ENVIROMAG 2000

Technical Datasheet

Electromagnetic flow sensor

- For water and wastewater applications
- NSF approved for potable water
- Robust, fully welded construction with full bore pipe

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

KROHNE

CONTENTS

1.1 Reliable solution for the water and wastewater industry

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

The ENVIROMAG 2000 has a field proven and unsurpassed lifetime. This is assured by the fully welded construction, full bore pipe, absence of moving parts and wear resistant liner materials. The flow sensor has the widest diameter range available in the market: from DN25 up to DN2000 or 1 inch up to 80 inches.

1 Robust fully welded construction
2 Diameter range: DN25...DN2000 / 1”... 80”
3 Polyurethane and hard rubber liners

PRODUCT FEATURES

Highlights

- Rugged liners suitable for almost any water and wastewater application
- Proven and unsurpassed lifetime, huge installed base
- Tamper proof, fully welded construction, also available in customer specific constructions
- Drinking water approval NSF
- Suitable for subsoil installation and constant flooding (IP68)
- Bi-directional flow metering
- Standard in house wet calibration of flow sensors up to diameter DN2000 / 80”
- Easy installation and commissioning
- No grounding rings with virtual reference option on IFC 300
- In-situ verification with OPTICHECK
- Extensive diagnostic capabilities
- Maintenance-free

Industries

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

Applications

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

1.2 Options

The reliable solution for the water and wastewater industry

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

Easy installation
Fitting the ENVIROMAG 2000 is easy with the flanged design ISO lengths on almost all sizes.
To further ease the operation, the ENVIROMAG 2000 can be installed without filters and straighteners. Even grounding rings are not required with the patented "Virtual Reference" option on the IFC 300 signal converter

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

1.3 Measuring principle

An electrically conductive fluid flows inside an electrically insulated pipe through a magnetic field. This magnetic field is generated by a current, flowing through a pair of field coils.
Inside of the fluid, a voltage U is generated:
U = v * k * B * D

in which:
v = mean flow velocity
k = factor correcting for geometry B =
magnetic field strength
D = inner diameter of flowmeter

The signal voltage U is picked off by electrodes and is proportional to the mean flow velocity v and thus the flow rate Q. A signal converter is used to amplify the signal voltage, filter it and convert it into signals for totalizing, recording and output processing.

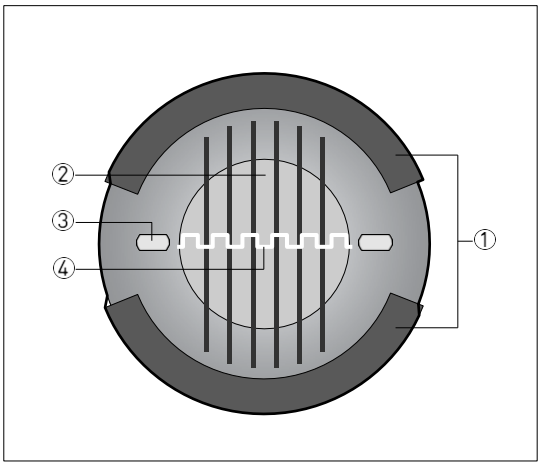


Figure 1-1: Measuring principle

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

2.1 Technical data

- *The following data is provided for general applications. If you require data that is more relevant to your specific application, please contact us or your local sales office.*
- *Additional information (certificates, special tools, software,...) and complete product documentation can be downloaded free of charge from the website (Downloadcenter).*

Measuring system

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

Design

Features	Fully welded maintenance-free flow sensor.
	Large diameter range DN25...2000 / 1”...80”
	Rugged liners approved for drinking water.
	Large standard range but also available in customer specific diameter, length and pressure rating depending on the request.
Modular construction	The measurement system consists of a flow sensor and a signal converter. It is available as compact and as separate version. Additional information can be found in the documentation of the signal converter.
Compact version	With signal converter IFC 050: ENVIROMAG 2050 C
	With signal converter IFC 100: ENVIROMAG 2100 C
	With signal converter IFC 300: ENVIROMAG 2300 C
Remote version	In wall (W) mount version with signal converter IFC 050: ENVIROMAG 2050 W
	In wall (W) mount version with signal converter IFC 100: ENVIROMAG 2100 W
	In field (F), wall (W) or rack (R) mount version with signal converter IFC 300: ENVIROMAG 2300 F, W or R
Nominal diameter	With signal converter IFC 050: DN25...1200 / 1...48"
	With signal converter IFC 100: DN25...1200 / 1...48"
	With signal converter IFC 300: DN25...2000 / 1...80"

Measuring accuracy

Maximum measuring error	IFC 050: up to 0.5% of the measured value ± 1 mm/s
	IFC 100: up to 0.3% of the measured value ± 1 mm/s
	IFC 300: up to 0.2% of the measured value ± 1 mm/s
	The maximum measuring error depends on the converter used in combination with the measuring tube as well as installation conditions.
	For detailed information refer to *Measuring accuracy* on page 20.
Repeatability	± 0.1% of the measured value, minimum 1 mm/s
Calibration / Verification	Standard:
	2 point calibration by a direct volume comparison.
	Optional:
	Calibration can be performed with 3, 5 or up to 10 points on customer request.

Operating conditions

Process temperature	Hard rubber liner: -5...+80°C / +23...+176°F
	Polyurethane liner: -5...+70°C / +23...+140°F
Ambient temperature	Standard (with aluminum signal converter housing): standard flanges
	-20…+65°C / -4…+149°F
	Option (with aluminum signal converter housing): carbon steel flanges or stainless steel flanges
	-40…+65°C / -40…+149°F
	Option (with stainless steel signal converter housing): carbon steel flanges or stainless steel flanges
	-40...+55°C / -40…+130°F
Protect electronics against self-heating at ambient temperatures above +55°C / +131°F.	
Storage temperature	-50...+70°C / -58...+140°F
Measuring range	-12...+12 m/s / -40...+40 ft/s

Pressure	
For detailed information in pressure / temperature refer to *Pressure derating* on page 21.	
ASME B16.5	1...24": 150 & 300 lb RF
	Other pressures on request
AWWA (class B or D FF)	Option:
	DN700...1000 / 28...40": ≤ 10 bar / 145 psi
	DN1200...2000 / 48...80": ≤ 10 bar / 145 psi
Vacuum load	For detailed information refer to *Vacuum load* on page 23.
Pressure loss	Negligible
Chemical properties	
Physical condition	Electrically conductive liquids
Electrical conductivity	Standard: ≥ 5 µS/cm
	Demineralized water: ≥ 20 µS/cm
Permissible gas content (volume)	IFC 050: ≤ 3%
	IFC 100: ≤ 3%
	IFC 300: ≤ 5%
Permissible solid content (volume)	IFC 050: ≤ 10%
	IFC 100: ≤ 10%
	IFC 300: ≤ 70%

Installation conditions

Installation	Assure that the flow sensor is always fully filled.
	For detailed information refer to *Installation* on page 30.
Flow direction	Forward and reverse
	Arrow on flow sensor indicates flow direction.
Inlet run	≥ 5 DN
Outlet run	≥ 2 DN
Dimensions and weights	For detailed information refer to *Dimensions and weights* on page 24.

Materials

Flow sensor housing	Sheet steel
	Other materials on request
Measuring tube	Austenitic stainless steel
Flanges	Carbon steel
	Other materials on request
Liner	Standard:
	DN50...1000 / 2...40": polyurethane
	DN25...2000 / 1...80": hard rubber
Protective coating	On exterior of the meter: flanges, housing, signal converter (compact version) and / or connection box (field version)
	Standard coating
	Option: subsoil coating on request
Connection box	Only for remote versions
	Standard: die-cast aluminum
	Option: stainless steel
Measuring electrodes	Standard: Hastelloy® C22
	Option: stainless steel(316L), titanium, tantalum, platinum, Hastelloy B2
	Other materials on request
Grounding rings	Standard: stainless steel
	Option: Hastelloy® C4
	Grounding rings can be omitted with virtual reference option for the signal converter IFC 300.

Process connections

Flange	
ASME	1…24" and larger in 150 & 300 lb RF
AWWA	DN700...2000 / 28”…80” in 6...10 bar / 87…145 PSIG
Design of gasket surface	RF
	Other sizes or pressure ratings on request

Electrical connections

For full detail refer to the relevant documentation of the signal converter.	
Signal cable (remote versions only)	
Type A (DS)	In combination with the signal converter IFC 050, IFC 100 and IFC 300
	Standard cable, double shielded. Max. length: 600 m / 1968 ft (depends on electrical conductivity and flow sensor)
Type B (BTS)	Only in combination with the signal converter IFC 300
	Optional cable, triple shielded. Max. length: 600 m / 1968 ft (depends on electrical conductivity and flow sensor)
I/O	For full details of I/O options, including data streams and protocols, see technical datasheet of the relevant signal converter.

Approvals and certificates

CE	
This device fulfils the statutory requirements of the relevant directives.The manufacturer certifies successful testing of the product by applying the conformity mark on the device.	
	For more information on the directives, standards and the approved certifications, please refer to the declaration of conformity supplied with the device or downloadable from the manufacturer’s website.
Hazardous area	
CSA (Canada)	ENVIROMAG CSA OL (with IFC 100 or IFC 300)

Other approvals and standards	
Drinking water approvals	Hard rubber liner: NSF / ANSI standard 61.
Protection category acc. to IEC 60529	Standard:
	IP66/67, NEMA 4/4X/6
	Option:
	IP68, NEMA 6P
	IP68 is only available for separate design and with a stainless steel connection box.
Protective coating	Standard; ISO 12944-2:; C3 medium / C4 high

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: +41…+95°F / +5...+35°C
- Operating pressure: 1.5...72.5 psig / 0.1...5 barg
- Inlet section: ≥ 5 DN
- Outlet section: ≥ 2 DN

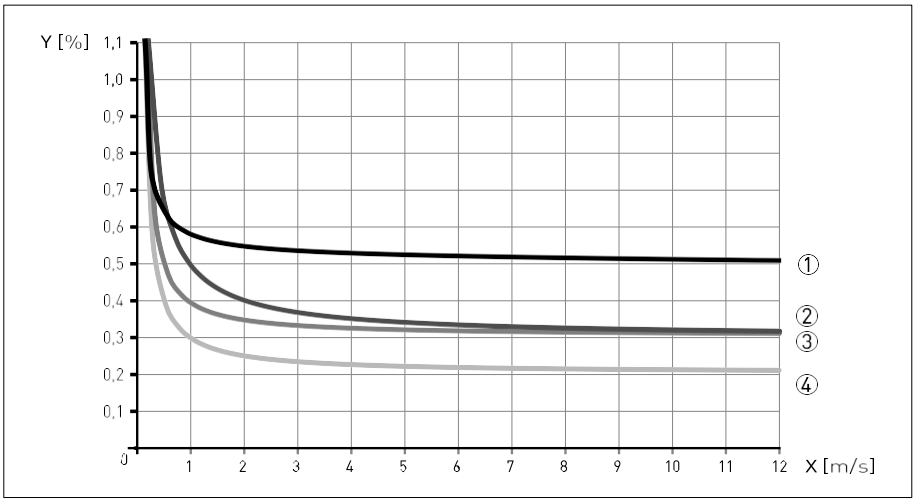


Figure 2-3: Flow velocity vs. accuracy X
[m/s] : flow velocity
Y [%]: deviation from the actual measured value (mv)

Accuracy

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

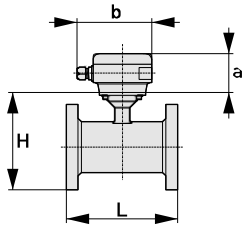
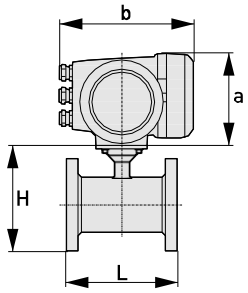
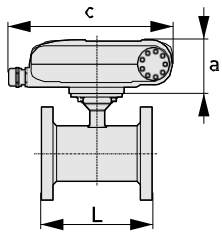
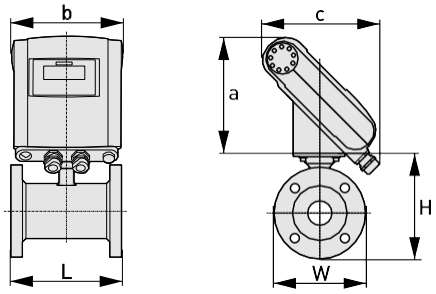
Optionally for IFC 050 and IFC 100; extended calibration at 2 points for optimized accuracy. For more details on optimized accuracy, see the concerning signal converter documentation.

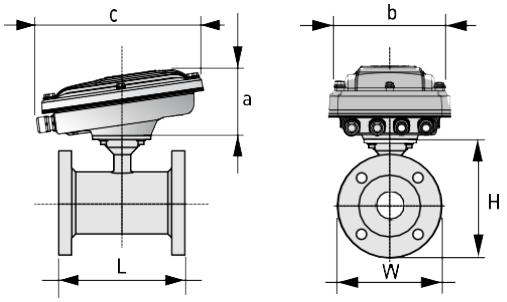
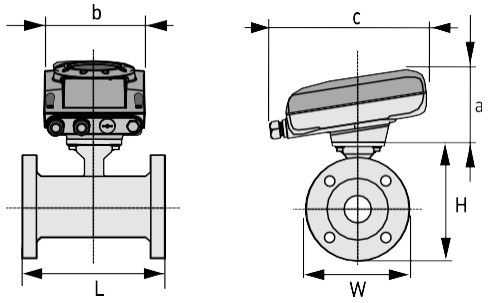
2.3 Vacuum load

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

Diameter	Vacuum load in psia at process temperature of			
[inch]	68ºF	104ºF	140ºF	176ºF
Hard rubber				
8…12	3.6	3.6	5.8	5.8
14…40	7.3	7.3	8.7	8.7
48…120	8.7	8.7	10.9	10.9
Polyurethane				
1…40	7.2	7.2	-	-

2.4 Dimensions and weights

Remote version		a = 88 mm / 3.5" 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

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

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

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

Nominal size DN [mm]	Dimensions [mm]			Approx. weight [kg]
	Standard length	H	W	
25	150	179	108	8
40	150	203	127	10
50	200	191	152	13
80	200	210	191	17
100	250	256	229	23
125	250	280	254	27
150	300	304	279	34
200	350	355	343	50
250	400	433	406	73
300	500	499	483	100
350	500	552	533	114
400	600	608	597	155
450	600	672	635	170
500	600	439	699	191
600	600	852	813	250
700	700	918	927	320
750	800	974	984	358
800	800	1038	1060	395
900	900	1144	1168	450
1000	1000	1258	1289	665
1050	1300	1313	1350	683
1200	1300	1483	1511	970
1350	1600	1635	1682	TBA
1500	1500	1782	1860	TBA

ASME B16.5 / 150 lb flanges

Nominal size [inch]	Dimensions [inch]			Approx. weight [lb]
	L	H	W	
1"	5.9	7.1	4.3	18
1½"	5.9	8.0	5.0	22
2"	7.9	7.5	6.0	29
3"	7.9	8.3	7.5	37
4"	9.8	10.1	9.0	51
5"	9.8	11.0	10.0	60
6"	11.8	12.0	11.0	75
8"	13.8	14.0	13.5	110
10"	15.8	17.1	16.0	160
12"	19.7	19.7	19.0	220
14"	19.7	21.7	21.0	250
16"	23.6	23.9	23.5	340
18"	23.6	26.5	25.0	375
20"	23.6	29.1	27.5	420
24"	23.6	33.5	32.0	550

ASME B16.5 / 300 lb flanges

Nominal size [inch]	Dimensions [inch]			Approx. weight [lb]
	L	H	W	
1"	5.9	5.71	4.87	11
1½"	7.9	6.65	6.13	20
2"	9.8	7.32	6.50	22
3"	9.8	8.43	8.25	31
4"	11.8	10.00	10.00	44
6"	12.6	12.44	12.50	73
8"	15.7	15.04	15.00	157
10"	19.7	17.05	17.50	247
12"	23.6	20.00	20.50	375
14"	27.6	21.65	23.00	474
16"	31.5	23.98	25.50	639
18″	31.5	27.90	28.00	789
20"	31.5	28.46	30.50	937
24"	31.5	33.39	36.00	1345

AWWA (D), class D, FF flanges

Nominal size		Dimensions (approximately) 1			Approx. weight [lb]
DN	[inch]	L [in]	H[in]	W [in]	
700	28"	27.6	36.1	36.5	704.0
750	30"	31.5	38.3	38.8	787.6
800	32"	31.5	40.9	41.8	869.0
900	36"	35.4	45.0	46.0	990.0
1000	40"	39.4	49.5	50.8	1463.0
1050	42"	51.2	51.7	53.1	1502.6
1200	48"	51.2	58.4	59.5	2134.0
1350	54"	63.0	64.4	66.2	TBA
1500	60"	59.1	70.2	73.2	TBA

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

3.1 Intended use

Responsibility for the use of the measuring devices with regard to suitability, intended use and corrosion resistance of the used materials against the measured fluid lies solely with the operator.

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

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

3.2 General notes on installation

Inspect the packaging carefully for damages or signs of rough handling. Report damage to the carrier and to the local office of the manufacturer.

Do a check of the packing list to make sure that you have all the elements given in the order.

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

3.2.1 Vibrations

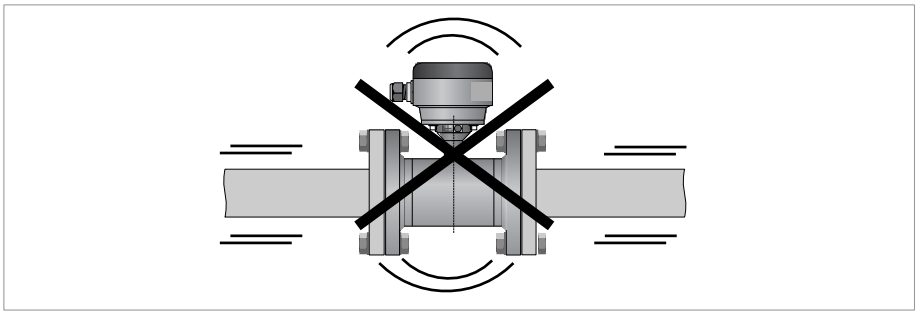


Figure 3-1: Avoid vibrations

3.2.2 Magnetic field

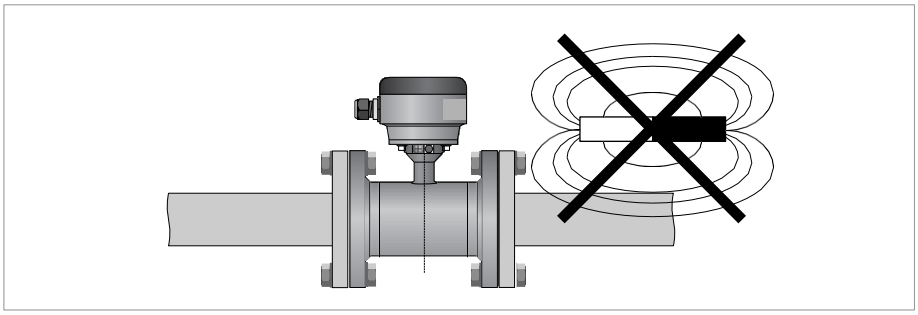


Figure 3-2: Avoid magnetic field

Keep at least 5 DN distance between electromagnetic flow sensors.

3.3 Installation conditions

For the highest measuring accuracy, respect the recommended inlet and outlet lengths in the following paragraphs.
The sensor tube in combination with the IFC 300 signal converter, can be installed in a 0D/0D configuration (no inlet and no outlet length).

3.3.1 Inlet and outlet

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

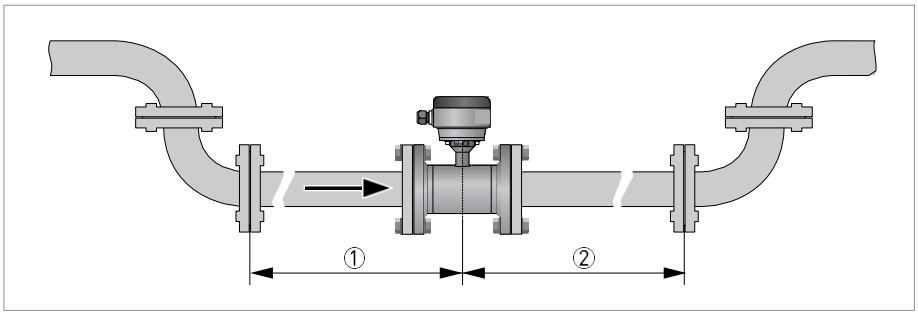


Figure 3-3: Recommended inlet and outlet section

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

3.3.2 Bends in 2 or 3 dimensions

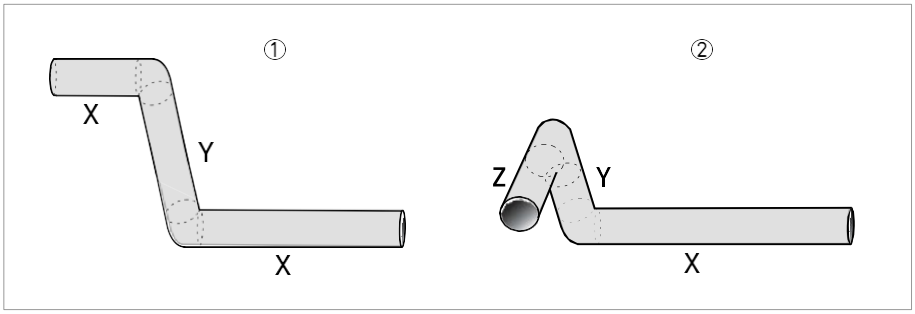


Figure 3-4: 2 and/or 3 dimensional bends upstream of the flowmeter

1 2 dimensions = X/Y
2 3 dimensions = X/Y/Z
Inlet length: using bends in 2 dimensions: ≥ 5 DN; when having bends in 3 dimensions: ≥ 10 DN

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

3.3.3 Bends

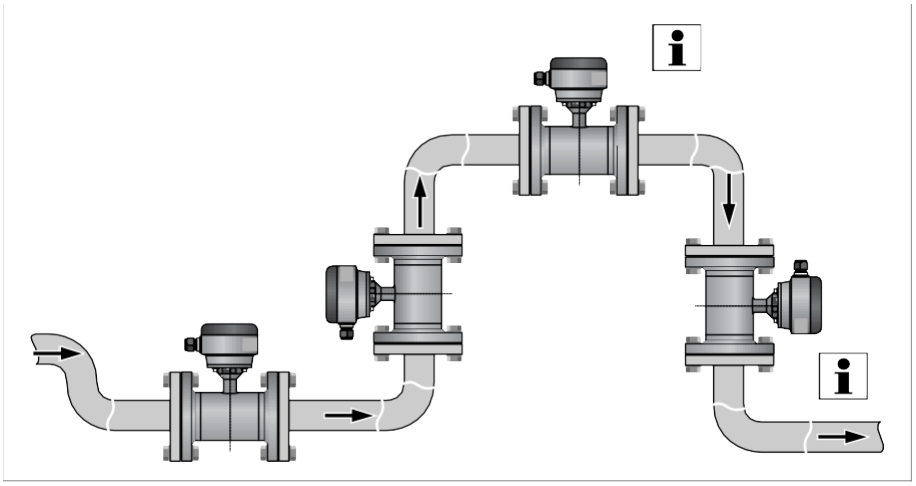


Figure 3-5: Installation in bending pipes (90°)

NOTE!
Recommended installation positions are at a lowered or ascending section of the pipeline installation. Installation at the highest point will enlarge the risk of flowmeter malfunction, because of air/gas bubbles.
Vertical installation in combination with an open discharge has to be avoided. Vertical installation with a controlled back-pressure is possible.

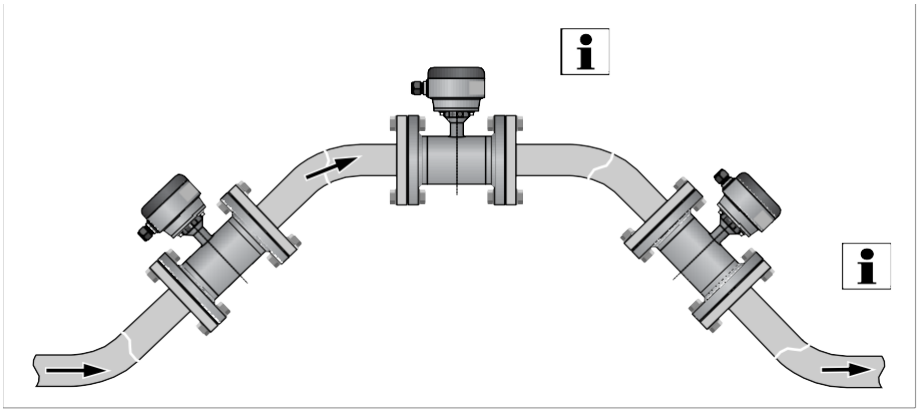


Figure 3-6: Installation in bending pipes (45°)

Avoid draining or partial filling of the flow sensor. NOTE!
Vertical installation on a descending slope in the pipeline is only recommended when the back-pressure is controlled.

3.3.4 T-section

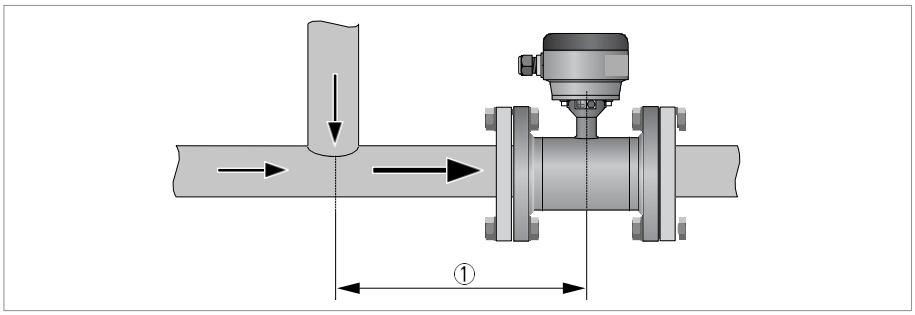


Figure 3-7: Distance behind a T-section 1 ≥ 10 DN

3.3.5 Open discharge

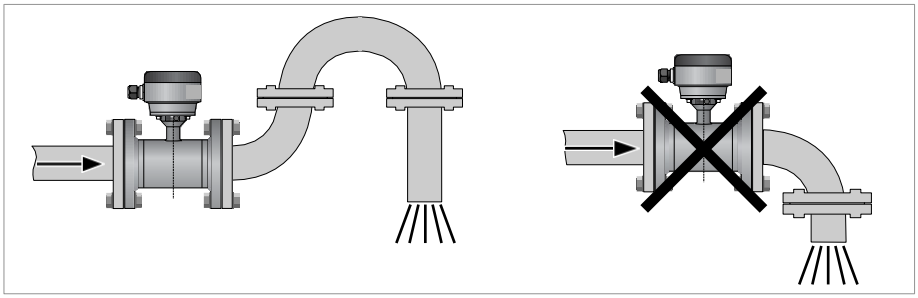


Figure 3-8: Installation in front of an open discharge

3.3.6 Control valve

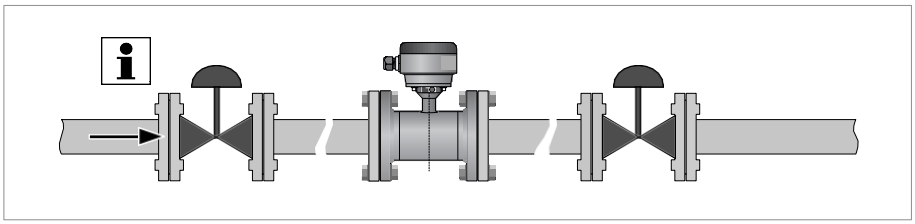


Figure 3-9: Installation in front of a control valve

NOTE!
Recommended position to install a flowmeter is upstream a control valve.
An electromagnetic flowmeter can be installed downstream of the control valve if there is no cavitation in the pipeline system (e.g. flow profile disturbances are resolved).

3.3.7 Pump

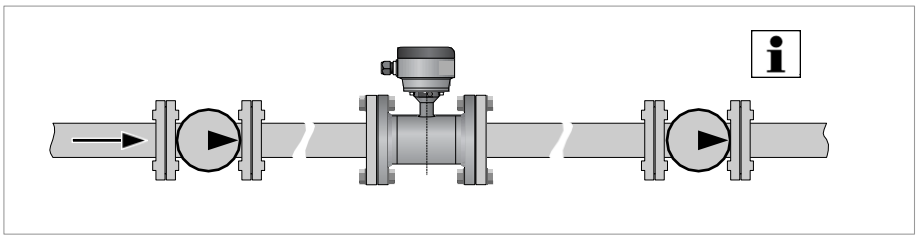


Figure 3-10: Installation behind a pump

NOTE!
Recommended position to install a flowmeter is downstream a pump (on a position where the flow disturbances of the pump are resolved).An electromagnetic flowmeter can be installed in the suction line of a pump if there is no cavitation in the pipeline system.

3.3.8 Air venting and vacuum forces

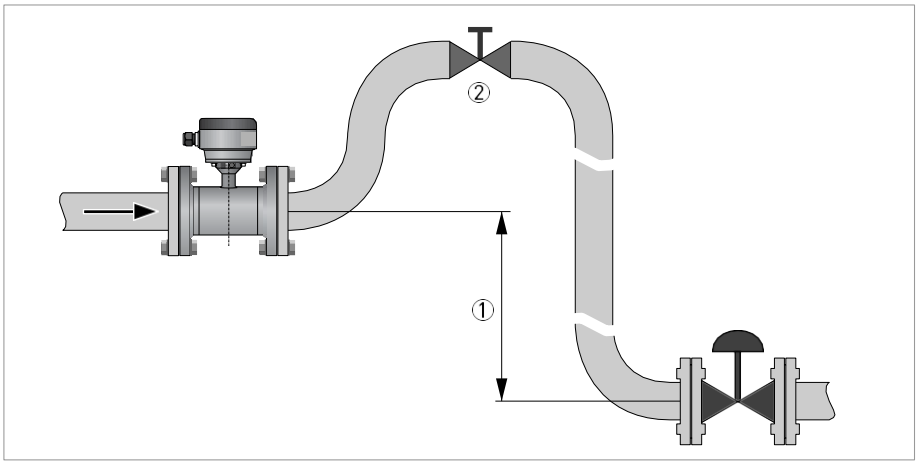


Figure 3-11: Air venting

1 ≥ 5 m / 17 ft
2 Air ventilation point

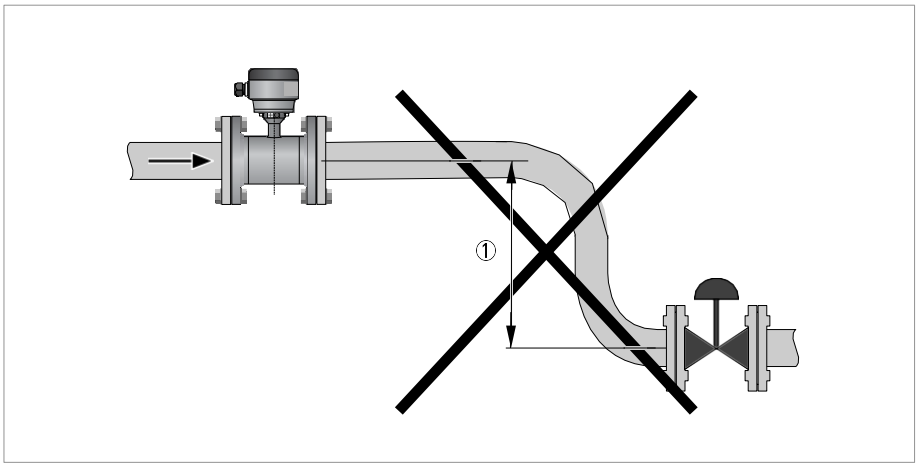


Figure 3-12: Vacuum

1 ≥ 5 m / 17 ft

3.3.9 Flange deviation

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

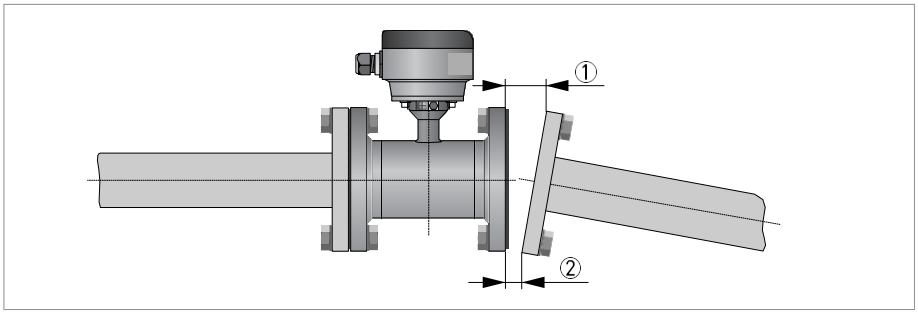


Figure 3-13: Flange deviation

1 L_{max}
2 L_{min}

3.3.10 Mounting position

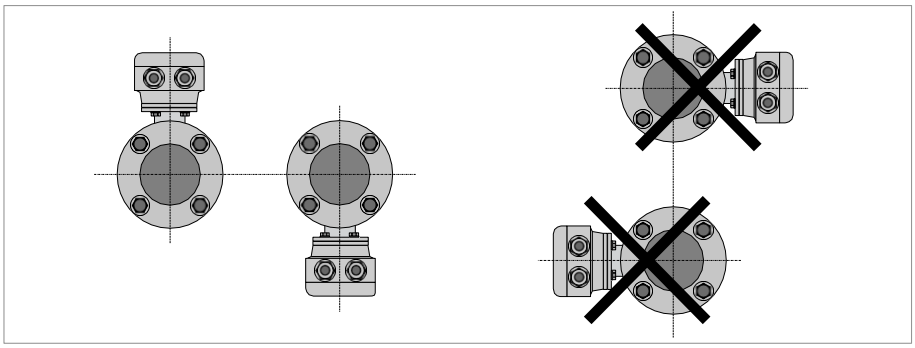


Figure 3-14: Mounting position

- Install the flow sensor with the signal converter aligned upwards or downwards.
- Install the flow sensor in line with the pipe axis.
- Pipe flange faces must be parallel to each other.

3.4 Installation in a metering pit and subsurface applications

The ENVIROMAG 2000 flow sensor is rated IP68, NEMA 6P and is suitable for full submersion in flooded measurement chambers. The flow sensor can withstand a 10 meter water column and can be installed (buried) underground also (optional coating for subsurface application).

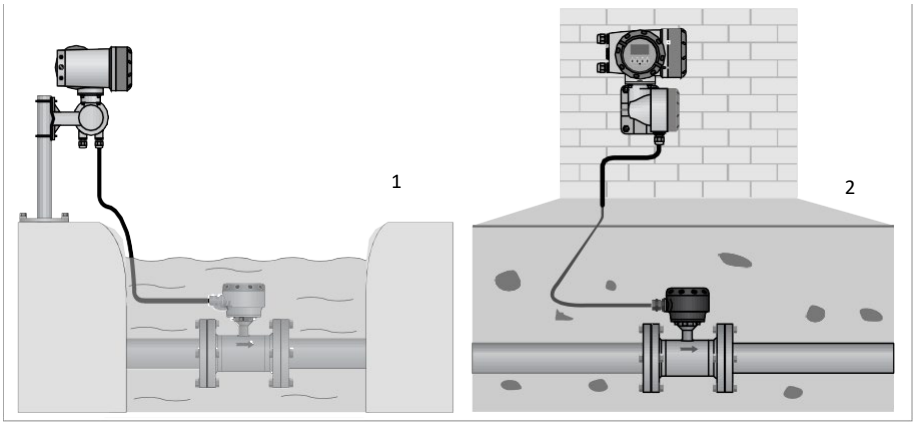


Figure 3-15: Examples of flooded and buried application

1 Submersible
2 Buried

The remote version of the IFC 050, IFC 100 and IFC 300 signal converters are IP66/67, NEMA 4/4X rated and can be installed in a dry area on the wall of the measuring pit for visual read out of the display.

Submersion applications

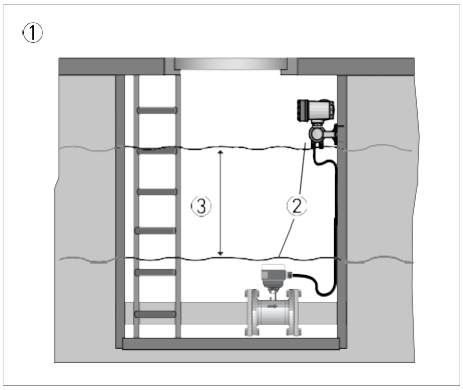


Figure 3-16: Examples of installation in measuring pit

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

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

3.5 Mounting

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

4.1 Safety instructions

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

Observe the national regulations for electrical installations!

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

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

4.2 Grounding

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

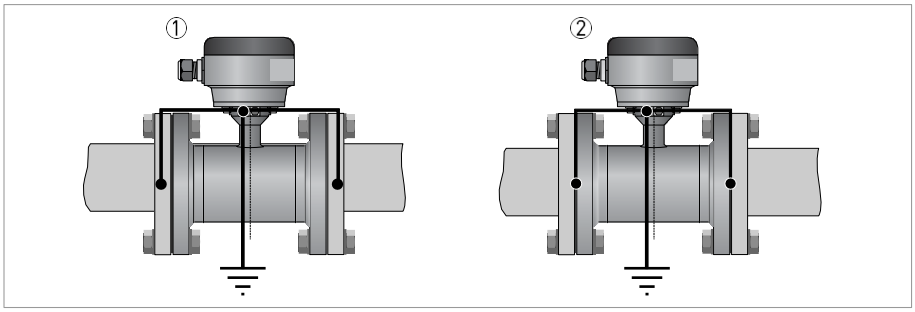


Figure 4-1: Grounding

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

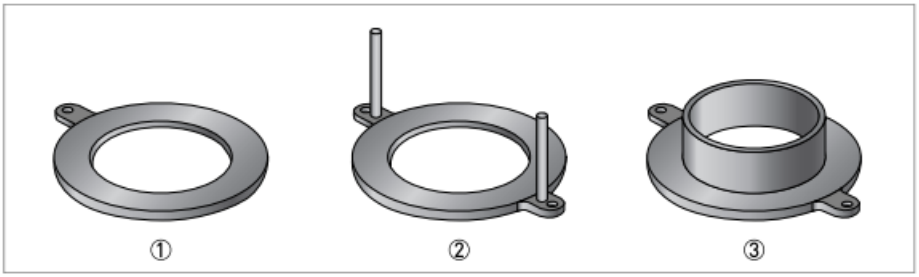


Figure 4-2: Different types of grounding rings

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

Grounding ring number 1:

- ≤ DN300 / 12": 3 mm / 0.12"
- ≥ DN350 / 14": 4 mm / 0.16"
  (tantalum: 0.5 mm / 0.02")

Grounding ring number 2:

- ≤ DN300 / 12": 3 mm / 0.12"
- ≥ DN350 / 14": 4 mm / 0.16"
- Prevents damage to the flanges during transport and installation
- Especially for flow sensors with PTFE liner

Grounding ring number 3:

- ≤ DN300 / 12": 3 mm / 0.12"
- ≥ DN350 / 14": 4 mm / 0.16"
- With cylindrical neck (length 30 mm / 1.25" for ...150 / 3/8...6")
- Offers liner protection against abrasive fluids

4.3 Virtual reference option

Available with:
- IFC 300 (C, W and F version)

Benefits of virtual reference:

- Grounding rings or grounding electrodes can be omitted.
- Safety increases by reducing the number of potential leakage points.
- The installation of the flowmeters is much easier.

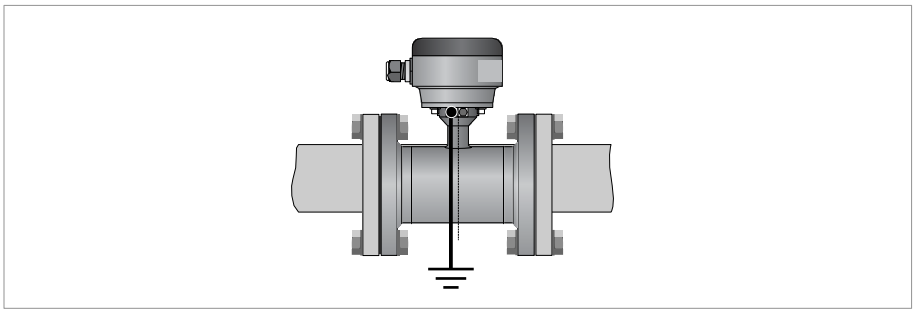


Figure 4-3: Virtual reference

Minimum requirements:

- Size: ≥ DN10 / 3/8"
- Electrical conductivity: ≥ 200 µS/cm
- Signal cable: max. 50 m / 164 ft, type DS

4.4 Connection diagrams

For the connection diagrams and more information on the connection of the flow sensor, please refer to the documentation of the applicable signal converter.

KROHNE – Products, Solutions and Services

- Process instrumentation for flow, level, temperature, pressure measurement and process analytics
- Flow metering, monitoring, wireless and remote metering solutions
- Engineering, commissioning, calibration, maintenance and training services

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