on EN 17025 accredited calibration rig by direct volume comparison.
Maximum measuring error	Related to volume flow (MV = Measured Value)
	These values are related to the pulse / frequency output.
	The additional typical measuring deviation for the current output is ±10 µA.
	For information refer to *Measuring accuracy* on page 30.
Repeatability	±0.1% of MV, minimum 1 mm/s
Long term stability	±0.1% of MV
Special calibration	On request

Operating conditions

Temperature	
Process temperature	-25...+120°C / -13...+248°F
Maximum temperature change (shock)	120°C / 248°F
Ambient temperature	-25...+65°C / -13...+149°F
Storage temperature	-50...+70°C / -58...+158°F
Pressure	
Ambient pressure	Atmospheric
Nominal flange pressure	**Standard:**
EN 1092-1	DN100... DN150: PN 16
	DN10...80: PN 40
ASME B16.5	**Standard:**
	3/8...6": 150 lb RF
	Option:
	3/8...4": 300 lb RF
JIS	DN10...100 / 3/8...4": 20 K
	DN150 / 6": 10 K
Vacuum load	0 mbar / 0 psi absolute
Pressure ranges for secondary containment	Pressure resistant up to 40 bar / 580 psi
	Burst pressure up to approx. 160 bar / 2320 psi

Chemical properties	
Physical condition	Liquids
Electrical conductivity	**Non water:**
	≥ 5 µS/cm
	Water:
	≥ 20 µS/cm
Permissible gas content (volume)	IFC 100: ≤ 3%
	IFC 300: ≤ 5%
Permissible solid content (volume)	IFC 100: ≤ 10%
	IFC 300: ≤ 70%
Recommended flow velocity	-12...+12 m/s / -40...+40 ft/s

Installation condtitions

Installation	Take care that flow sensor always fully filled.
	For information refer to *Installation* on page 11.
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	≥ 2 DN
Dimensions and weights	For information refer to *Dimensions and weights* on page 28.

Materials

Sensor housing	DN10...40: GTW-S 38
	DN50...150: sheet steel
Measuring tube	PFA
Connection box	Die-cast aluminium (polyurethane coated)
	Option: stainless steel
Measuring electrodes	Hastelloy C4
Grounding rings	DN10...15: Integrated stainless steel 316 (1.4571) (AISI 316 Ti)
	DN25...150: Separate stainless steel 316 (1.4571) (AISI 316 Ti)
	Grounding rings can be omitted with virtual reference option for the IFC 300 converter.
Stud bolts and nuts	DN40...150: rubber centering sleeves
	Option: steel, stainless steel

Process connections

EN 1092-1	DN10...150 in PN 16...40
ASME	3/8...6" in 150...300 lb
JIS	DN10...150 in JIS 10...20 K

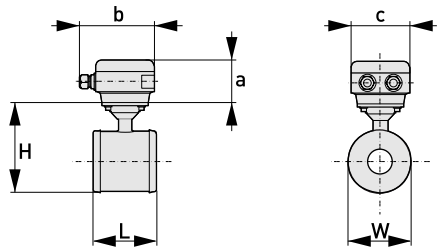
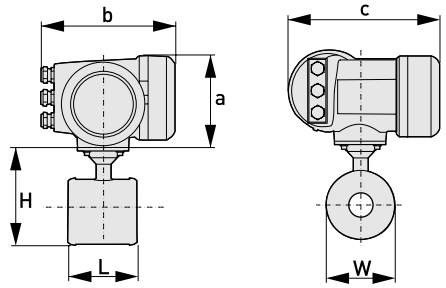
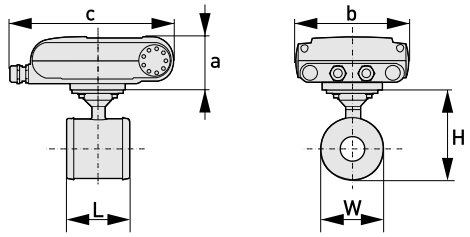
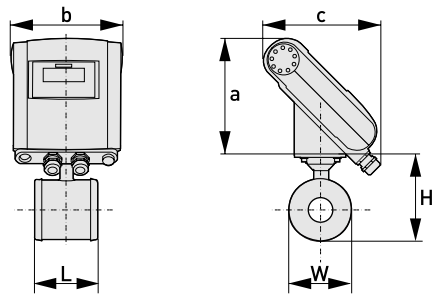
Electrical connections

Signal cable	Only for remote systems
Type A	Standard cable, double shielded. Max. length: 600 m / 1950 ft (dep. on electrical conductivity and measuring sensor). See documentation of the converter for more information.
Type B	Optional cable, triple shielded. Max. length: 600 m / 1950 ft (dep. on electrical conductivity and measuring sensor). See documentation of the converter for more information.

Approvals and certifications

CE	
	This device fulfills the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
Electromagnetic compatibility	Directive: 2004/108/EC and A1,A2 NAMUR NE21/04
	Harmonized standard: EN 61326-1 : 2006
Low Voltage Directive	Directive: 2006/95/EC
	Harmonized standard: EN 61010 : 2001
Pressure Equipment Directive	Directive: 97/23/EC
	Category I, II or SEP
	Fluid group 1
	Production module H
Other approvals and standards	
Protection category acc. to IEC 529 / EN 60529	Standard: IP 66/67 (NEMA 4/4X/6)
	Optional: IP 68 (NEMA 6P)
Vibration test	IEC 68-2-6

6.3 Dimensions and weights

Remote version		a = 77 mm / 3.1" b = 139 mm / 5.5" ① c = 106 mm / 4.2" Total height = H + a
Compact version with IFC 300		a = 155 mm / 6.1" b = 230 mm / 9.1" ① c = 260 mm / 10.2" Total height = H + a
Compact version with IFC 100 (0°)		a = 82 mm / 3.2" b = 161 mm / 6.3" c = 257 mm / 10.1" ① Total height = H + a
Compact version with IFC 100 (45°)		a = 186 mm / 7.3" b = 161 mm / 6.3" c = 184 mm / 2.7" ① Total height = H + a

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

INFORMATION!

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

Nominal size		Dimensions [mm]			Approx. weight [kg]
DN	PN [bar]	L	H	W	
10	40	68	137	47	1.7
15	40	68	137	47	1.7
25	40	54	147	66	1.7
40	40	78	162	82	2.6
50	40	100	151	101	4.2
80	40	150	180	130	5.7
100	16	200	207	156	10.5
150	16	200	271	219	15.0

Nominal size		Dimensions [inches]			Approx. weight [lb]
ASME	PN [psi]	L	H	W	
3/8"	580	2.68	5.39	1.85	3.7
½"	580	2.68	5.39	1.85	3.7
1"	580	2.13	5.79	2.6	3.7
1½"	580	3.07	6.38	3.23	5.7
2"	580	3.94	5.94	3.98	9.3
3"	580	5.91	7.08	5.12	12.6
4"	232	7.87	8.15	6.14	23.1
6"	232	7.87	10.67	8.62	33.1

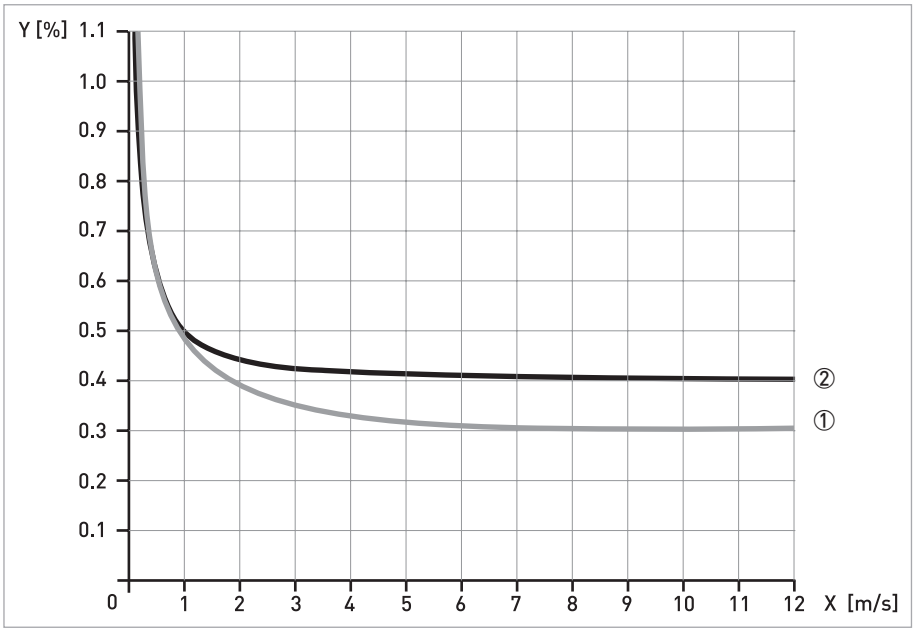
CAUTION!

- *Pressures are applicable at 20° C / 68° F.*
- *For higher temperatures, the pressure ratings are as per ASME B16.5 (up to 24").*

6.4 Measuring accuracy

Reference conditions

- Medium: water
- Temperature: 20°C / 68°F
- Pressure: 1 bar / 14.5 psi



X [m/s]: flow velocity
Y [%]: deviation from the actual measured value (mv)

Compact with IFC 300	Accuracy	Curve
DN10...150 / 3/8...6"	0.3% of mv + 2 mm/s	①

Compact with IFC 100	Accuracy	Curve
DN10...150 / 3/8...6"	0.4% of mv + 1 mm/s	②

KROHNE product overview

- Electromagnetic flowmeters
- Variable area flowmeters
- Ultrasonic flowmeters
- Mass flowmeters
- Vortex flowmeters
- Flow controllers
- Level meters
- Temperature meters
- Pressure meters
- Analysis products
- Measuring systems for the oil and gas industry
- Measuring systems for sea-going tankers

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

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

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