OPTIFLUX 5000 Handbook

Electromagnetic flowmeter in sandwich version

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

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1.1 Intended use

The flow meter measures the volumetric flow rate of electrically conductive liquids, acids, alkaline solutions, pastes and slurries, also with very high solid contents. It can be combined with an IFC 100 or an IFC 300electromagnetic signal converter.

1.2 Safety instructions from the manufacturer

1.2.1 Copyright and data protection

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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.

1.2.3 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.

1.2.4 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.

1.2.5 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.

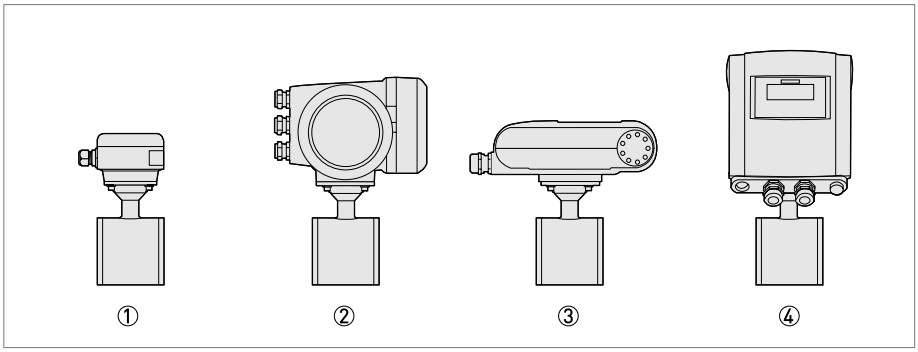
- HANDLING
  This symbol designates all instructions for actions to be carried out by the operator in the specified sequence.

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

1.3 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



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

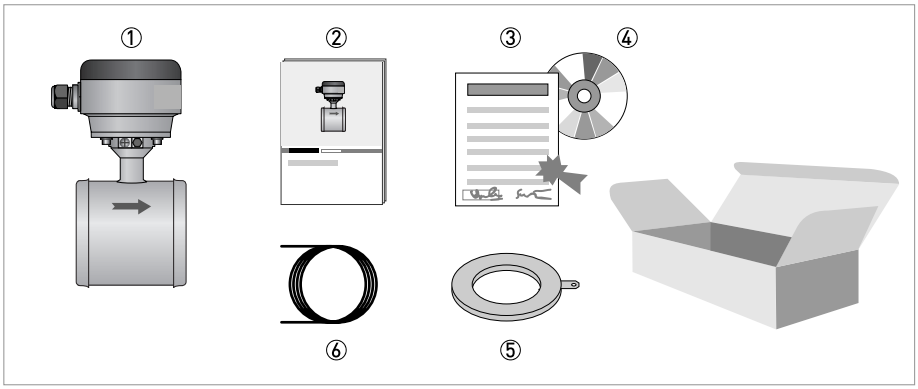


Figure 2-1: Scope of delivery

① Ordered flowmeter
② Quick Start
③ Factory calibration report
④ CD-ROM with product documentation
⑤ Grounding rings (optionally)
⑥ Cable (remote versions only)

2.2 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.

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

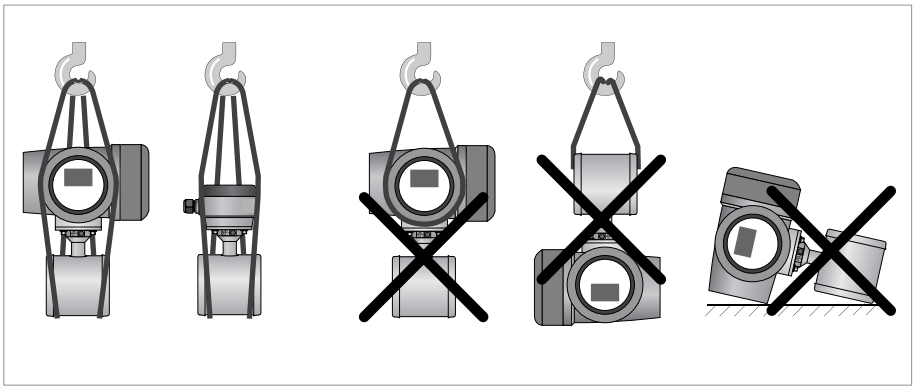


Figure 3-1: Transport

3.4 Installation conditions

3.4.1 Inlet and outlet

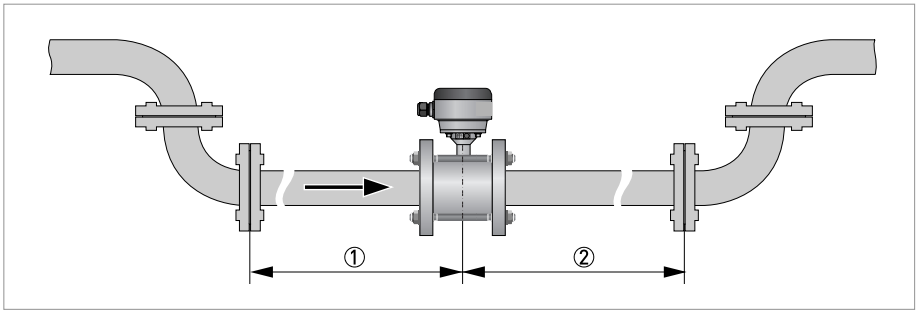


Figure 3-2: Recommended inlet and outlet

① ≥ 5 DN
② ≥ 2 DN

3.4.2 Mounting position

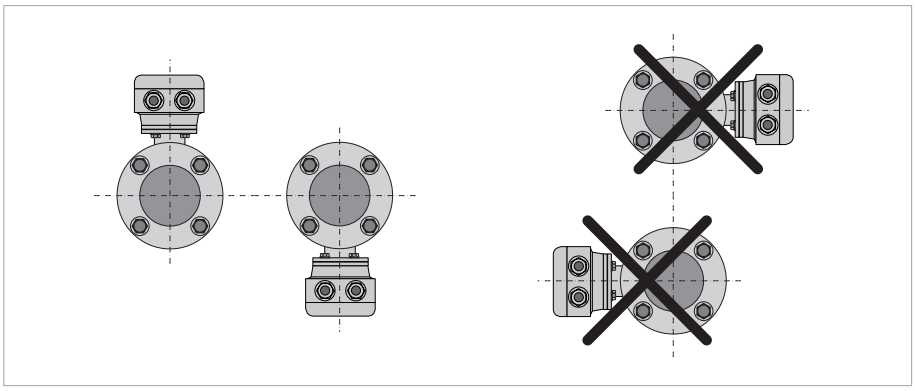


Figure 3-3: Mounting position

3.4.3 Flange deviation

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

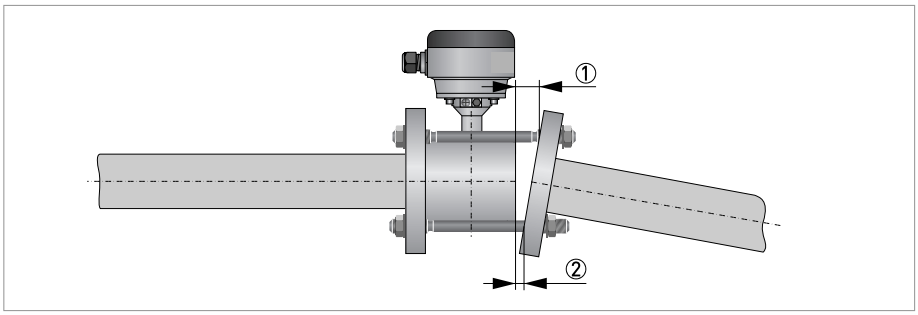


Figure 3-4: Flange deviation

① L_{max}
② L_{min}

3.4.4 T-section

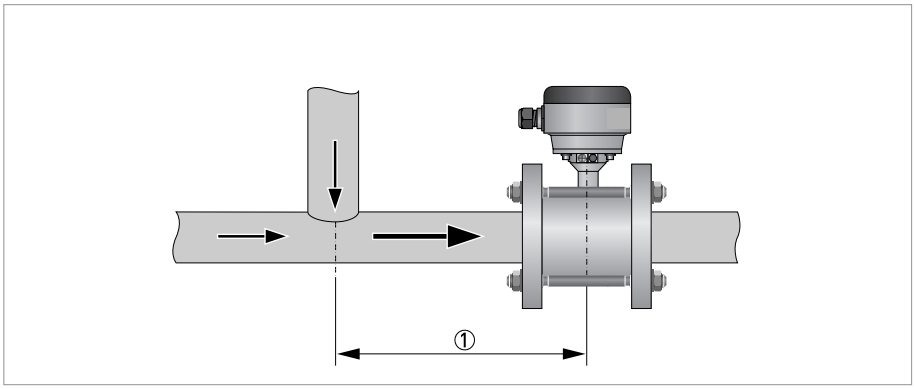


Figure 3-5: Distance after T-sections

① ≥ 10 DN

3.4.5 Vibration

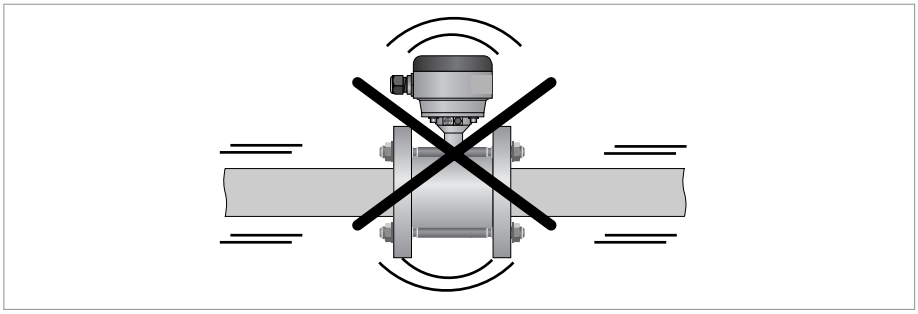


Figure 3-6: Avoid vibrations

3.4.6 Magnetic field

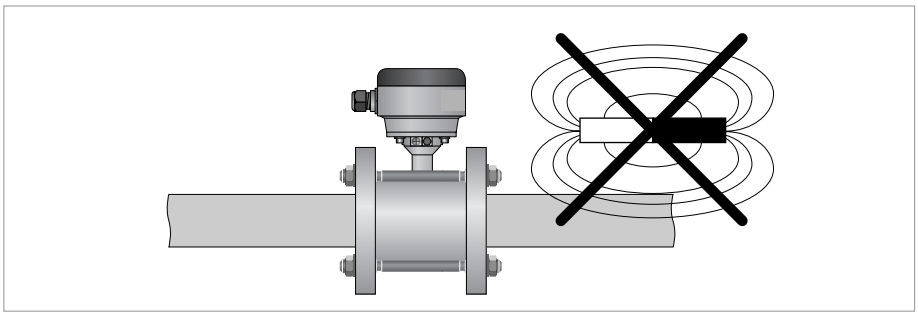


Figure 3-7: Avoid magnetic fields

3.4.7 Bends

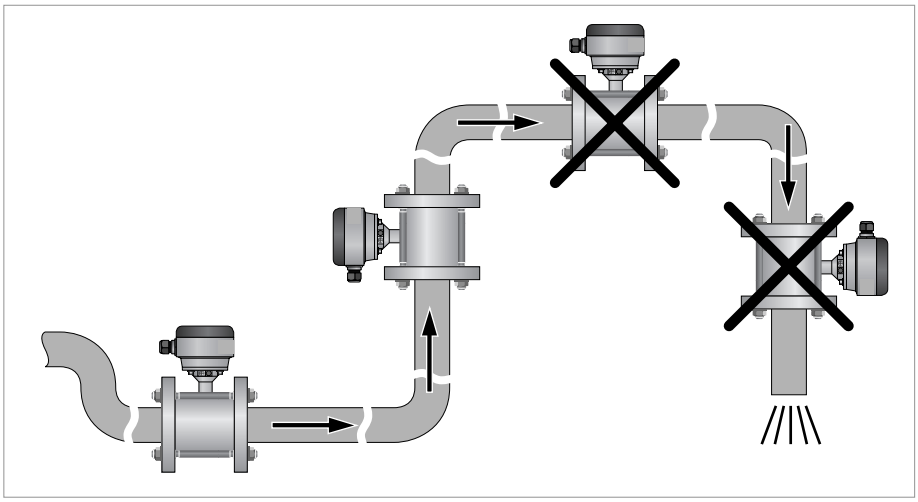


Figure 3-8: Installation in bending pipes

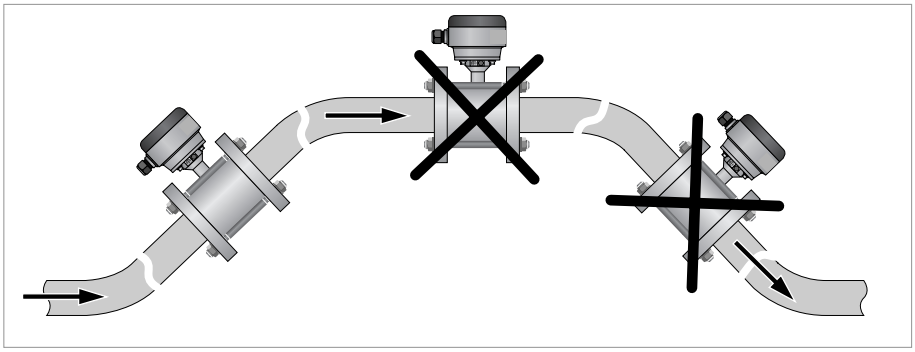


Figure 3-9: Installation in bending pipes

3.4.8 Open discharge

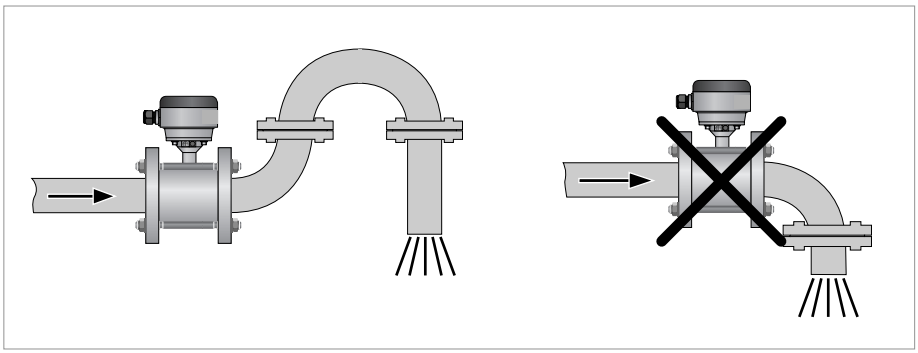


Figure 3-10: Installation before an open discharge

3.4.9 Control valve

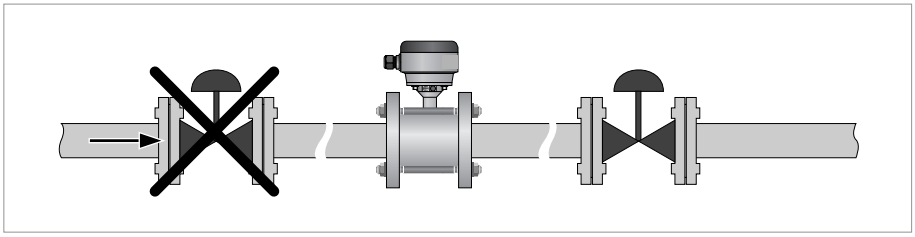


Figure 3-11: Installation before control valve

3.4.10 Air venting

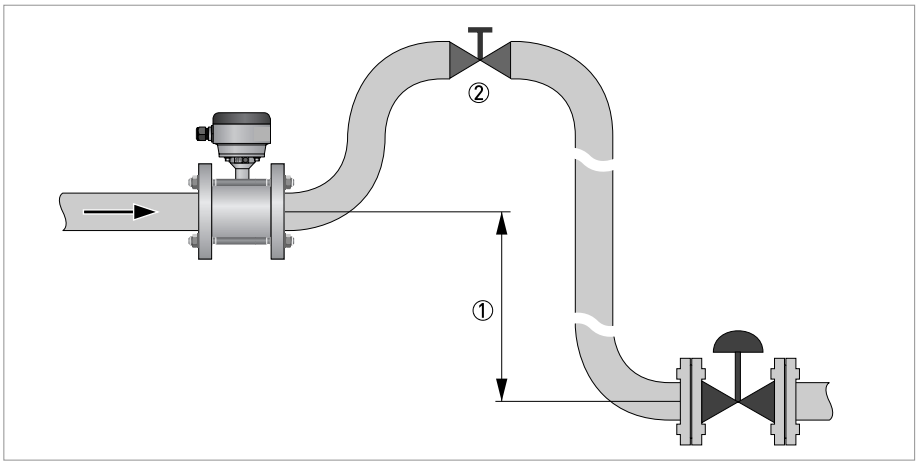


Figure 3-12: Air venting

① ≥ 5 m
② Air ventilation point

3.4.11 Pump

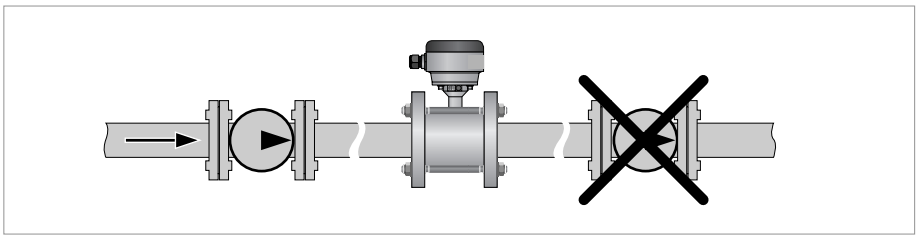
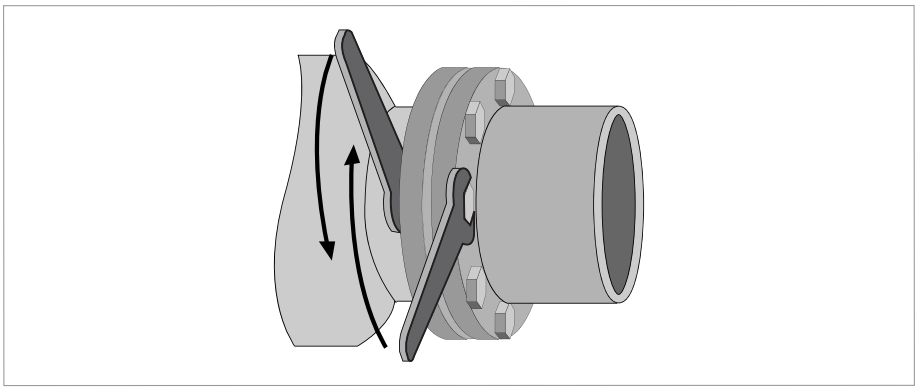


Figure 3-13: Installation after pump

3.5 Mounting

3.5.1 Torques and pressure



Max. torque:

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

Nominal size EN 1092-1	Pressure rating	Max. allowable operating pressure	
		bar	psig
DN2.5...80	PN40	16	580
DN100	PN16	16	230
	PN25	25	360

Pressures ASME

Nominal size ASME B 16.5	Pressure rating	Max. allowable operating pressure	
		bar	psig
1/10...4"	150 lb	16	230
1/10...3"	300 lb	40	580
4"	300 lb	25	360

Torques EN 1092-1

Nominal size EN 1092-1	Pipe flanges	Max. allowable torque with gaskets made of					
		Gylon		Chemotherm		FPM / FKM ①	
	Rating	Nm	ftlb	Nm	ftlb	Nm	ftlb
DN2.5...10	PN40	-	-	-	-	32	24
DN15	PN40	-	-	-	-	36	27
DN25	PN40	22	16	32	24	-	-
DN40	PN40	47	35	66	49	-	-
DN50	PN40	58	43	82	60	-	-
DN80	PN40	48	35	69	51	-	-
DN100	PN16	75	55	106	78	-	-
	PN25	94	69	133	98	-	-
① according DIN ISO 1629 / ASTM D 1418							

Torques ASME

Nominal size ASME B 16.5	Pipe flanges	Max. allowable torque with gaskets made of					
		Gylon		Chemotherm		FPM / FKM ①	
	Rating	Nm	ftlb	Nm	ftlb	Nm	ftlb
1/10...3/8"	150 lb	-	-	-	-	35	26
1/2"	150 lb	-	-	-	-	35	26
1"	150 lb	24	18	33	24	-	-
1 1/2"	150 lb	38	28	54	40	-	-
2"	150 lb	58	43	83	61	-	-
3"	150 lb	98	72	138	102	-	-
4"	150 lb	75	55	108	80	-	-
① according DIN ISO 1629 / ASTM D 1418							

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!

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

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.

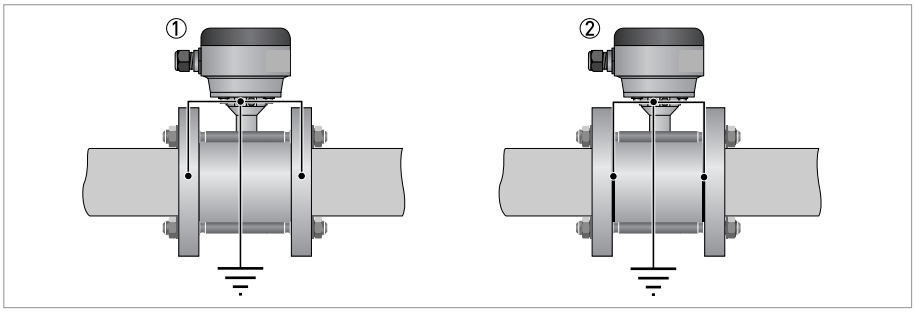


Figure 4-1: Grounding

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

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

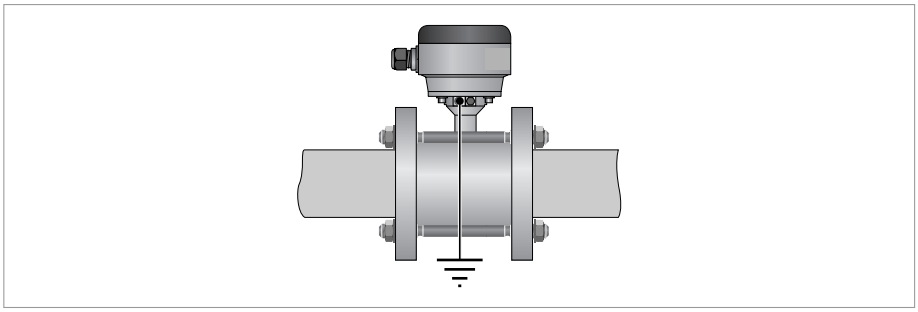


Figure 4-2: Virtual reference

Possible if:
≥ DN10
Electrical conductivity ≥ 200 µS/cm

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 under normal operating conditions subjects to wear and tear.

5.2 Availability of services

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

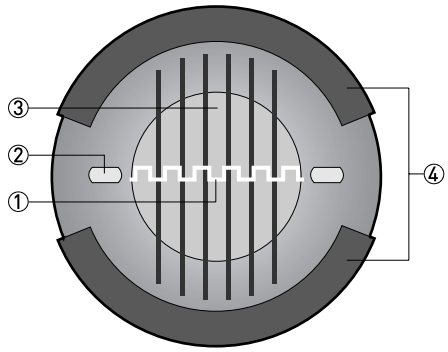
CAUTION!
Disposal must be carried out in accordance with legislation applicable in your country.

6.1 Measuring principle

An electrically conductive fluid flows inside an electrically insulating 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. The signal voltage is quite small (typically 1 mV at v = 3 m/s / 10 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.



① Voltage (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 (Downloadcenter).*

Measuring system

Measuring principle	Faraday's law
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 with optimized flow tube
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 5100 C
	With IFC 300 converter : OPTIFLUX 5300 C
Remote version	In wall (W) mount version with IFC 100 converter: OPTIFLUX 5100 W
	In field (F), wall (W) or rack (R) mount version with IFC 300 converter: OPTIFLUX 5300 F, W or R
Nominal diameter	DN2.5...100 / 1/10...4"
Measurement range	-12...+12 m/s / -40...+40 ft/s

Measuring accuracy

Reference conditions	Medium: water
	Temperature: 20°C / 68°F
	Inlet section: 10 DN
	Outlet section: 5 DN
	Flow velocity: > 1 m/s / > 3 ft/s
	Operating pressure: 1 bar / 14.5 psig
	Valve closing time variation: < 1 ms
	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
	With IFC 100 converter:
	DN2.5...6: ± 0.4% of MV + 1 mm/s
	DN10...100: ± 0.3% of MV + 1 mm/s
	With IFC 300 converter:
	DN2.5...6: ± 0.3% of MV + 2 mm/s
	DN10...100: ± 0.15% of MV + 1 mm/s
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	Ceramic liner: -40...+180°C / -40...+356°F (remote versions, compact versions are limited to +140°C / +284°F).
	For Ex versions different temperature ranges are applicable. Please see the relevant Ex documentation for details.
Maximum temperature change (shock)	120°C / 248°F
Ambient temperature	Non-Ex: -40...+65°C / -40...+149°F
	Ex: -40...+60°C / -40...+140°F
Storage temperature	-50...+70°C / -58...+158°F

Pressure	
Ambient	Atmospheric
Nominal flange pressure	**Standard:**
DIN (EN 1092-1)	PN16 for DN100
	PN40 for DN2.5...80
	Option:
	PN25 for DN100
ASME B16.5	**Standard:**
	150 lbs for ASME1/10...4"
	Option:
	300 lbs RF for ASME1/10...4"
Vacuum load	0 mbar / 0 psi
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:**
	DN25...100: ≥ 1 µS/cm
	DN4...15: ≥ 5 µS/cm
	DN2.5: ≥ 10 µS/cm
	Demineralised cold water:
	DN2.5...100: ≥ 20 µS/cm
Permissible gas content (volume)	≤ 5%
Permissible solid content (volume)	IFC 100: ≤ 10%; IFC 300 ≤ 70%
Recommended flow velocity	-12...+12 m/s / -40...+40 ft/s
Other conditions	
Protection category acc. to IEC 529 / EN 60529	Standard: IP66/67 (NEMA 4/4X/6)
	Optional: IP68 (NEMA 6P)
Vibration resistance	IEC 68-2-6

Installation condtitions

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 detailed information see chapter "Dimensions and weights".

Materials

Sensor housing	DN2.5...15: Stainless steel Duplex (1.4462)
	DN25...100: Stainless steel AISI 304 (1.4306)
Measuring tube	Ceramic
Grounding rings	Stainless steel, Hastelloy® C, Titanium, Tantalum
	Other materials on request
	Also available as alternative for grounding rings (IFC 300 only): Virtual Reference.
Stud bolts and nuts	Standard: Steel
	Option: Stainless steel, rubber centering sleeves
Gaskets	FPM / FKM, Gylon, EPDM, Kalrez, PTFE-PF 29, Chemotherm
	Other materials on request
Measuring electrodes	DN2.5...15: Cermet
	DN25...100: Platinum

Process connections

DIN	DN2.5...100 in PN16...40
ASME	1/10...4" in 150...300 lbs
JIS	DN2.5...100 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 Sign	This device fulfills the statutory requirements of the EC directives. The manufacturer certifies successful testing of the product by applying the CE mark.
Hazardous areas	
ATEX	KEMA 04 ATEX 2126 X
	ATEX II 2 GD EEx me ia IIC
	ATEX II 2 GD EEx de ia IIC
	T6...T3
	For more details, see Ex documentation of sensor and converter.
FM	Class I, Div 2, groups A, B, C and D
	Class II, Div 2, groups F and G
	Class III, Div 2, groups F and G
CSA	Class I, Div 2, groups A, B, C and D
	Class II, Div 2, groups F and G
IEC-Ex	pending
NEPSI	GYJ05240
	Ex me ia IIC T6...T3
	Ex de ia IIC T6...T3
Other approvals and standards	
Electromagnetic compatibility	Directive: 89/336/EEC 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
Custody transfer	Standard: without
	Option: MI-001, MI-005
Hygiene	Ceramic measuring tube is FDA approved.

6.3 Dimensions and weights

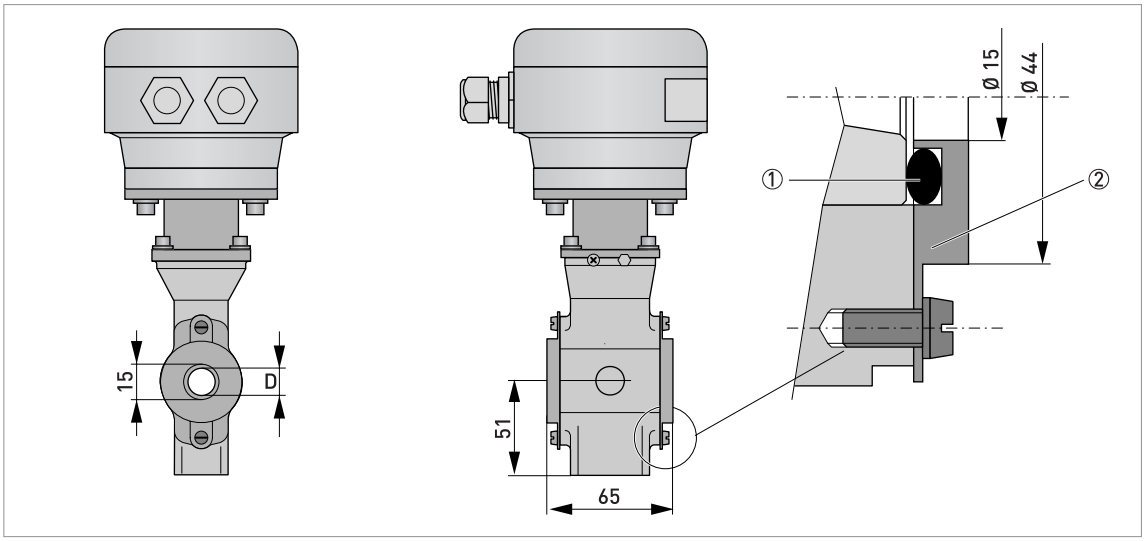


Figure 6-1: Contruction details DN2.5...15

① O-ring
② Grounding ring

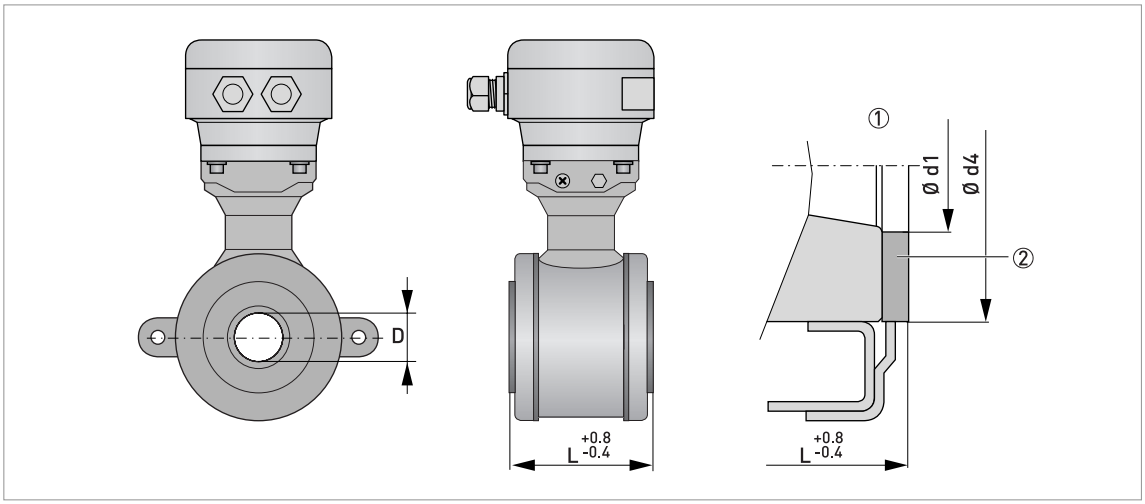


Figure 6-2: Construction details DN25...100

① Situation without grounding rings
② Gasket

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	Ød1	Ød4	
2.5	40	65 ①	123	44	-	-	1.6
4	40	65 ①	123	44	-	-	1.6
6	40	65 ①	123	44	-	-	1.6
10	40	65 ①	123	44	-	-	1.6
15	40	65 ①	123	44	-	-	1.6
25	40	58 ②	116	68	26	46	1.6
40	40	83 ②	131	83	39	62	2.4
50	40	103 ②	149	101	51	74	2.9
80	40	153 ②	181	133	80	106	6.4
100	16	203 ②	206	158	101	133	8.8

① Total fitting length of flowmeter with integrated rings: Dim. L + 2 x gasket thickness.
② Total fitting length of flowmeter without rings: Dim. L only (no gaskets required).

Nominal size		Dimensions [inches]					Approx. weight [lbs]
ASME	PN [psi]	L	H	W	Ød1	Ød4	
1/10"	580	2.56 ①	4.84	1.73	-	-	3.53
1/8"	580	2.56 ①	4.84	1.73	-	-	3.53
¼"	580	2.56 ①	4.84	1.73	-	-	3.53
3/8"	580	2.56 ①	4.84	1.73	-	-	3.53
½"	580	2.56 ①	4.84	1.73	-	-	3.53
1"	580	2.28 ②	4.57	2.68	1.02	1.81	3.53
1½"	580	3.27 ②	5.16	3.27	1.54	2.44	5.29
2"	580	4.06 ②	5.87	3.98	2.01	2.91	6.39
3"	580	6.02 ②	7.13	5.24	3.15	4.17	14.11
4"	232	7.99 ②	8.11	6.22	3.98	5.24	19.40

① Total fitting length of flowmeter with integrated rings: Dim. L + 2 x gasket thickness.
② Total fitting length of flowmeter without rings: Dim. L only (no gaskets required).

CAUTION!

- *Pressures are applicable at 20° C / 68° F.*
- *For higher temperatures, the pressure and temperature ratings are as per ASME B16.5 (up to 24") or ASME B16.47 (>24").*
- *Dimensions for other sizes on request.*

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

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