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Technical Information

Promag 55S

Electromagnetic Flow Measuring System
Flow rate measurement of liquids with solids content or inhomogeneous liquids

Application
Electromagnetic flowmeter for bidirectional measurement of liquids with a minimum conductivity of ≥ 5 µS/cm – in particular fluids with solids, and fluids which are abrasive, inhomogeneous or tend to build-up, for example:

- Chemical/mechanical pulps, paper pulp or wood pulp with solids contents up to 15 Vol.-%
- Fruit mashes, fruit concentrates and final products (salad dressings, soups with vegetable pieces)
- Slurries containing high amounts of sand or stone with an abrasive effect, e.g. ore slurry or mortar
- Chemically inhomogeneous fluids (e.g. additives)
- Thick wastewater sludges

- Flow measurement up to 9600 m^3/h
- Can be used up to +180 °C and max. 40 bar
- Fitting lengths as per DVGW/ISO

Application-specific linings and electrodes:
- Natural rubber, polyurethane, PTFE or PFA linings
- Flat, bullet nose, neck, bow or brush electrodes

Approvals for hazardous area:
- ATEX, FM, CSA

Connection to process control system:
- HART, PROFIBUS PA, FOUNDATION Fieldbus

Your benefits
Promag measuring devices offer you cost-effective flow measurement with a high degree of accuracy for a wide range of process conditions.

The **Proline transmitter concept** comprises of:
- High degree of efficiency due to the modular device and operating concept
- Software options for: electrode cleaning, advanced diagnostics, calculation of mass flow and solids content

The robust **Promag S sensors** offer:
- Universal devices, even for difficult fluids
- Excellent accuracy and repeatability
- High resistance to abrasion thanks to industry-optimized linings and measuring electrodes
- Optimum operational safety due to advanced, permanent self-diagnosis
- Simple installation and commissioning
- Insensitive to vibration
- No pressure loss

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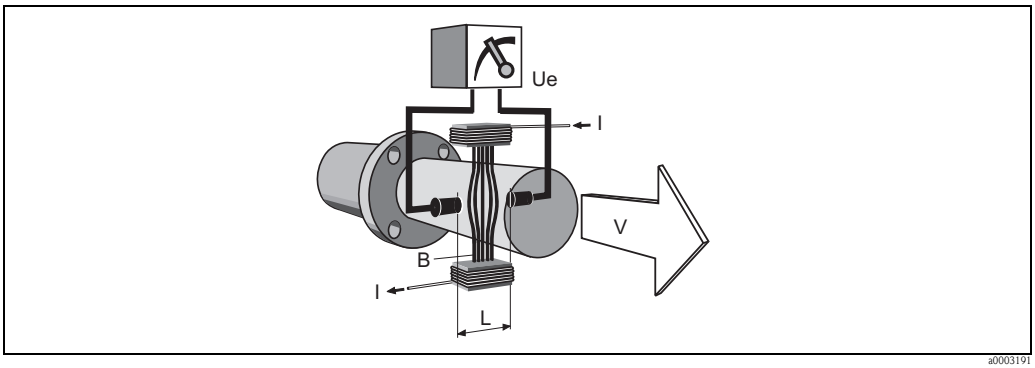
Function and system design

Measuring principle

Faraday's law of induction states that a voltage is induced in a conductor moving in a magnetic field.
In electromagnetic measuring, the flowing medium corresponds to the moving conductor. The induced voltage is proportional to the flow velocity and is detected by two measuring electrodes and transmitted to the amplifier. Flow volume is computed on the basis of the pipe's diameter. The constant magnetic field is generated by a switched direct current of alternating polarity.



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$Ue = B \cdot L \cdot v$
$Q = A \cdot v$

Ue *induced voltage*
B *magnetic induction (magnetic field)*
L *electrode gap*
v *flow velocity*
Q *volume flow*
A *pipe cross-section*
I *current strength*

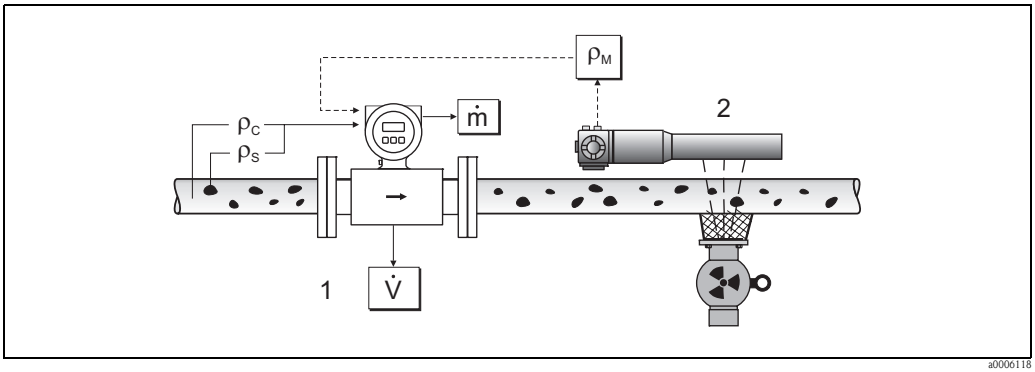
Measuring system

The flow measuring system consists of the following components:
- Promag 55 transmitter
- Promag S sensor (DN 15 to 600)

Two versions are available:
- Compact version: Transmitter and sensor form a single mechanical unit.
- Remote version: Transmitter and sensor are installed separately.

Measurement of solids flow rates

In combination with a density meter, e.g. with "Gammapilot M" from Endress+Hauser, Promag 55S also determines the throughput of solids in mass, volume or percentage rates.
The following order specifications are required for this: order option for software function "Solids content flow" (F-CHIP) and order option for a current input.



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Solids content flow measurement (m) with the aid of a density and flow measuring device. If the solid density (ρ_S) and the density of the carrier liquid (ρ_C) are also known, they can be used to calculate the solids flow.

1 *Flow measuring device (Promag 55S) → volume flow (V). The solid density (ρ_S) and the density of the transport liquid (ρ_C) must be entered in the transmitter.*
2 *Density measuring device (e.g. "Gammapilot M") → total fluid density (ρ_M) (transport liquid and solids)*

Input

Measured variable

Flow rate (proportional to induced voltage)

Measuring range

Typical v = 0.01 to 10 m/s with the specified measuring accuracy

Operable flow range

Over 1000 : 1

Input signal

Status input (auxiliary input):

U = 3…30 V DC, R_i = 5 kΩ, galvanically isolated
Configurable for: totalizer(s) reset, positive zero return, error-message reset

Current input:

active/passive selectable, galvanically isolated, full scale value adjustable, resolution: 3 µA, temperature coefficient: typically 0.005% o.f.s./°C;
- active: 4 to 20 mA, $R_i \leq 150\ \Omega$, U_{out} = 24 V DC, short-circuit proof
- passive: 0/4 to 20 mA, $R_i \leq 150\ \Omega$, U_{max} = 30 V DC

Output

Output signal

Current output:
active/passive selectable, galvanically isolated, time constant selectable (0.01 to 100 s),
full scale value adjustable, temperature coefficient: typically 0.005% o.f.s./°C, resolution: 0.5 µA

- active: 0/4 to 20 mA, $R_L < 700\ \Omega$ (for HART: $R_L \geq 250\ \Omega$)
- passive: 4 to 20 mA; supply voltage V_S: 18 to 30 V DC; $R_i \geq 150\ \Omega$

Pulse/frequency output:
active/passive selectable (Ex i version passive only), galvanically isolated

- active: 24 V DC, 25 mA (max. 250 mA over 20 ms), $R_L > 100\ \Omega$
- passive: open collector, 30 V DC, 250 mA
- Frequency output: end frequency 2 to 10000 Hz (f_{max} = 12500 Hz), on/off ratio 1:1, pulse width max. 10 s
- Pulse output: pulse value and pulse polarity selectable, pulse width configurable (0.05 to 2000 ms)

PROFIBUS PA interface:
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- Profile version 3.0
- Current consumption: 11 mA
- Permissible supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Function blocks: 2 x analog input, 3 x totalizer
- Output data: volume flow, calculated mass flow, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), totalizer control, value for local display
- Cyclic data transmission compatible with previous model Promag 35S
- Bus address adjustable via miniature switches or local display (optional) at the measuring device

FOUNDATION Fieldbus interface:
- FOUNDATION Fieldbus H1
- Transmission technology (Physical Layer): IEC 61158-2 (MBP), galvanically isolated
- ITK version 5.0
- Current consumption: 12 mA
- Inrush current: <12 mA
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Permissible supply voltage: 9 to 32 V
- Bus connection with integrated reverse polarity protection
- Function blocks:
  - 5 x Analog Input (execution time: 20 ms)
  - 1 x PID (50 ms)
  - 1 x Descrete Output (20 ms)
  - 1 x Arithmetic (20 ms)
  - 1 x Signal Characterizer (20 ms)
  - 1 x Input Selector (20 ms)
  - 1 x Integrator (25 ms)
- Total VCRs: 48
- Total link objects in VFD: 40
- Output data: volume flow, calculated mass flow, temperature, totalizer 1 to 3
- Input data: positive zero return (ON/OFF), reset totalizer
- Link Master (LM) functionality is supported

Signal on alarm

Current output:
Failsafe mode selectable (e.g. according to NAMUR recommendation NE 43)

Pulse/frequency output:
Failsafe mode selectable

Relay output:
"de-energized" in the event of a fault or power supply failure

Load

See "output signal"

Low flow cutoff

Switch points for low flow cut off freely selectable.

Galvanic isolation

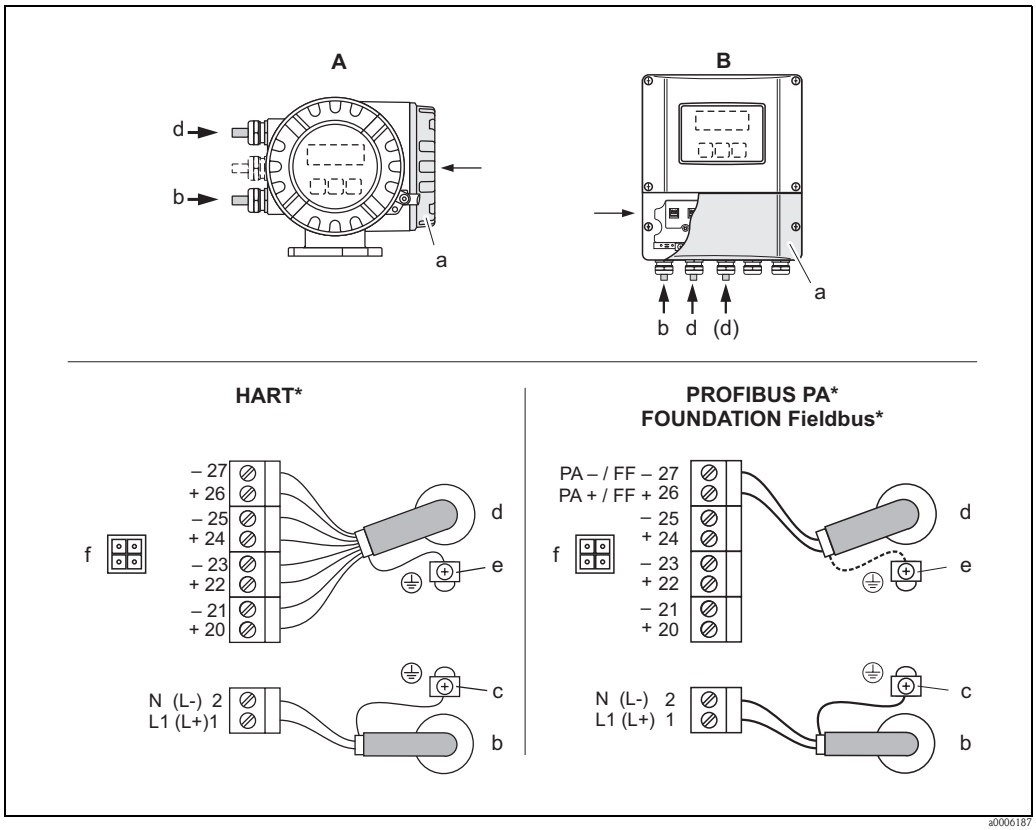
All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

Switching output

Relay output:
Normally closed (NC or break) or normally open (NO or make) contacts available
(default: relay 1 = NO, relay 2 = NC),
max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated.
Configurable for: error messages, empty pipe detection (EPD), direction of flow, limit values.

Power supply

Electrical connection measuring unit



Connecting the transmitter, cable cross-section max. 2.5 mm²

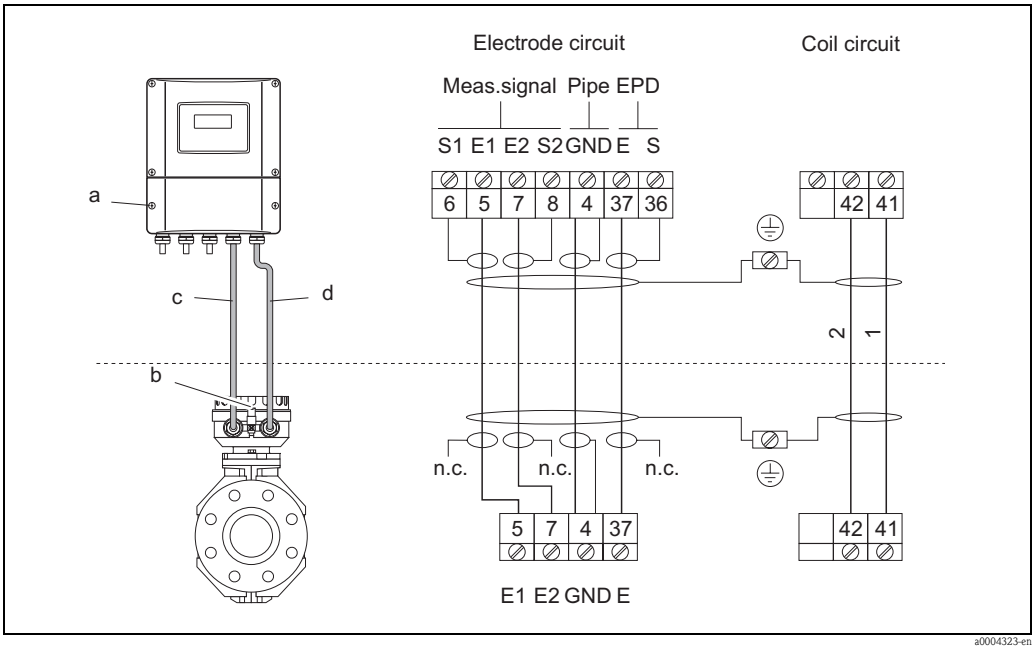
A View A (field housing)
B View C (wall mount housing)

**) Fixed communication boards*
a Connection compartment cover
b Cable for power supply: 20 to 260 V AC / 20 to 64 V DC
Terminal No. 1: L1 for AC, L+ for DC
Terminal No. 2: N for AC, L– for DC
c Ground terminal for protective conductor
d Signal cable: see "Electrical connection terminal assignment"
Fieldbus cable:
Terminal No. 26: PA + / FF + (with polarity protection)
Terminal No. 27: PA – / FF – (with polarity protection)
e Ground terminal for signal cable shield / Fieldbus cable
f Service adapter for connecting service interface FXA193 (Fieldcheck, ToF Tool - Fieldtool Package)

Electrical connection terminal assignment

Order version	Terminal No. (inputs / outputs			
	20 (+) / 21 (–)	**22 (+) / 23 (–)**	**24 (+) / 25 (–)**	**26 (+) / 27 (–)**
Fixed communication boards (fixed assignment)				
55***-***********A	–	–	Frequency output	Current output HART
55***-***********B	Relay output 2	Relay output 1	Frequency output	Current output HART
55***-***********H				PROFIBUS PA
55***-***********K				FOUNDATION Fieldbus
Flexible communication boards				
55***-***********C	Relay output 2	Relay output 1	Frequency output	Current output HART
55***-***********D	Status input	Relay output	Frequency output	Current output HART
55***-***********L	Status input	Relay output 2	Relay output 1	Current output HART
55***-***********M	Status input	Frequency output 2	Frequency output 1	Current output HART
55***-***********2	Relay output	Current output 2	Frequency output	Current output 1 HART
55***-***********4	Current input	Relay output	Frequency output	Current output HART
55***-***********5	Status input	Current input	Frequency output	Current output HART

Electrical connection remote version



Connecting the remote version

a Connection compartment, wall-mount housing
b Cover of connection housing, sensor
c Signal cable
d Coil current cable
n.c. unconnected, insulated cable shields
Terminal no. and cable colors: 6/5 = brown; 7/8 = white; 4 = green; 36/37 = yellow

Electrical connections

20 to 260 V AC, 45 to 65 Hz
20 to 64 V DC

Cable entries

Power-supply and signal cables (inputs/outputs):
- Cable gland M20 x 1.5 (8 to 12 mm)
- Cable entries for thread ½" NPT, G ½"

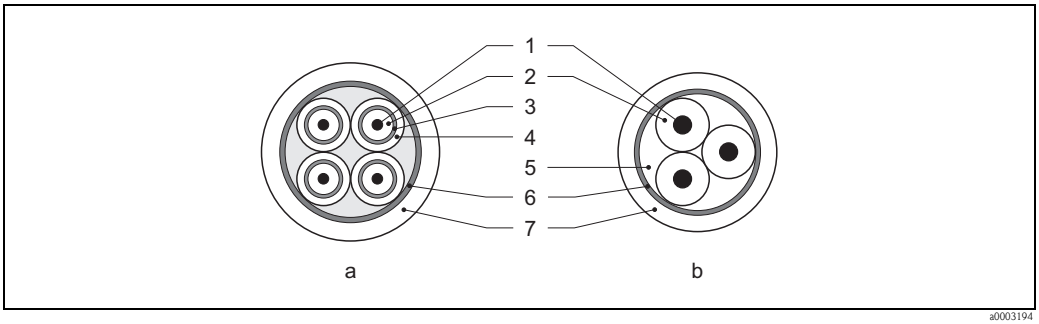
Fieldbus cable:
- Fieldbus connector for PROFIBUS PA, M12 x 1 / PG 13.5 plus adapter PG 13.5 / M20.5
- Fieldbus connector for FOUNDATION Fieldbus, 7/8-16 UNC x M20

Connecting cable for remote version:
- Cable gland M20 x 1.5 (8 to 12 mm)
- Cable entries for thread ½" NPT, G ½"

Cable specifications (remote version)

Coil cable
- 2 x 0.75 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm)
- Conductor resistance: ≤37 Ω/km
- Capacitance: core/core, shield grounded: ≤120 pF/m
- Operating temperature:
  – Cable not permanently routed: –20 to +80 °C
  – Cable permanently routed: –40 to +80 °C
- Cable cross-section: max. 2.5 mm²

Signal cable
- 3 x 0.38 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm) and individually shielded cores
- With Empty Pipe Detection (EPD): 4 x 0.38 mm² PVC cable with common, braided copper shield (∅ ~ 7 mm) and individually shielded cores
- Conductor resistance: ≤50 Ω/km
- Capacitance: core/shield: ≤420 pF/m
- Operating temperature:
  – Cable not permanently routed: –20 to +80 °C
  – Cable permanently routed: –40 to +80 °C
- Cable cross-section: max. 2.5 mm²



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a Signal cable
b Coil current cable

1 Core
2 Core insulation
3 Core shield
4 Core jacket
5 Core reinforcement
6 Cable shield
7 Outer jacket

As an option, Endress+Hauser can also deliver reinforced connecting cables with an additional, reinforcing metal braid. We recommend such cables for the following cases:
- Directly buried cable
- Cables endangered by rodents
- Device operation which should comply with the IP 68 (NEMA 6P) standard of protection

Operation in zones of severe electrical interference
The measuring device complies with the general safety requirements in accordance with EN 61010-1, the EMC requirements of IEC/EN 61326 and NAMUR recommendation NE 21.

Caution!
Grounding of the shield is by means of the ground terminals provided for the purpose inside the connection housing. Keep the stripped and twisted lengths of cable shield to the terminals as short as possible.

Power consumption

AC: <45 VA at 260 V AC; <32 VA at 110 V AC (incl. sensor)
DC: <19 W (including sensor)

Switch-on current:
- max. 2.00 A (<700 ms) at 20 V AC
- max. 2.28 A (<5 ms) at 110 V AC
- max. 5.5 A (<5 ms) at 260 V AC

Power supply failure

Lasting min. 1 power cycle:
- EEPROM or HistoROM/T-DAT saves measuring system data if power supply fails
- HistoROM/S-DAT: exchangeable data storage device which stores sensor characteristic data (nominal diameter, serial number, calibration factor, zero point etc.)

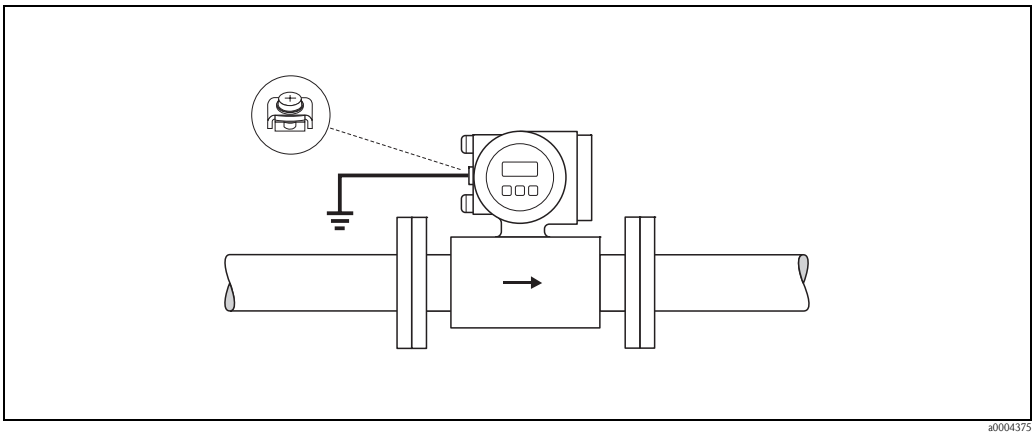
Potential equalization

Standard case

Perfect measurement is only ensured when the medium and the sensor have the same electrical potential. Most Promag sensors have a reference electrode installed as standard, which guarantees the required potential equalization. This usually means that additional potential equalization measures are unnecessary.

Promag S:
- Reference electrode is standard for electrode materials 1.4435 (SS 316L), Alloy C-22 and tantalum.
- Reference electrode is optional for electrode material Pt/Rh.
- Reference electrode not present in measuring tubes with a lining made of natural rubber

Note!
For installation in metal pipes, it is advisable to connect the ground terminal of the transmitter housing to the piping. Also, observe company-internal grounding guidelines.



Potential equalization by means of the transmitter's ground terminal

Caution!
- For sensors without reference electrodes or without metal process connections, carry out potential equalization as per the instructions for special cases described below. These special measures are particularly important when standard grounding practice cannot be ensured or extremely strong matching currents are expected.
- As sensors with a natural rubber lining do not have a reference electrode, ground disks must be installed if necessary to ensure sufficient potential equalization to the fluid. This applies in particular to ungrounded metal pipes → Page 10.

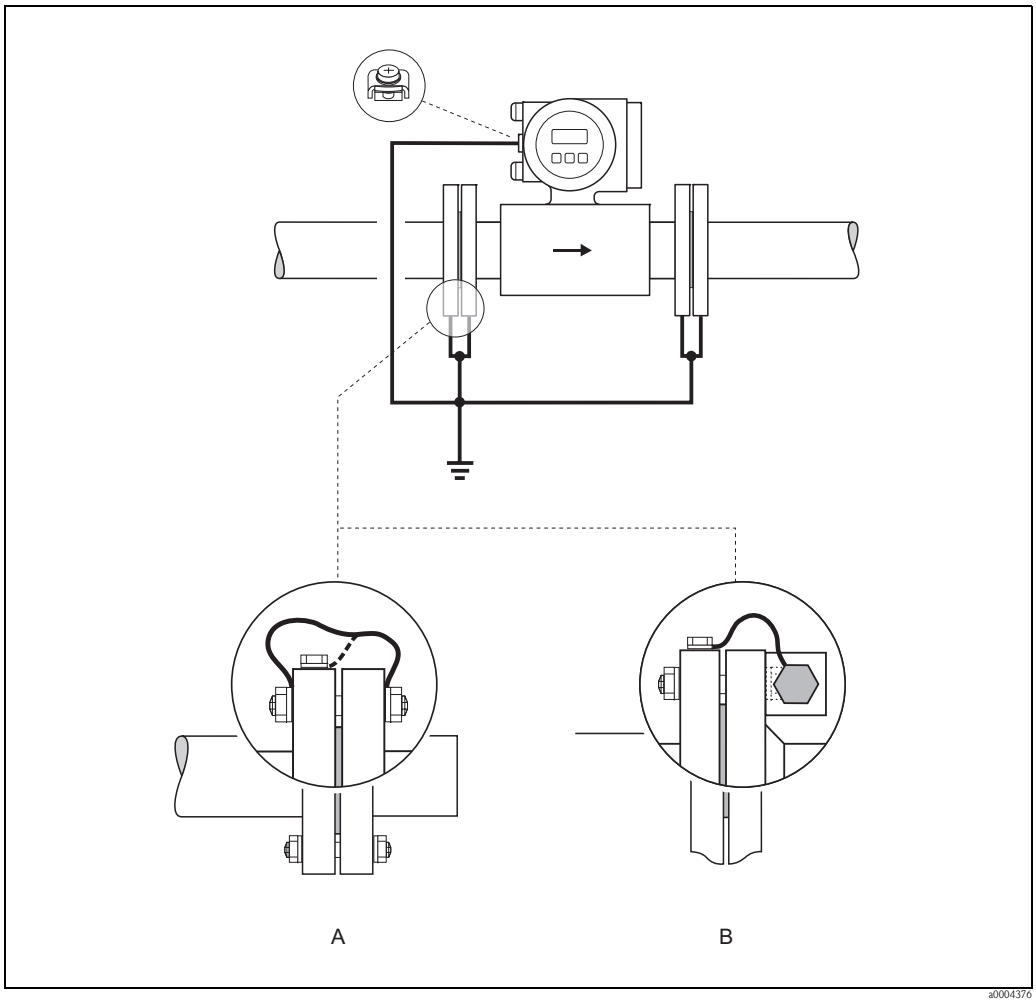
Special cases

Metal, ungrounded piping

In order to prevent outside influences on measurement, it is necessary to use ground cables to connect each sensor flange to its corresponding pipe flange and ground the flanges. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose (see diagram).
The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser → Page 39.

- DN ≤ 300: The ground cable is in direct connection with the conductive flange coating and is secured by the flange screws (A).
- DN ≥ 350: The ground cable connects directly to the metal transport bracket (B).

Caution!
Also, observe company-internal grounding guidelines.

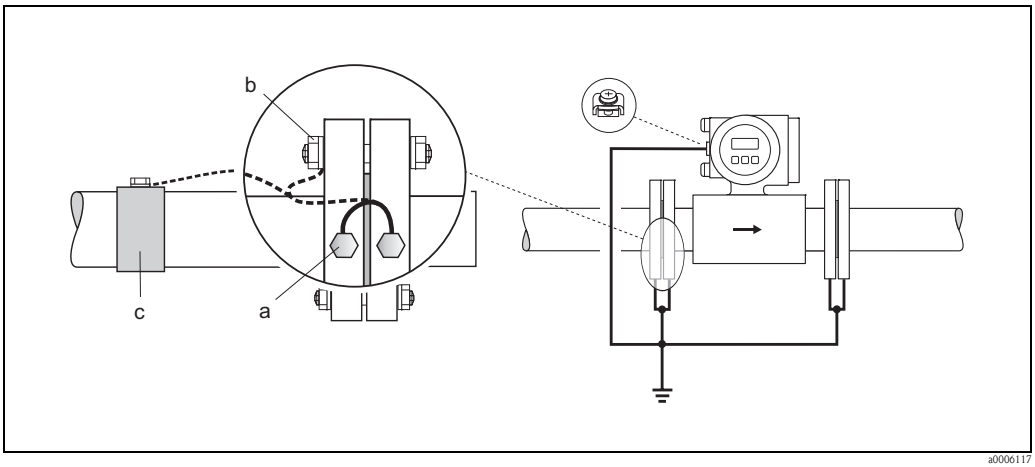


Potential equalization with equalizing currents in ungrounded, metal pipes (ground cable: copper wire, at least 6 mm²)

A Installing ground cable at DN ≤ 300
B Installing ground cable at DN ≥ 350

Pre-installed ground cable for DN ≤ 300 (order option)
Ground cables which are preinstalled on the sensor flange, are also available. These ground cables can be mounted and connected electrically to the piping in different ways:

- Using a screw on the side of the pipe flange (a)
- Using the flange screws (b)
- Using a pipe clip installed around the pipe (c)

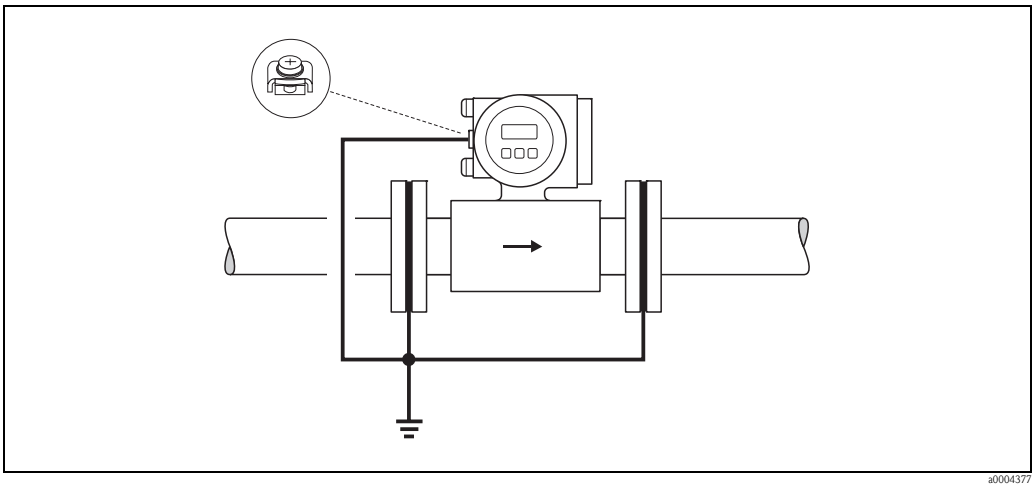


Possibilities for connecting and mounting pre-installed ground cables (ground cable: copper wire at least 6 mm²)

Plastic pipes and isolating lined pipes

Normally, potential is matched using the reference electrodes in the measuring tube. However, in exceptional cases it is possible that, due to the grounding plan of a system, matching currents flow over the reference electrodes. This can lead to destruction of the sensor, e.g. through electro-chemical decomposition of the electrodes. In such cases, e.g. for fiberglass or PVC pipings, it is therefore **essential** that you use additional ground disks for potential equalization. This applies also to two-phase or two-component flow, where the fluid is not well mixed or its constituents are not mixable.

Caution!
- Risk of damage by electrochemical corrosion. Note the electrochemical insulation rating, if the ground disks and measuring electrodes are made of different materials.
- Also, observe company-internal grounding guidelines.

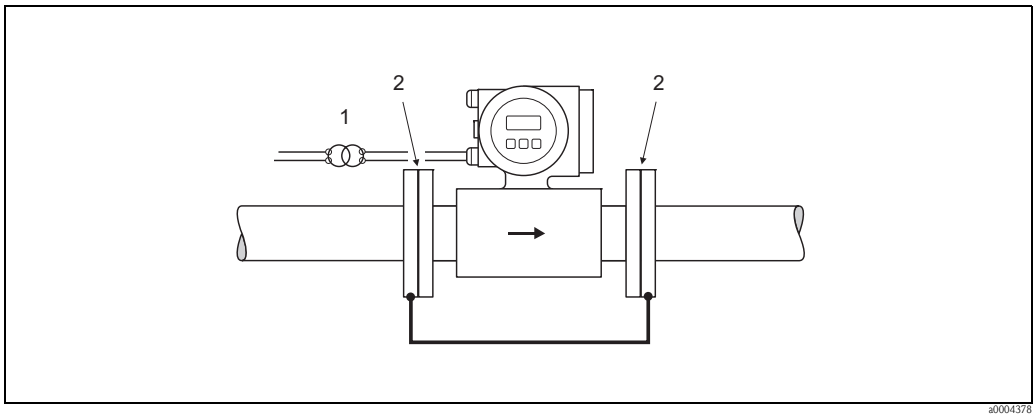


Potential equalization/ground disks in the case of plastic pipes or isolating lined pipes (ground cable: copper wire at least 6 mm²)

Plastic pipes and isolating lined pipes

In such cases, install the measuring instrument without potential in the piping:
- When installing the measuring device, make sure that there is an electrical connection between the two piping runs (copper wire, at least 6 mm^2).
- When using ground disks in plastic or isolating lined pipes, ensure that they are electrically connected with each other (copper wire at least 6 mm^2).
- Make sure that the mounting material used does not establish a conductive connection between the pipe and the measuring device and that the mounting material withstands the torques applied when the threaded fasteners are tightened during installation.
- Check the galvanic isolation using an insulation tester (protection against contact).
- Also comply with the regulations applicable to potential-free installation.

Note!
For the remote version, both the sensor and the transmitter must be installed so that they are potential-free.



Potential equalization and cathodic protection (connecting cable: copper wire at least 6 mm^2)

1 Isolation transformer power supply
2 Electrically insulated

Performance characteristics

Reference conditions

To DIN EN 29104 and VDI/VDE 2641:
- Fluid temperature: +28 °C ± 2 K
- Ambient temperature: +22 °C ± 2 K
- Warm-up time: 30 minutes

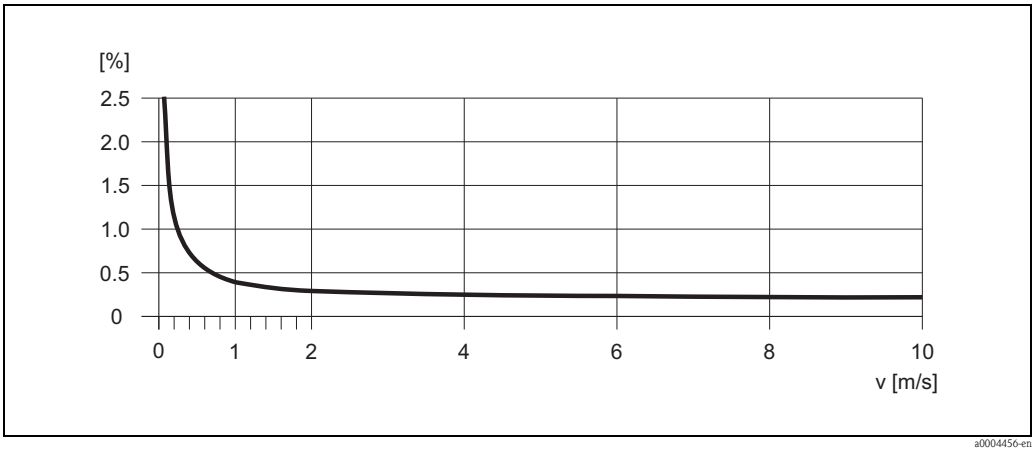
Installation:
- Inlet run >10 x DN
- Outlet run > 5 x DN
- Sensor and transmitter grounded.
- Sensor centered relative to the pipe.

Maximum measured error

Pulse output:
- Standard: ±0.2% o.r. ± 2 mm/s (o.r. = of reading)
- With brush electrodes (Option): ±0.5% o.r. ± 2 mm/s (o.r. = of reading)

Current output:
in addition typically ± 5 µA

Note!
Supply-voltage fluctuations have no effect within the specified range.



Max. measured error in % of reading

Repeatability

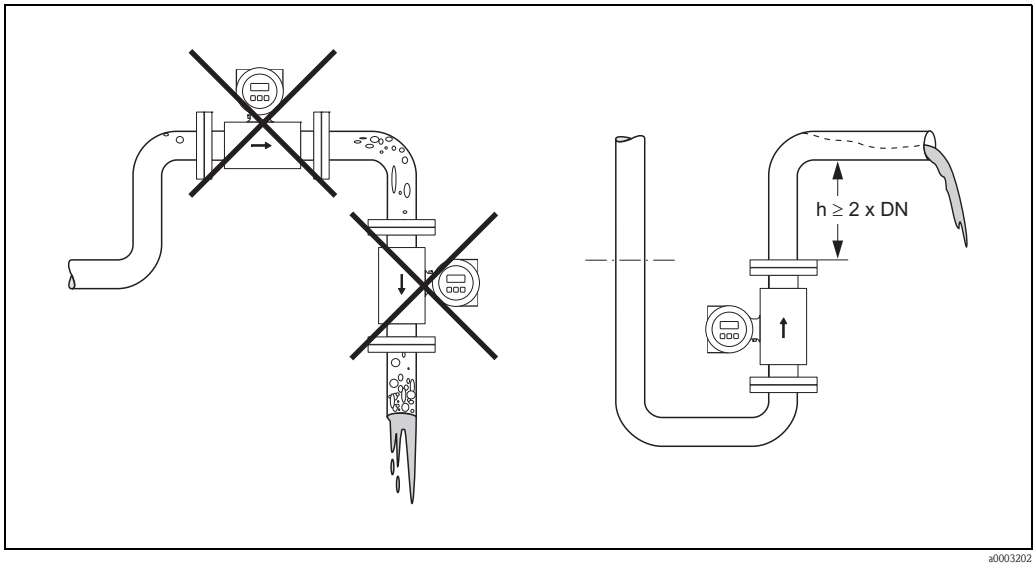
- Standard: max. ±0.1% o.r. ± 0.5 mm/s (o.r. = of reading)
- With brush electrodes (Option): max. ±0.2% o.r. ± 0.5 mm/s (o.r. = of reading)

Operating conditions: Installation

Installation instructions

Location

The accumulation of air or gas bubbles in the measuring tube could result in an increase in measuring errors.
Avoid the following locations:
- At the highest point of a pipeline. Risk of air accumulating.
- Directly upstream from a free pipe outlet in a vertical pipeline.



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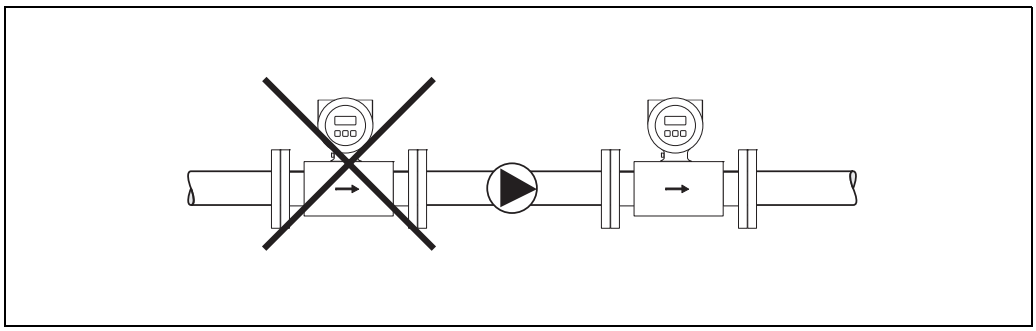
Installing pumps

Do not install the sensor on the intake side of a pump. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the lining's resistance to partial vacuum → Page 22
It might be necessary to install pulse dampers in systems incorporating reciprocating, diaphragm or peristaltic pumps. Information on the measuring system's resistance to vibration and shock → Page 20



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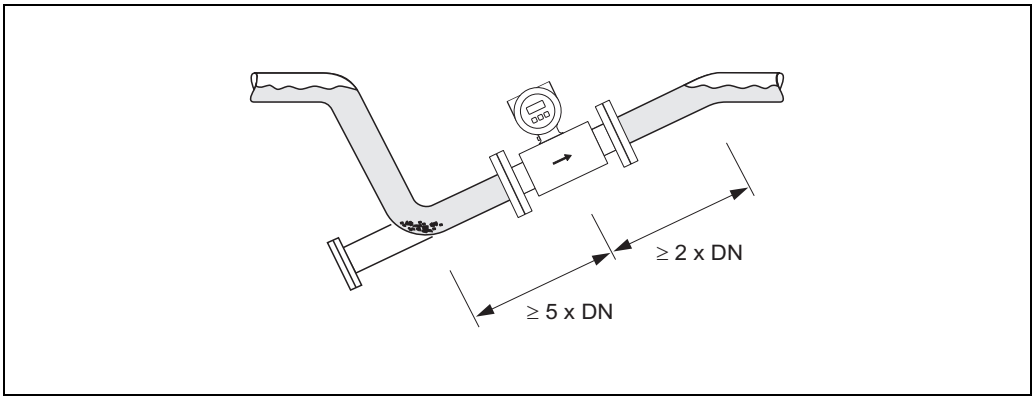
Partially filled pipes

Partially filled pipes with gradients necessitate a drain-type configuration. The Empty Pipe Detection function offers additional protection by detecting empty or partially filled pipes.

Caution!
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.



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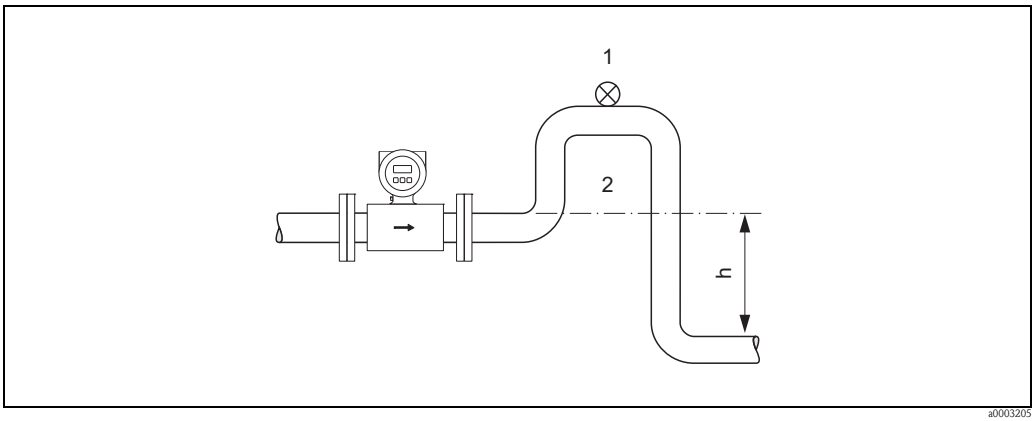
Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes longer than 5 meters. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. This measure also prevents the system losing prime, which could cause air inclusions.
Information on the lining's resistance to partial vacuum → Page 22



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Measures for installation in a down pipe (h > 5 m)

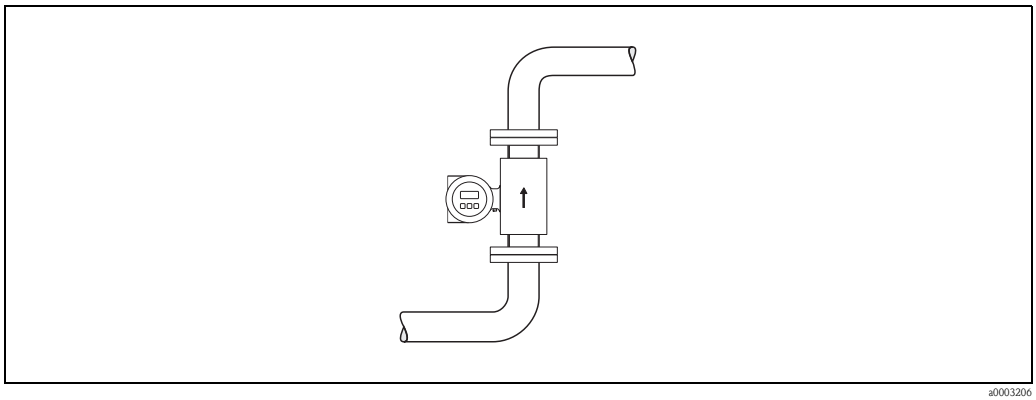
1 Vent valve
2 Siphon

Orientation

An optimum orientation position helps avoid gas and air accumulations and deposits in the measuring tube. Promag, nevertheless, supplies a range of functions and accessories for correct measuring of problematic fluids:
- Electrode Cleaning Circuit (ECC) for applications with fluids producing build-up, e.g. electrically conductive deposits → "Description of Device Functions" manual.
- Empty Pipe Detection (EPD) ensures the detection of partially filled measuring tubes, e.g. in the case of degassing fluids or varying process pressures

Vertical orientation

A vertical orientation is ideal in the following cases:
- For self-emptying piping systems and when using empty pipe detection.
- For sludge containing sand or stones and where the solids cause sedimentation.



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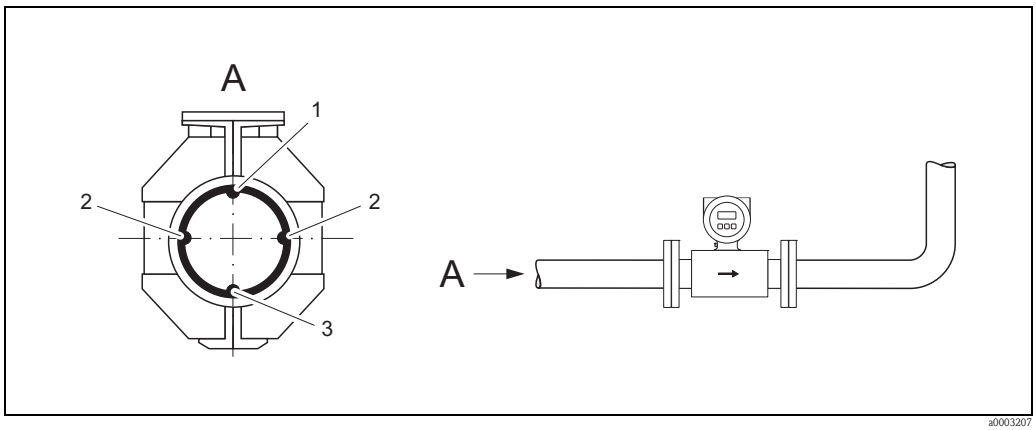
Horizontal orientation

The measuring electrode plane should be horizontal. This prevents brief insulation of the two electrodes by entrained air bubbles.

Caution!
Empty Pipe Detection functions correctly with the measuring device installed horizontally only when the transmitter housing is facing upward (see diagram). Otherwise there is no guarantee that Empty Pipe Detection will respond if the measuring tube is only partially filled or empty.



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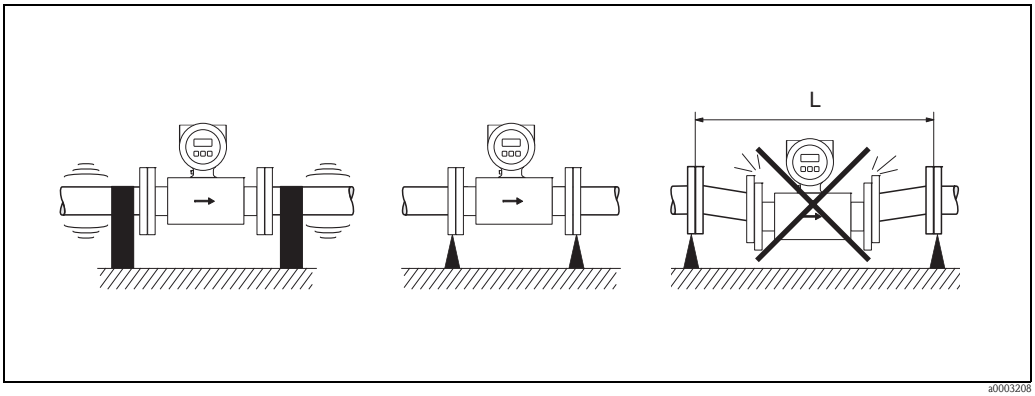
1 EPD electrode for empty pipe detection (not for lining made of natural rubber)
2 Measuring electrodes for signal detection
3 Reference electrode for potential equalization (not for lining made of natural rubber)

Vibrations

Secure and fix both the piping and the sensor if the vibrations are severe.

Caution!
It is advisable to install sensor and transmitter separately if vibration is excessively severe. Information on the permitted resistance to vibration and shock → Page 20

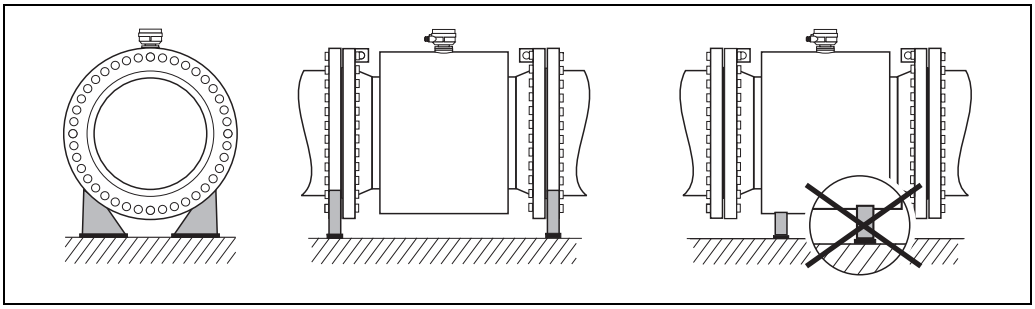


Measures to prevent vibration of the measuring device (L > 10 m)

Foundations, supports

If the nominal diameter is DN ≥ 350, mount the sensor on a foundation of adequate load-bearing strength.

Caution!
Risk of damage.
Do not support the weight of the sensor on the metal casing: the casing would buckle and damage the internal magnetic coils.

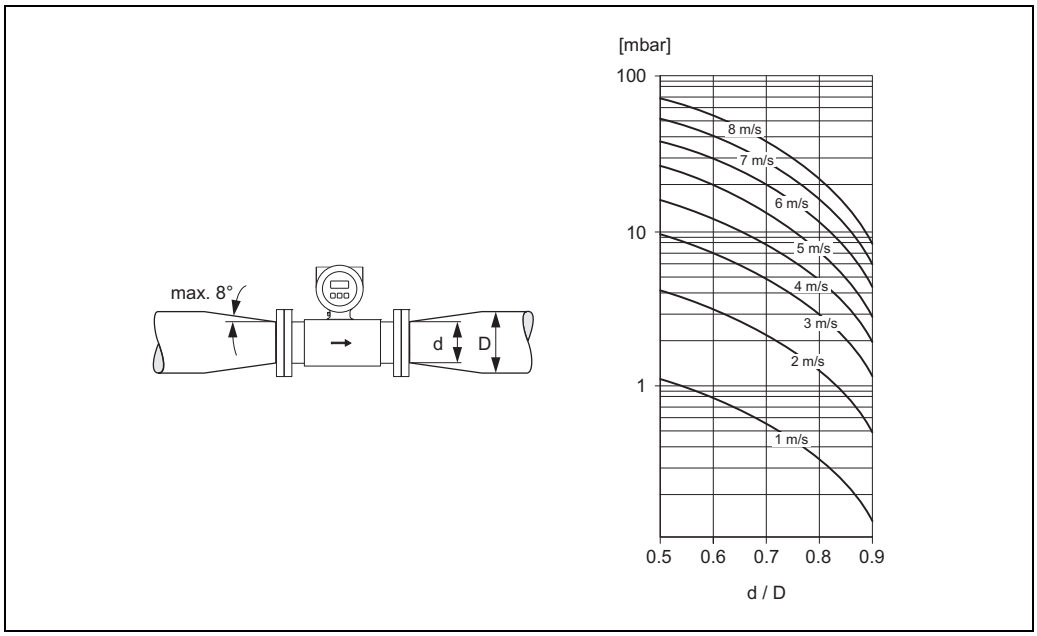


Adapters

Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by cross-section reduction.

Note!
The nomogram applies to fluids of viscosity similar to water.

1. Calculate the ratio of the diameters d/D.
2. From the nomogram, read off the pressure loss as a function of fluid velocity (*downstream* from the reduction) and the d/D ratio.



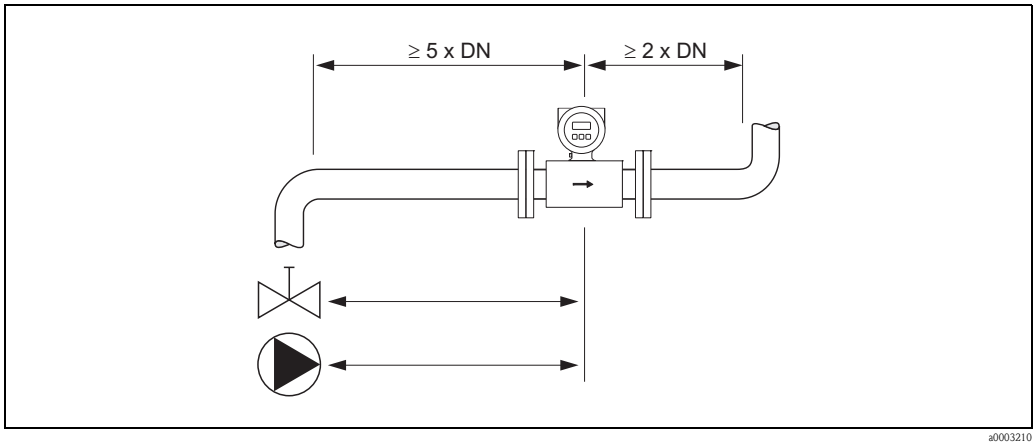
a0003213

Inlet and outlet runs

If possible, install the sensor well clear of fittings such as valves, T-pieces, elbows, etc.

Compliance with the following requirements for the inlet and outlet runs is necessary in order to ensure measuring accuracy.

- Inlet run ≥ 5 x DN
- Outlet run ≥ 2 x DN

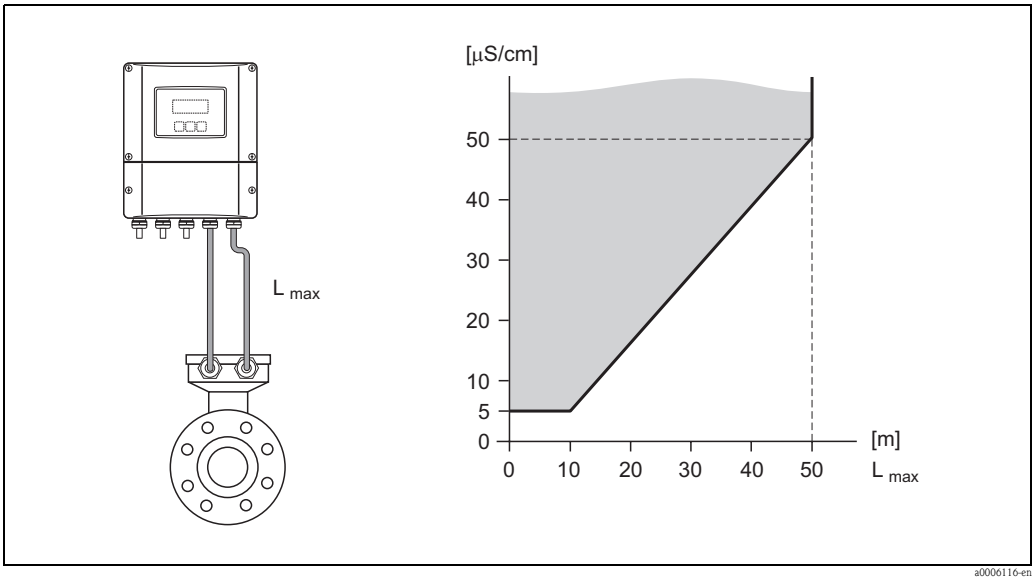


a0003210

Length of connecting cable

In order to ensure measuring accuracy, comply with the following instructions when installing the remote version:

- Secure the cable run or route the cable in an armored conduit. Movement of the cable can falsify the measuring signal, particularly if the fluid conductivity is low.
- Route the cable well clear of electrical machines and switching elements.
- Ensure potential equalization between sensor and transmitter, if necessary.
- The permissible cable length L_{max} depends on the fluid conductivity (see Figure).



Permitted lengths for connecting cable in remote version, as a function of the conductivity of the fluid

Gray shaded area = permissible area
L_{max} = Length of connecting cable

Operating conditions: Environment

Ambient temperature

Transmitter:
- Standard:
  - Compact version: –20 to +50 °C
  - Remote version: –20 to +60 °C
- Optional:
  - Compact version: –40 to +50 °C
  - Remote version: –40 to +60 °C

Note!
At ambient temperatures below –20 °C, the readability of the display may be impaired.

Sensor:
- Flange material carbon steel: –10 to +60 °C
- Flange material stainless steel: –40 to +60 °C

Caution!
Do not exceed the min. and max. temperatures for the lining of the measuring tube (→ "Medium temperature range").

Note the following points:
- Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions.
- If both fluid and ambient temperatures are high, install the transmitter at a remote location from the sensor (→ "Medium temperature range").

Storage temperature

The storage temperature corresponds to the operating temperature range of the transmitter and sensor.

Degree of protection

- Standard: IP 67 (NEMA 4X) for transmitter and sensor
- Optional: IP 68 (NEMA 6P) for remote version of Promag S sensor

Shock and vibration resistance

Acceleration up to 2 g by analogy with IEC 600 68-2-6

(High temperature version: no data available)

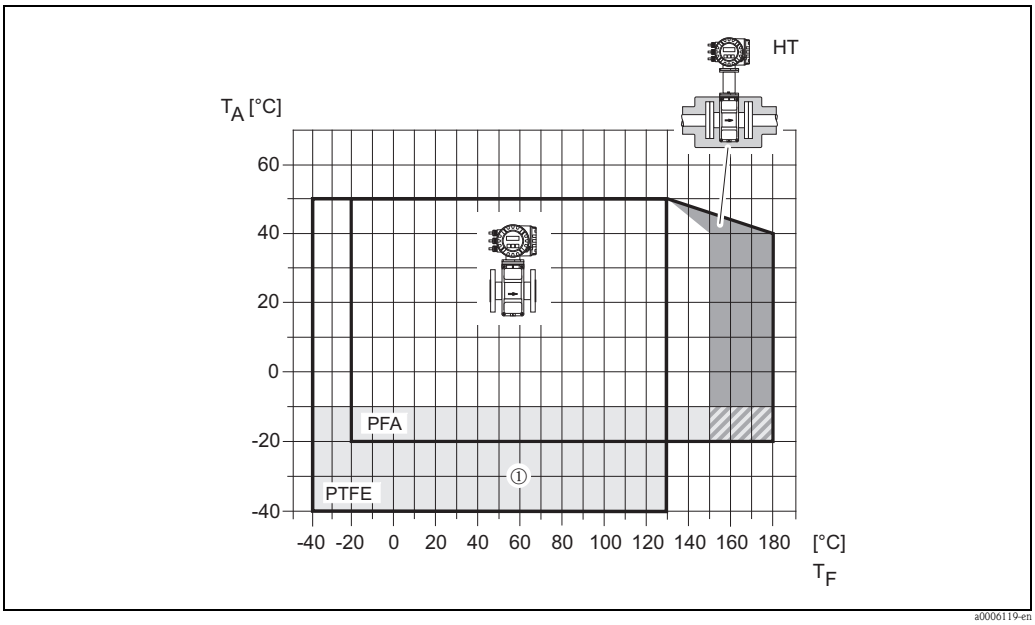
Electromagnetic compatibility (EMC)

According to IEC/EN 61326 and NAMUR recommendation NE 21

Operating conditions: Process

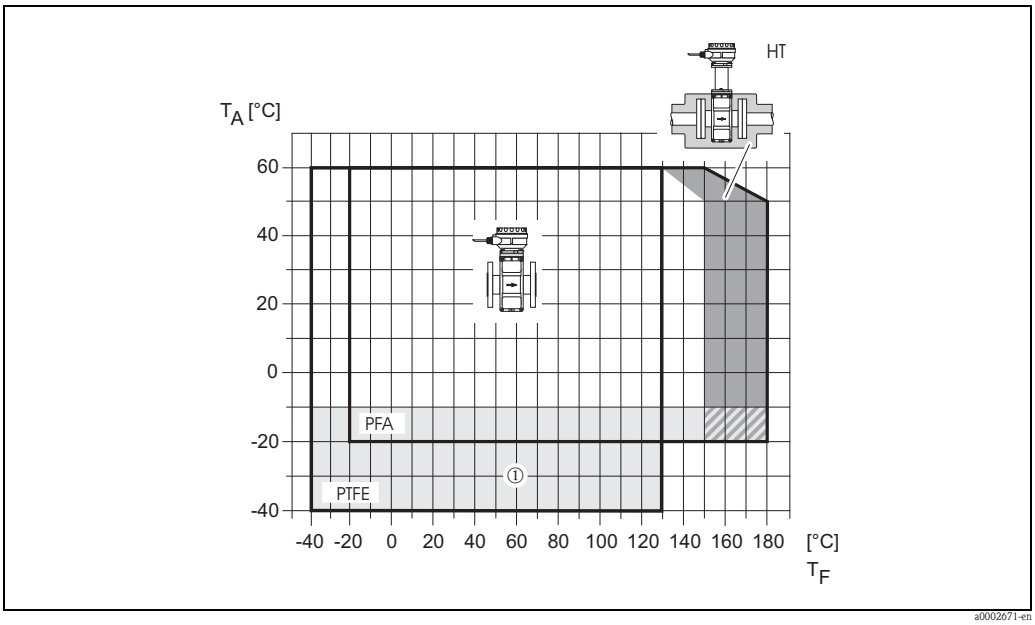
Medium temperature range

The permitted temperature depends on the lining of the measuring tube:
- 0 to +60 °C for natural rubber (DN 65 to 600)
- –20 to +50 °C for polyurethane (DN 25 to 1000)
- –20 to +180 °C for PFA (DN 25 to 200), restrictions → see diagrams
- –40 to +130 °C for PTFE (DN 15 to 600), restrictions → see diagrams



Promag S compact versions (with PFA or PTFE lining)

T_A Ambient temperature
T_F Fluid temperature
HT High temperature version with insulation
① Gray shaded area → temperature range from –10 to –40 °C applies only to stainless steel flanges



Promag S remote versions (with PFA or PTFE lining)

T_A Ambient temperature
T_F Fluid temperature
HT High temperature version with insulation
① Gray shaded area → temperature range from –10 to –40 °C applies only to stainless steel flanges

Conductivity

Minimum conductivity:
- ≥5 µS/cm for all liquids (incl. demineralized water)

Note!
In the remote version, the required minimum conductivity is also influenced by the length of the cable
→ Page 19

Limiting medium pressure range (nominal pressure)

- EN 1092-1 (DIN 2501): PN 10 (DN 200 to 600), PN 16 (DN 65 to 600), PN 25 (DN 200 to 600), PN 40 (DN 15 to 150)
- ANSI B 16.5: Class 150 (DN ½ to 24"), Class 300 (DN ½ to 6")
- JIS B2238: 10 K (DN 50 to 300), 20 K (DN 15 to 300)
- AS 2129: Table E (DN 25, DN 50)
- AS 4087: Cl. 14 (DN 50)

Pressure tightness (lining)

Promag S Nominal diameter [mm]	**Measuring tube lining**	**Resistance of measuring tube lining to partial vacuum** Limit values for abs. pressure [mbar] at various fluid temperatures						
		25 °C	50 °C	80° C	100 °C	130 °C	150 °C	180 °C
25 to 600	Polyurethane	0	0	-	-	-	-	-
65 to 600	Natural rubber	0	0	-	-	-	-	-

Promag S Nominal diameter [mm]	**Measuring tube lining**	**Resistance of measuring tube lining to partial vacuum** Limit values for abs. pressure [mbar] at various fluid temperatures					
		25 °C	80° C	100 °C	130 °C	150 °C	180 °C
15	PTFE	0	0	0	100	–	–
25	PTFE / PFA	0/0	0/0	0/0	100/0	–/0	–/0
32	PTFE / PFA	0/0	0/0	0/0	100/0	–/0	–/0
40	PTFE / PFA	0/0	0/0	0/0	100/0	–/0	–/0
50	PTFE / PFA	0/0	0/0	0/0	100/0	–/0	–/0
65	PTFE / PFA	0/0	*	40/0	130/0	–/0	–/0
80	PTFE / PFA	0/0	*	40/0	130/0	–/0	–/0
100	PTFE / PFA	0/0	*	135/0	170/0	–/0	–/0
125	PTFE / PFA	135/0	*	240/0	385/0	–/0	–/0
150	PTFE / PFA	135/0	*	240/0	385/0	–/0	–/0
200	PTFE / PFA	200/0	*	290/0	410/0	–/0	–/0
250	PTFE	330	*	400	530	–	–
300	PTFE	400	*	500	630	–	–
350	PTFE	470	*	600	730	–	–
400	PTFE	540	*	670	800	–	–
450	PTFE	Partial vacuum is impermissible					
500	PTFE						
600	PTFE						

* No value can be quoted.

Nominal diameter and flow rate

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum flow velocity is between 2 and 3 m/s. The flow velocity (v), moreover, has to be matched to the physical properties of the fluid:

- v < 2 m/s: for abrasive fluids where solids do not cause sedimentation (e.g. lime milk)
- v > 2 m/s: for fluids producing build-up (e.g. wastewater sludge)
- v > 2 m/s: for abrasive sludge with a high sand or stone content and where the solids easily cause sedimentation (e.g. ore slurry)

Note!
Flow velocity can be increased, if necessary, by reducing the nominal diameter of the sensor through the use of adapters → Page 18.

Flow rate characteristic values - Promag S

Nominal diameter [mm]	Recommended flow rate min./max. full scale value (v ≈ 0.3 or 10 m/s)	Factory settings Full scale value (v ≈ 2.5 m/s)	Pulse value (≈ 2 pulse/s)	Low flow cut off (v ≈ 0.04 m/s)
15	4 to 100 dm³/min	25 dm³/min	0.20 dm³	0.5 dm³/min
25	9 to 300 dm³/min	75 dm³/min	0.50 dm³	1 dm³/min
32	15 to 500 dm³/min	125 dm³/min	1.00 dm³	2 dm³/min
40	25 to 700 dm³/min	200 dm³/min	1.50 dm³	3 dm³/min
50	35 to 1100 dm³/min	300 dm³/min	2.50 dm³	5 dm³/min
65	60 to 2000 dm³/min	500 dm³/min	5.00 dm³	8 dm³/min
80	90 to 3000 dm³/min	750 dm³/min	5.00 dm³	12 dm³/min
100	145 to 4700 dm³/min	1200 dm³/min	10.00 dm³	20 dm³/min
125	220 to 7500 dm³/min	1850 dm³/min	15.00 dm³	30 dm³/min
150	20 to 600 m³/h	150 m³/h	0.025 m³	2.5 m³/h
200	35 to 1100 m³/h	300 m³/h	0.05 m³	5.0 m³/h
250	55 to 1700 m³/h	500 m³/h	0.05 m³	7.5 m³/h
300	80 to 2400 m³/h	750 m³/h	0.10 m³	10 m³/h
350	110 to 3300 m³/h	1000 m³/h	0.10 m³	15 m³/h
400	140 to 4200 m³/h	1200 m³/h	0.15 m³	20 m³/h
450	180 to 5400 m³/h	1500 m³/h	0.25 m³	25 m³/h
500	220 to 6600 m³/h	2000 m³/h	0.25 m³	30 m³/h
600	310 to 9600 m³/h	2500 m³/h	0.30 m³	40 m³/h

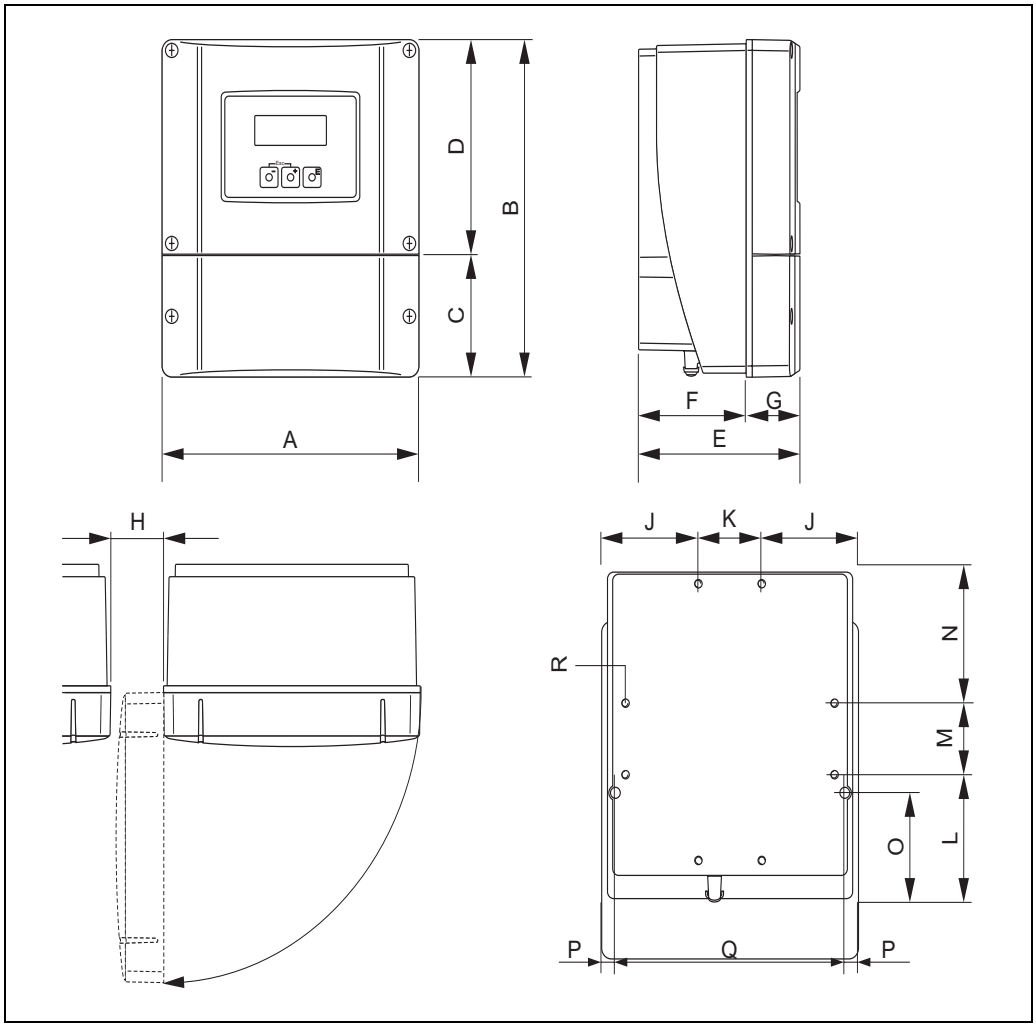
Pressure loss

- No pressure loss if the sensor is installed in a pipe of the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 → Page 18

Mechanical construction

Design, dimensions

Dimensions: Wall-mount housing (non hazardous area and II3G / zone 2)

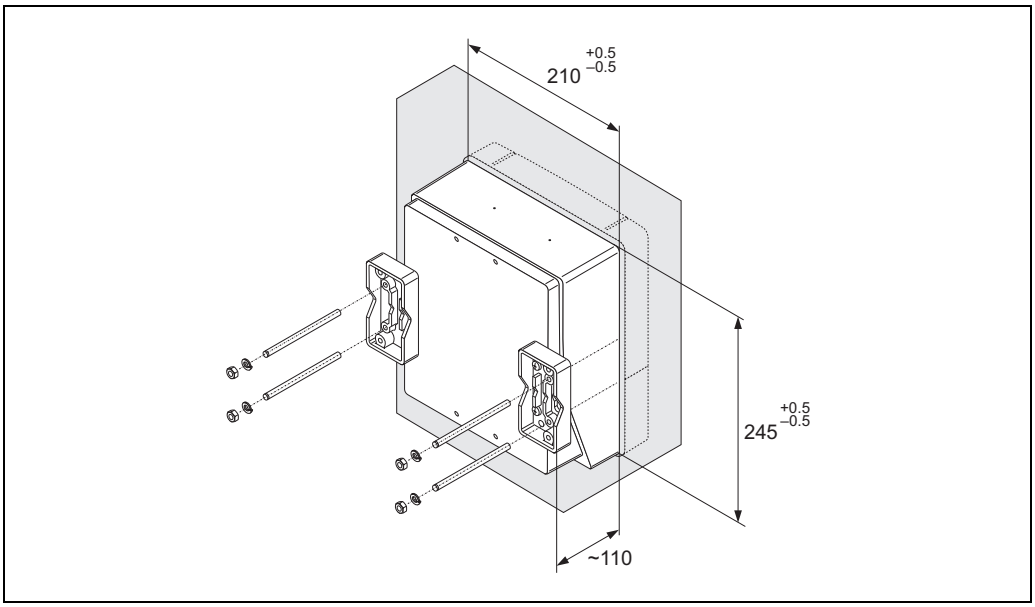


Metric units [mm]

A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R
215	250	90.5	159.5	135	90	45	>50	81	53	95	53	102	81.5	11.5	192	8xM5

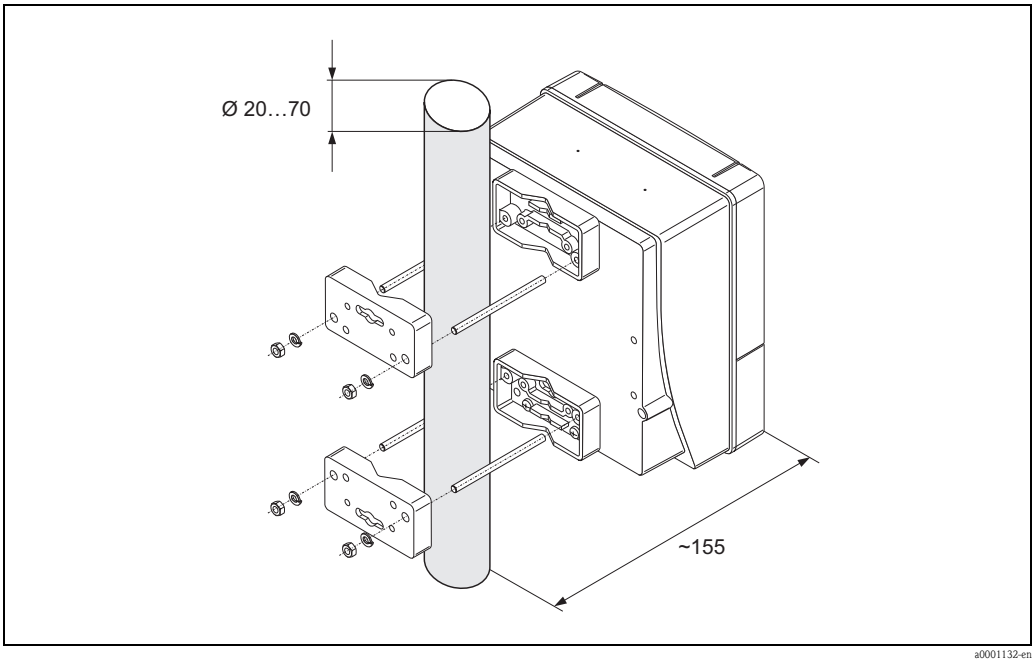
There is a separate mounting kit for the wall-mounted housing. It can be ordered from Endress+Hauser as an accessory. The following installation variants are possible:
- Panel-mounted installation
- Pipe mounting

Installation in control panel



a0001131-en

Pipe mounting



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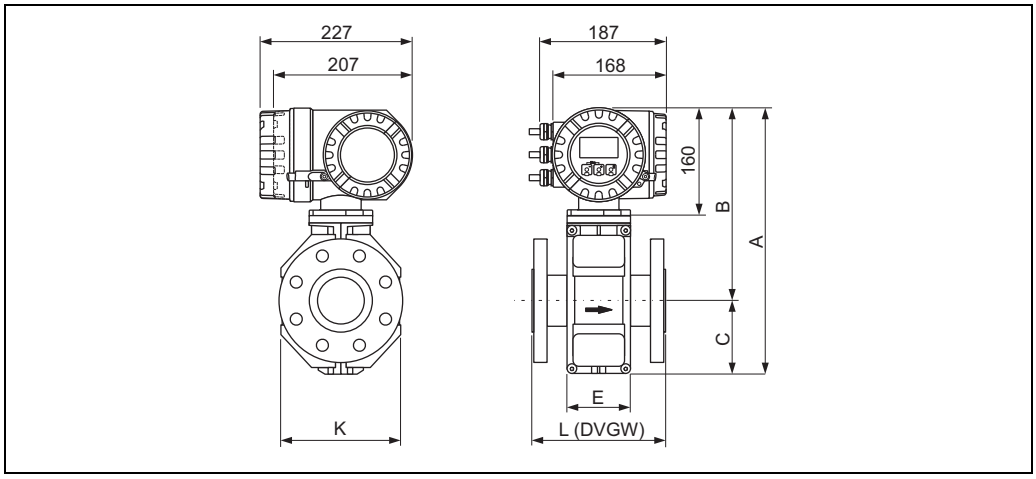
Compact version DN ≤ 300, Flange connections to EN (DIN) / JIS / AS

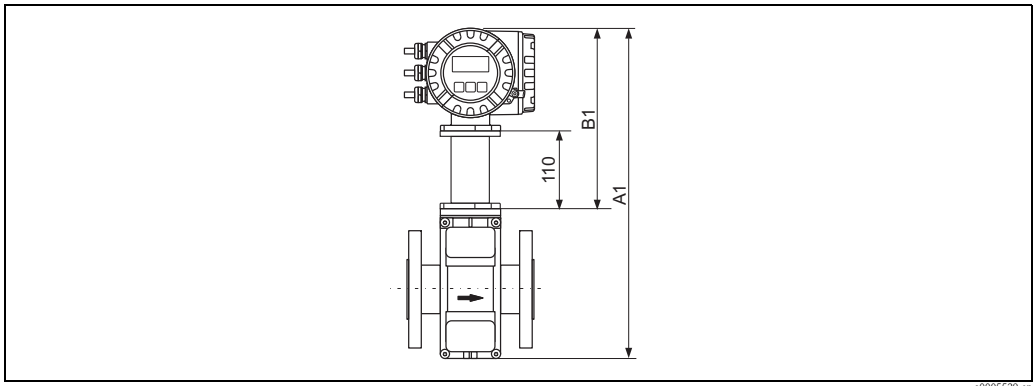


a0005423-en

DN EN (DIN) / JIS / AS [1)] [mm]	L [mm]	A [mm]	B [mm]	C [mm]	K [mm]	E [mm]
15	200	341	257	84	120	94
25	200	341	257	84	120	94
32	200	341	257	84	120	94
40	200	341	257	84	120	94
50	200	341	257	84	120	94
65	200	391	282	109	180	94
80	200	391	282	109	180	94
100	250	391	282	109	180	94
125	250	472	322	150	260	140
150	300	472	322	150	260	140
200	350	527	347	180	324	156
250	450	577	372	205	400	156
300	500	627	397	230	460	166

The fitting length (L) is always the same, regardless of the pressure rating.
[1)] Only DN 25 and DN 50 are available for flanges according to AS.

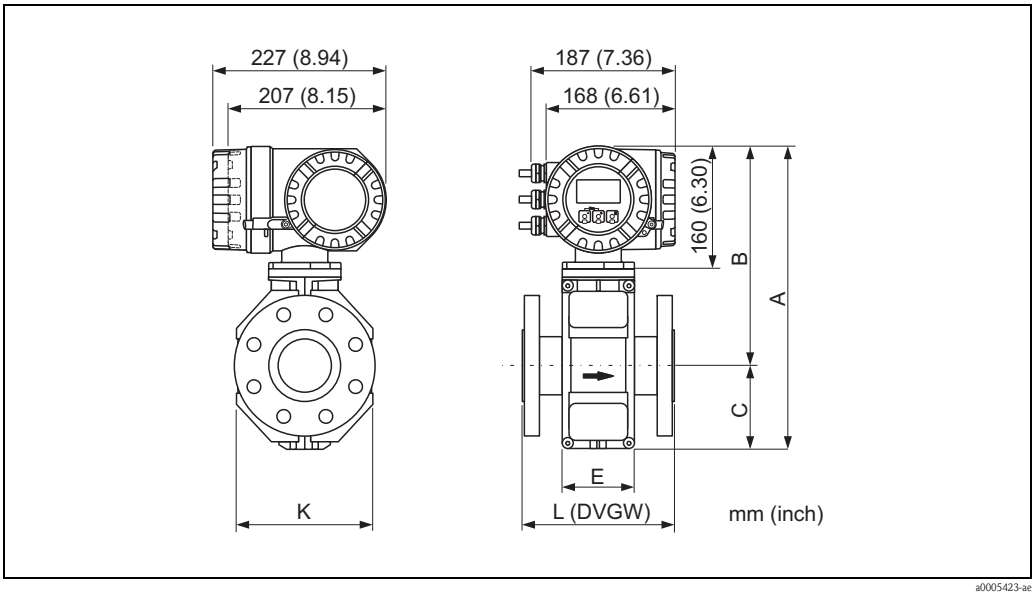
High temperature version DN ≤ 300



a0005529-en

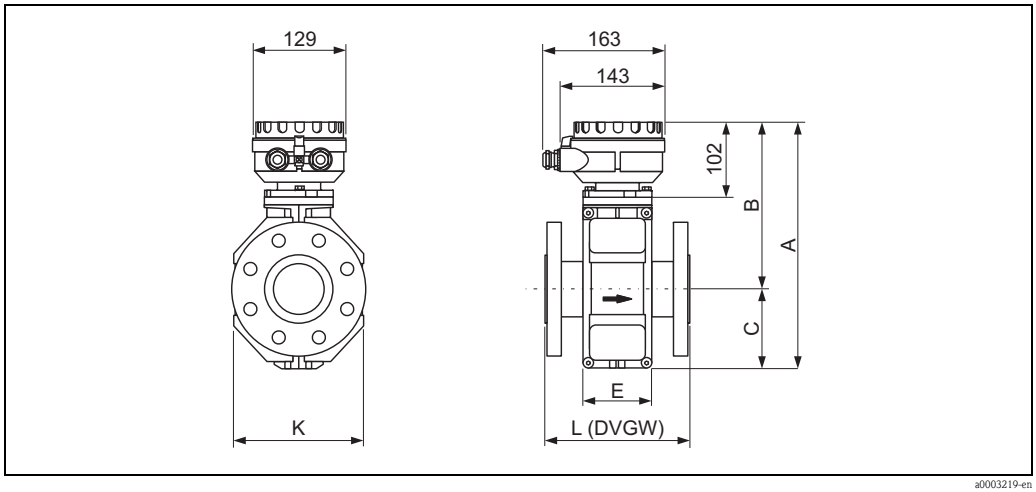
Measurement A1, B1 = Measurement A, B of the standard compact version plus 110 mm

Compact version DN ≤ 300, Flange connections to ANSI



DN ANSI [inch]	L [inch]	A [inch]	B [inch]	C [inch]	K [inch]	E [inch]
½"	7.87	13.43	10.12	3.31	4.72	3.70
1	7.87	13.43	10.12	3.31	4.72	3.70
1 ½"	7.87	13.43	10.12	3.31	4.72	3.70
2"	7.87	13.43	10.12	3.31	4.72	3.70
3"	7.87	15.39	11.10	4.29	7.09	3.70
4"	9.84	15.39	11.10	4.29	7.09	3.70
6"	11.81	18.58	12.68	5.91	10.24	5.51
8"	13.78	20.75	13.66	7.09	12.76	6.14
10"	17.72	22.72	14.65	8.07	15.75	6.14
12"	19.69	24.69	15.63	9.06	18.11	6.54
The fitting length (L) is always the same, regardless of the pressure rating.						

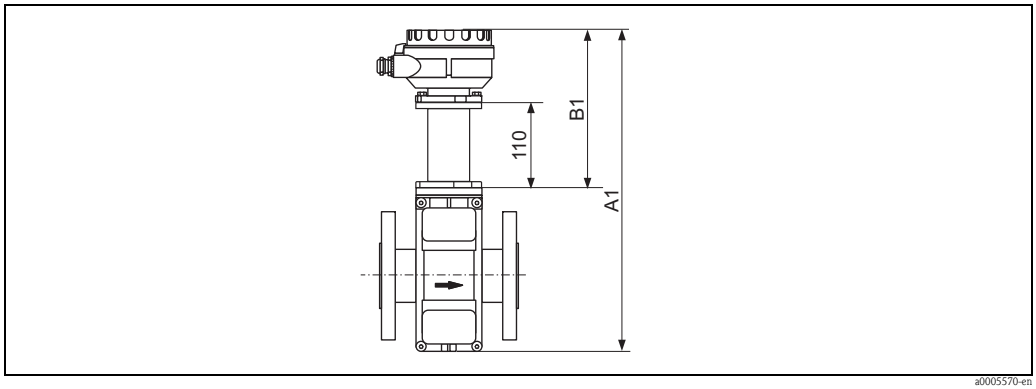
Remote version DN ≤ 300, Flange connections to EN (DIN) / JIS / AS



DN EN (DIN) / JIS / AS [1)] [mm]	L [mm]	A [mm]	B [mm]	C [mm]	K [mm]	E [mm]
15	200	286	202	84	120	94
25	200	286	202	84	120	94
32	200	286	202	84	120	94
40	200	286	202	84	120	94
50	200	286	202	84	120	94
65	200	336	227	109	180	94
80	200	336	227	109	180	94
100	250	336	227	109	180	94
125	250	417	267	150	260	140
150	300	417	267	150	260	140
200	350	472	292	180	324	156
250	450	522	317	205	400	156
300	500	572	342	230	460	166

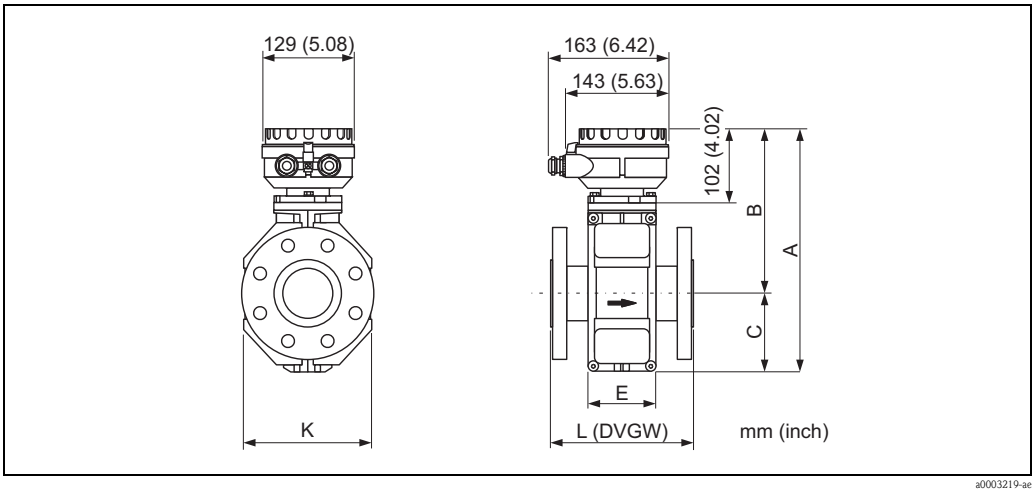
The fitting length (L) is always the same, regardless of the pressure rating.
[1)] Only DN 25 and DN 50 are available for flanges according to AS.

High temperature version DN ≤ 300



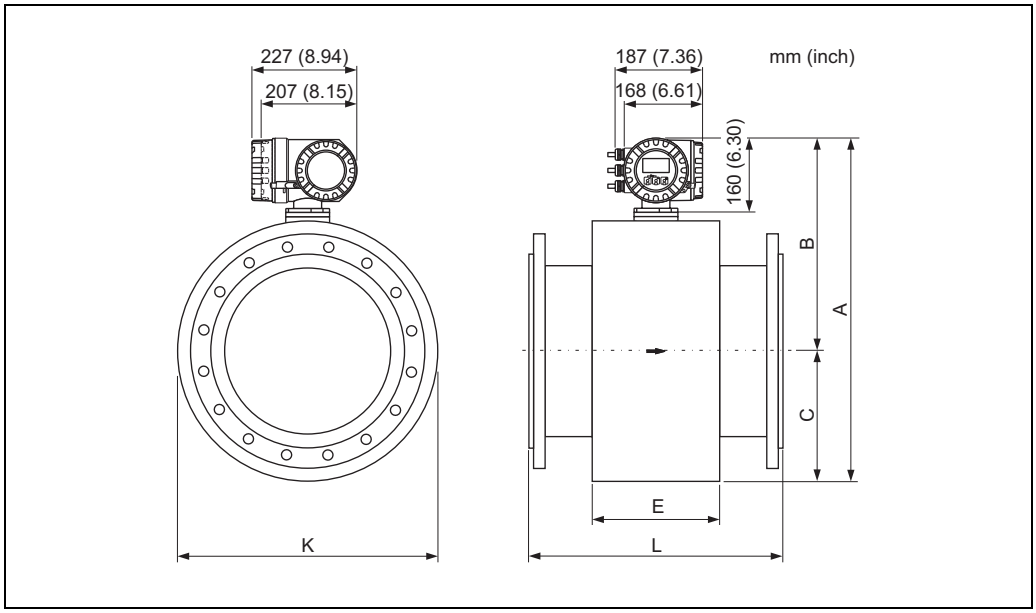
Measurement A1, B1 = Measurement A, B of the standard compact version plus 110 mm

Remote version DN ≤ 300, Flange connections to ANSI



DN ANSI [inch]	L [inch]	A [inch]	B [inch]	C [inch]	K [inch]	E [inch]
½"	7.87	11.26	7.95	3.31	4.72	3.70
1"	7.87	11.26	7.95	3.31	4.72	3.70
1 ½"	7.87	11.26	7.95	3.31	4.72	3.70
2"	7.87	11.26	7.95	3.31	4.72	3.70
3"	7.87	13.23	8.94	4.29	7.09	3.70
4"	9.84	13.23	8.94	4.29	7.09	3.70
6"	11.81	16.42	10.51	5.91	10.24	5.51
8"	13.78	18.58	11.50	7.08	12.76	6.14
10"	17.72	20.55	12.48	8.07	15.75	6.14
12"	19.69	22.52	13.46	9.06	18.11	6.54
The fitting length (L) is always the same, regardless of the pressure rating.						

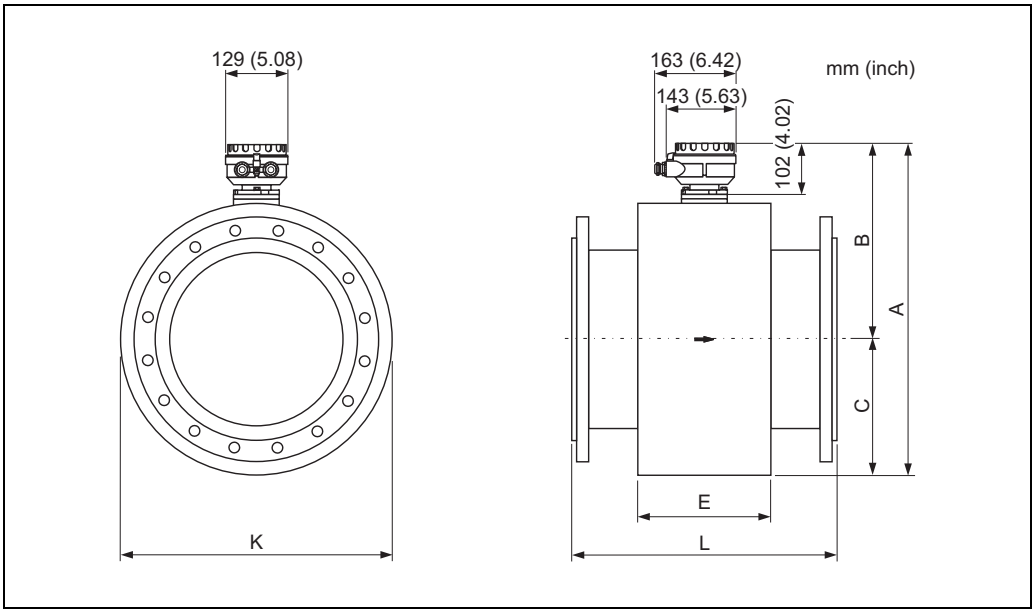
Compact version DN ≥ 300, Flange connections to EN (DIN) und ANSI



DN EN (DIN) [mm]	L [mm]	A [mm]	B [mm]	C [mm]	K [mm]	E [mm]
350	550	738.5	456.5	282.0	564	276
400	600	790.5	482.5	308.0	616	276
450	650	840.5	507.5	333.0	666	292
500	650	891.5	533.0	358.5	717	292
600	780	995.5	585.0	410.5	821	402
The fitting length (L) is always the same, regardless of the pressure rating.						

DN ANSI [inch]	L [inch]	A [inch]	B [inch]	C [inch]	K [inch]	E [inch]
14"	21.65	29.07	17.97	11.10	22.20	10.87
16"	23.62	31.12	19.00	12.12	24.25	10.87
18"	25.59	33.09	19.98	13.11	26.22	11.50
20"	25.59	35.10	20.98	14.12	28.23	11.50
24"	30.71	39.19	23.03	16.16	32.32	15.83
The fitting length (L) is always the same, regardless of the pressure rating.						

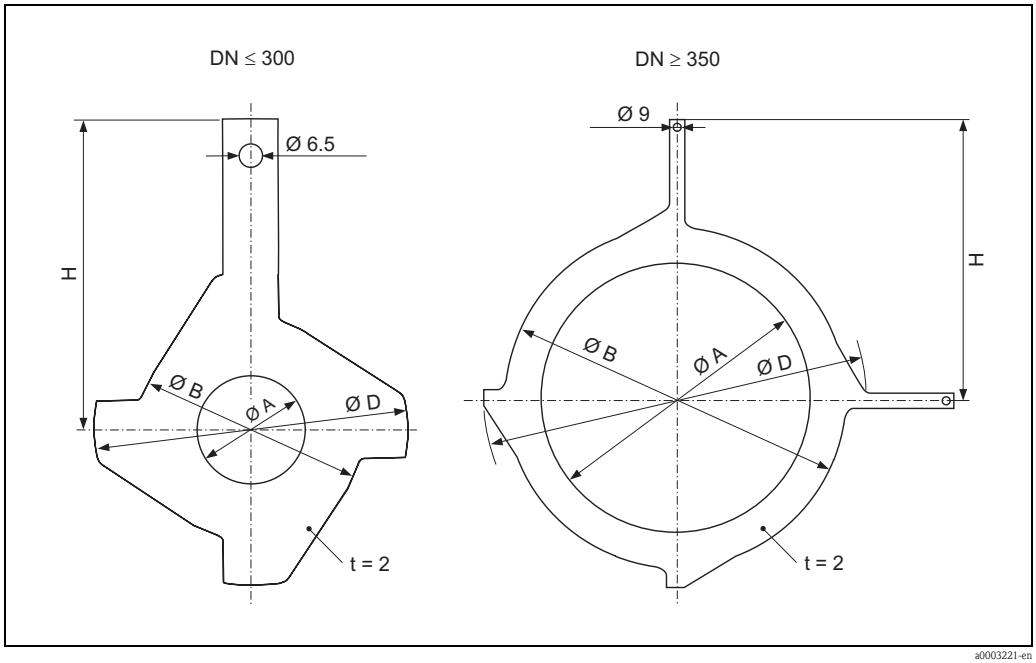
Remote version DN ≥ 300, Flange connections to EN (DIN) und ANSI



DN EN (DIN) [mm]	L [mm]	A [mm]	B [mm]	C [mm]	K [mm]	E [mm]
350	550	683.5	401.5	282.0	564	276
400	600	735.5	427.5	308.0	616	276
450	650	785.5	452.5	333.0	666	292
500	650	836.5	478.0	358.5	717	292
600	780	940.5	530.0	410.5	821	402
The fitting length (L) is always the same, regardless of the pressure rating.						

DN ANSI [inch]	L [inch]	A [inch]	B [inch]	C [inch]	K [inch]	E [inch]
14"	21.65	26.91	15.81	11.10	22.20	10.87
16"	23.62	28.96	16.83	12.13	24.25	10.87
18"	25.59	30.93	17.81	13.12	26.22	11.50
20"	25.59	32.93	18.82	14.11	28.23	11.50
24"	30.71	37.03	20.87	16.16	32.32	15.83
The fitting length (L) is always the same, regardless of the pressure rating.						

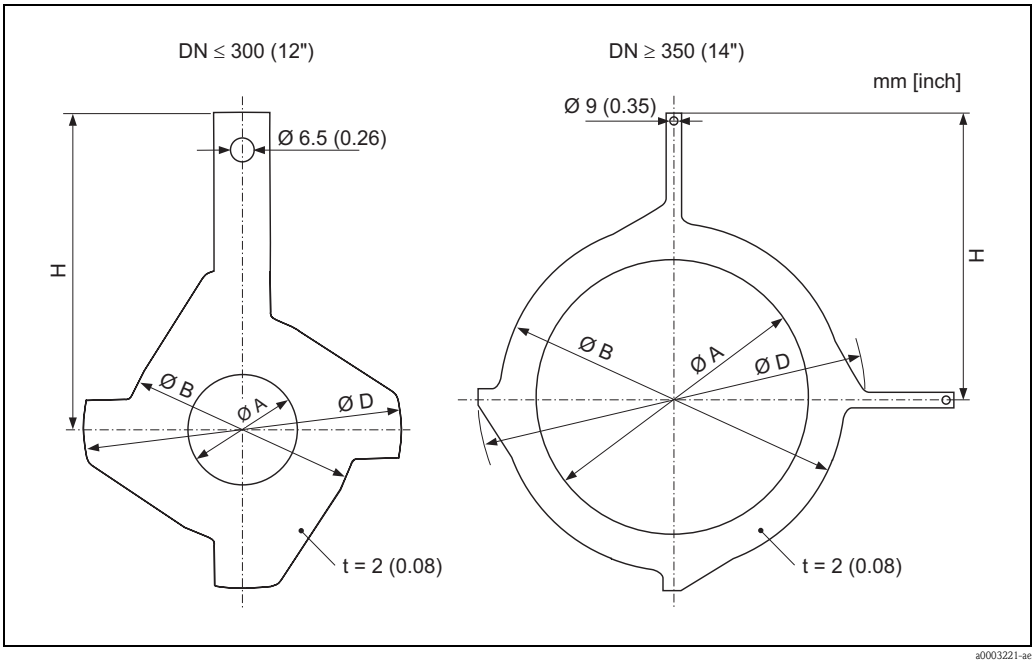
Ground disk for flange connections to EN (DIN) / JIS / AS



DN [1]	A		B	D	H
EN (DIN) / JIS / AS[4] [mm]	PTFE, PFA, PU[5] [mm]	NR[5] [mm]	[mm]	[mm]	[mm]
15	16	–	43	61.5	73
25	26	–	62	77.5	87.5
32	35	–	80	87.5	94.5
40	41	–	82	101	103
50	52	–	101	115.5	108
65	68	53	121	131.5	118
80	80	66	131	154.5	135
100	104	91.5	156	186.5	153
125	130	117	187	206.5	160
150	158	143.5	217	256	184
200	206	192	267	288	205
250	260	245	328	359	240
300[2]	312	294.5	375	413	273
300[3]	310	–	375	404	268
350[2]	343	323.5	433	479	365
400[2]	393	371	480	542	395
450[2]	439	420	538	583	417
500[2]	493	469	592	650	460
600[2]	593	566	693	766	522

[1] Ground disks at DN 15 to 250 can be used for all flange standards/nominal pressures available as standard.
[2] PN 10/16, Cl 150
[3] PN 25, JIS 10 K/20 K
[4] Only DN 25 and DN 50 are available for flanges according to AS
[5] Abbreviations (lining): PU = Polyurethane, NR = Natural rubber

Ground disk for flange connections to ANSI



DN [1]	A		B	D	H
ANSI [inch]	PTFE, PFA, PU [2] [inch]	NR [2] [inch]	[inch]	[inch]	[inch]
½"	0.63	–	1.69	2.42	2.87
1"	1.02	–	2.44	3.05	3.44
1 ½"	1.61	–	3.23	3.98	4.06
2"	2.05	–	3.98	4.55	4.25
3"	3.15	2.60	5.16	6.08	5.31
4"	4.09	3.60	6.14	7.34	6.02
6"	6.22	5.65	8.54	10.08	7.24
8"	8.11	7.56	10.51	11.34	8.07
10"	10.24	9.65	12.91	14.13	9.45
12"	12.28	11.59	14.76	16.26	10.75
14"	13.50	12.74	17.05	18.86	14.37
16"	15.47	14.61	18.90	21.34	15.55
18"	17.28	16.54	21.18	22.95	16.42
20"	19.41	18.46	23.31	25.59	18.11
24"	23.35	22.28	27.28	30.16	20.55

[1] Ground disks can be used for all pressure ratings.
[2] Abbreviations (lining): PU = Polyurethane, NR = Natural rubber

Weight

Nominal diameter		Weight in kilograms [kg]												
		Compact version						Remote version (without cable)						
								Sensor						Transmitter
[mm]	[inch]		EN (DIN) / AS*		JIS		ANSI		EN (DIN) / AS*		JIS		ANSI	(Wall-mount housing)
15	½"	PN 40	6.5	10K	6.5	Class 150	6.5	PN 40	4.5	10K	4.5	Class 150	4.5	6.0
25	1"		7.3		7.3		7.3		5.3		5.3		5.3	6.0
32	1 ¼"		8.0		7.3		–		6.0		5.3		–	6.0
40	1 ½"		9.4		8.3		9.4		7.4		6.3		7.4	6.0
50	2"		10.6		9.3		10.6		8.6		7.3		8.6	6.0
65	2 ½"	PN 16	12.0		11.1		–	PN 16	10.0		9.1		–	6.0
80	3"		14.0		12.5		14.0		12.0		10.5		12.0	6.0
100	4"		16.0		14.7		16.0		14.0		12.7		14.0	6.0
125	5"		21.5		21.0		–		19.5		19.0		–	6.0
150	6"		25.5		24.5		25.5		23.5		22.5		23.5	6.0
200	8"	PN 10	45		41.9		45	PN 10	43		39.9		43	6.0
250	10"		65		69.4		75		63		67.4		73	6.0
300	12"		70		72.3		110		68		70.3		108	6.0
350	14"		115				175		113				173	6.0
400	16"		135				205		133				203	6.0
450	18"		175				255		173				253	6.0
500	20"		175				285		173				283	6.0
600	24"		235				405		233				403	6.0

Transmitter (compact version): 3.4 kg
High temperature version: +1.5 kg
(Weight data valid for standard pressure ratings and without packaging material)
* Only DN 25 and DN 50 are available for flanges according to AS

Materials

Transmitter housing:
- Compact and remote version: Powder-coated die-cast aluminum

Sensor housing:
- DN 15 to 300: Powder-coated die-cast aluminum
- DN 350 to 600: Painted steel (Amerlock 400)

Measuring tube:
- DN < 350: Stainless steel 1.4301 (SS 304) or 1.4306/304L. For flanges of carbon steel with Al/Zn protective coating.
- DN > 300: Stainless steel 1.4301/304. For flanges of carbon steel with Amerlock 400 paint finish.

Flange:
- EN 1092-1 (DIN 2501): 316L / 1.4571 (SS 316Ti); RSt37-2 (S235JRG2) / C22 / FE 410W B (DN < 350: with Al/Zn protective coating; DN > 300 with Amerlock 400 paint finish)
- ANSI: A105; F316L (DN < 350 with Al/Zn protective coating; DN > 300 with Amerlock 400 paint finish)
- JIS: RSt37-2 (S235JRG2) / HII / 1.0425 / 316L (DN < 350 with Al/Zn protective coating; DN > 300 with Amerlock 400 paint finish)
- AS 2129:
  - DN 25: A105 or RSt37-2 (S235JRG2), with Al/Zn protective coating
  - DN 50: A105 or St44-2 (S275JR), with Al/Zn protective coating
- AS 4087:
  - DN 50: A105 or St44-2 (S275JR), with Al/Zn protective coating

Ground disks: 1.4435/316L or Alloy C-22

Electrodes: 1.4435/316L, platinum/rhodium 80/20, Alloy C-22, tantalum, tungsten carbide coating (for electrodes made from 1.4435), 1.4310/302 (for brush electrodes)

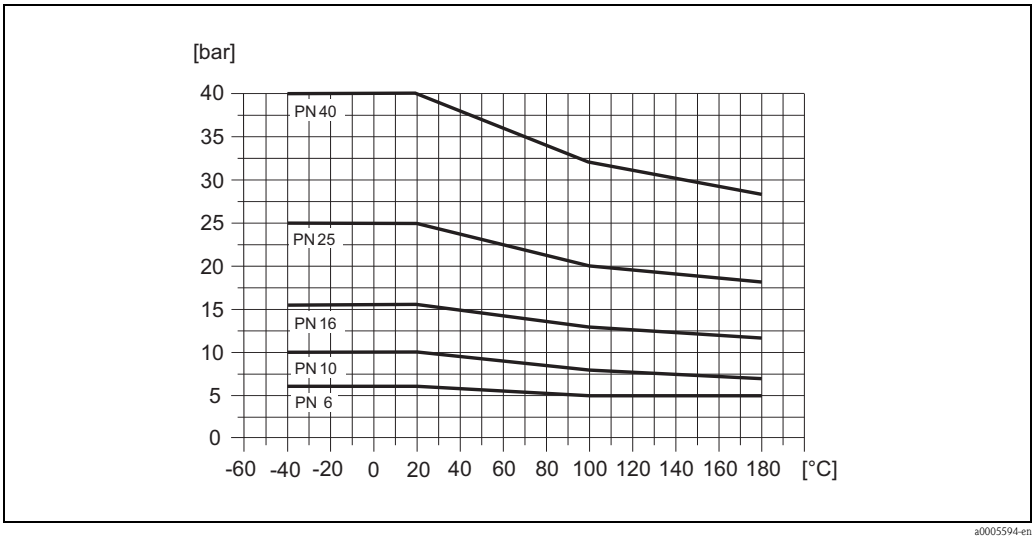
Seals: according to DIN EN 1514-1

Material load diagrams

Caution!
The following diagrams contain material load curves (reference curves) for various process connections relating to the fluid temperature. But the maximal permissible fluid temperature always depends on the lining material of the sensor and/or the sealing material.

Flange connection to EN 1092-1 (DIN 2501)

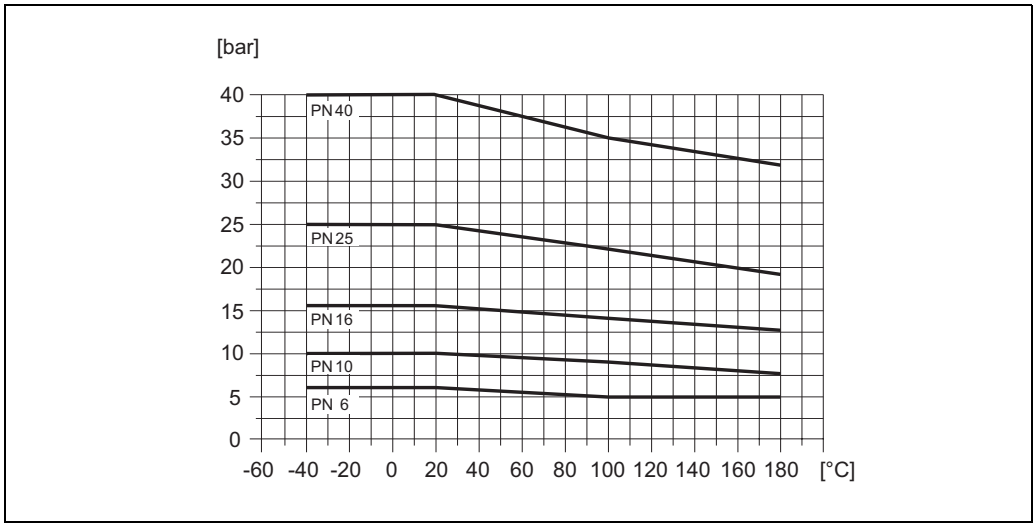
Flange material: RSt37-2 (S235JRG2) / C22 / Fe 410W B



a0005594-en

Flange connection to EN 1092-1 (DIN 2501)

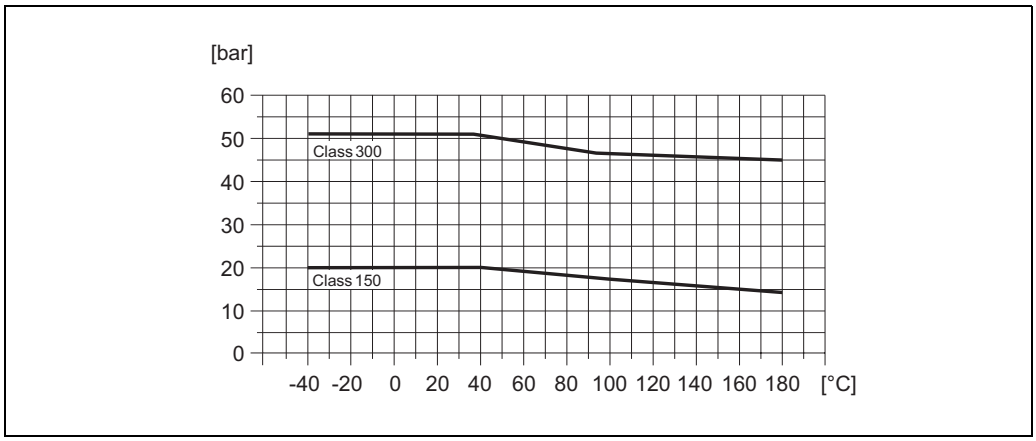
Flange material: 316L / 1.4571



a0005304-en

Flange connection to ANSI B16.5

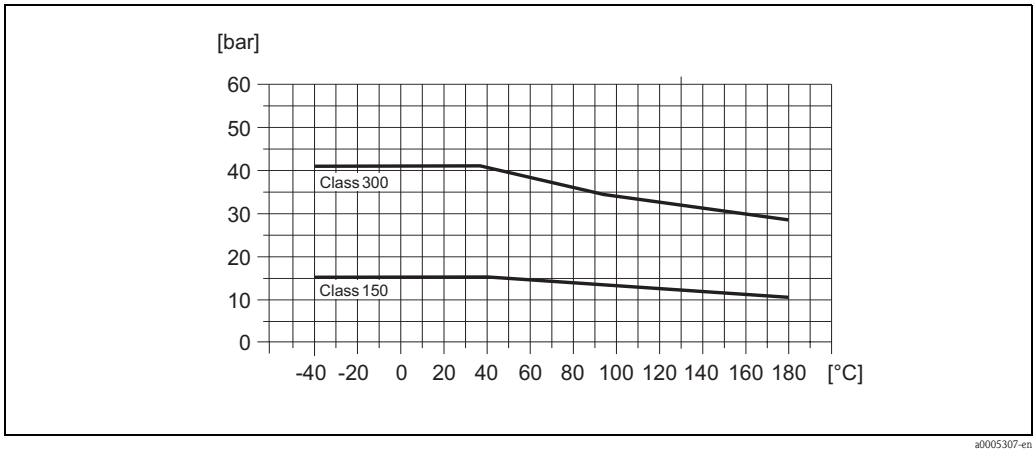
Flange material: A105



a0003226-en

Flange connection to ANSI B16.5

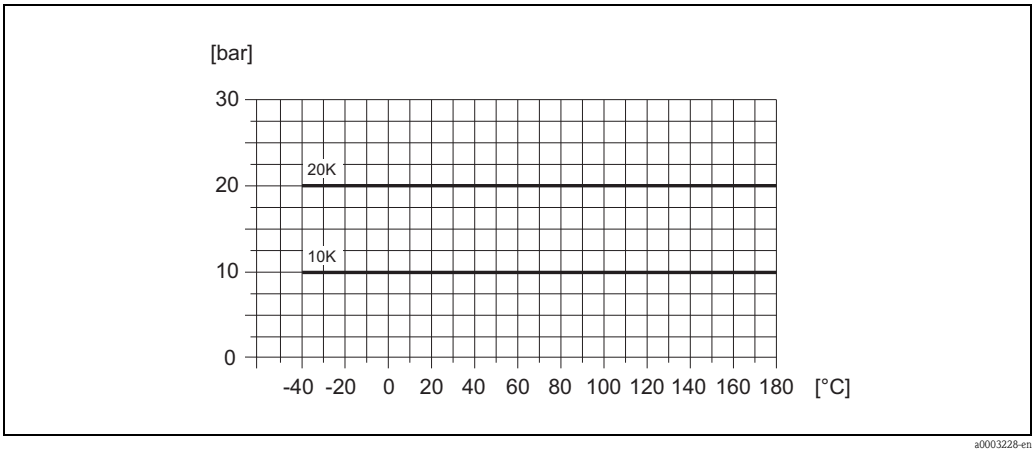
Flange material: F316L



a0005307-en

Flange connection to JIS B2238

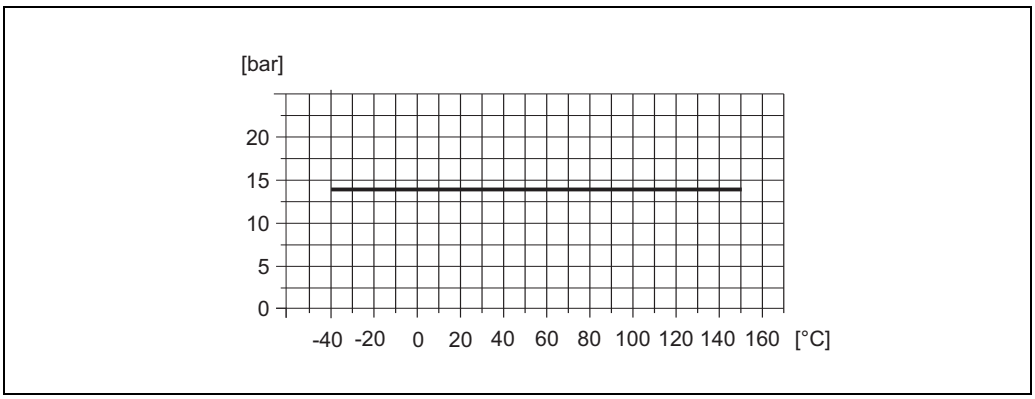
Flange material: RSt37-2 (S235JRG2) / H II / 1.0425



a0003228-en

Flange connection to AS 2129 Table E or AS 4087 Cl. 14

Flange material: A105 / RSt37-2 (S235JRG2) / St44-2 (S275JR)



a0005595-en

Fitted electrodes

Reference and empty pipe detection electrodes:
- Comes as standard with: 1.4435/SS 316L, Alloy C-22, tantalum, platinum/rhodium 80/20, tungsten carbide coating (for electrodes made of 1.4435)
- Optionally available: only for measuring electrodes made of platinum/rhodium 80/20
- Not available: for measuring tubes with natural rubber lining and brush electrodes

Process connections

Flange connection:
- EN 1092-1 (DIN 2501; DN < 300: Form A; DN > 300: Form B; DN 65 PN 16 and DN 600 PN 16 exclusively according to EN 1092-1)
- ANSI B16.5
- JIS B2238
- AS 2129 Table E
- AS 4087 Cl. 14

Surface roughness

- Lining with PFA: ≤0.4 µm
- Electrodes: 0.3 to 0.5 µm

All data relate to wetted parts.

Human interface

Display elements

- Liquid-crystal display: illuminated, four lines with 16 characters per line
- Custom configurations for presenting different measured values and status variables
- 3 totalizers
- At ambient temperatures below –20 °C, the readability of the display may be impaired.

Operating elements

- Onsite operation with three optical sensor keys (−/+/E)
- Application-specific Quick Setup menus for straightforward commissioning

Language groups

Language groups available for operation in different countries:

- Western Europe and America (WEA):
  English, German, Spanish, Italian, French, Dutch, Portuguese
- Eastern Europe/Scandinavia (EES):
  English, Russian, Polish, Norwegian, Finnish, Swedish, Czech
- South and East Asia (SEA):
  English, Japanese, Indonesian
- China (CN):
  English, Chinese

Note!
You can change the language group via the operating program "ToF Tool – Fieldtool Package."

Language groups

via HART protocol

Certificates and approvals

CE mark

The measuring system described in these Operating Instructions therefore complies with the legal requirements of the EU Directives. Endress+Hauser confirms this by affixing the CE mark to it and by issuing the CE declaration of conformity.

C-tick mark

The measuring system meets the EMC requirements of the "Australian Communications and Media Authority (ACMA)".

Ex certification

Information on the currently available Ex-rated versions (ATEX, FM, CSA, etc.) is available on request from your Endress+Hauser sales outlet. All information relevant to explosion protection is available in separate documents that you can order as necessary.

Sanitary compatibility

No applicable approvals or certification

Pressure measuring device approval

All measuring devices, including those with a nominal diameter smaller than or equal to DN 25, correspond to Article 3(3) of the EC Directive 97/23/EC (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice. For nominal diameters greater than DN 25 (depending on the fluid and process pressure), there are additional optional approvals according to category II/III.

FOUNDATION Fieldbus certification

The flow device has successfully passed all the test procedures carried out and is certified and registered by the Fieldbus Foundation. The device thus meets all the requirements of the following specifications:

- Certified to FOUNDATION Fieldbus Specification
- The device meets all the specifications of the FOUNDATION Fieldbus H1
- Interoperability Test Kit (ITK), revision status 5.0 (device certification number: on request)
- The device can also be operated with certified devices of other manufacturers
- Physical Layer Conformance Test of the Fieldbus Foundation

PROFIBUS PA certification

The flowmeter has successfully passed all the test procedures carried out and is certified and registered by the PNO (PROFIBUS User Organization). The device thus meets all the requirements of the following specifications:

- Certified in accordance with PROFIBUS Profile Version 3.0 (device certification number: available on request)
- The measuring device can also be operated with certified devices of other manufacturers (interoperability)

Other standards, guidelines

- EN 60529
  Degrees of protection by housing (IP code)
- EN 61010-1
  Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures
- IEC/EN 61326
  "Emission in accordance with requirements for class A".
  Electromagnetic compatibility (EMC requirements).
- NAMUR NE 21
  Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.
- NAMUR NE 43
  Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53
  Software of field devices and signal-processing devices with digital electronics.

Ordering information

The Endress+Hauser service organization can provide detailed ordering information and information on specific order codes on request.

Accessories

Various accessories are available for the transmitter and the sensor. These can be ordered separately from Endress+Hauser.

Note!
For detailed information on specific order codes, please contact the Endress+Hauser service organization.

Supplementary documentation

- Flow Measurement (FA005D/06/en)
- Operating Instructions Promag 55 (BA119D/06/en, BA120D/06/en)
- Operating Instructions Promag 55 PROFIBUS PA (BA124D/06/en, BA125D/06/en)
- Operating Instructions Promag 53 FOUNDATION Fieldbus (BA126D/06/en, BA127D/06/en)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA

Registered trademarks

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PROFIBUS®
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