

# Technical Information

## Proline Promag 10P

Electromagnetic flowmeter



### Flow measurement of liquids in chemical or process applications

#### Application

Electromagnetic flowmeter for bidirectional measurement of liquids with a minimum conductivity of  $\geq 50 \mu\text{S}/\text{cm}$ :

- Acid, alkalis
- Paints
- Pastes
- Water, wastewater etc.
- Flow measurement up to  $9600 \text{ m}^3/\text{h}$  (42268 gal/min)
- Fluid temperature up to  $+130 \text{ }^\circ\text{C}$  (266  $^\circ\text{F}$ )
- Process pressures up to 40 bar (580 psi)
- Lengths in accordance with DVGW/ISO

Application-specific lining material:

- PTFE

#### 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 uniform Proline transmitter concept comprises:

- High degree of reliability and measuring stability
- Uniform operating concept

The tried-and-tested Promag sensors offer:

- No pressure loss
- Not sensitive to vibrations
- Simple installation and commissioning

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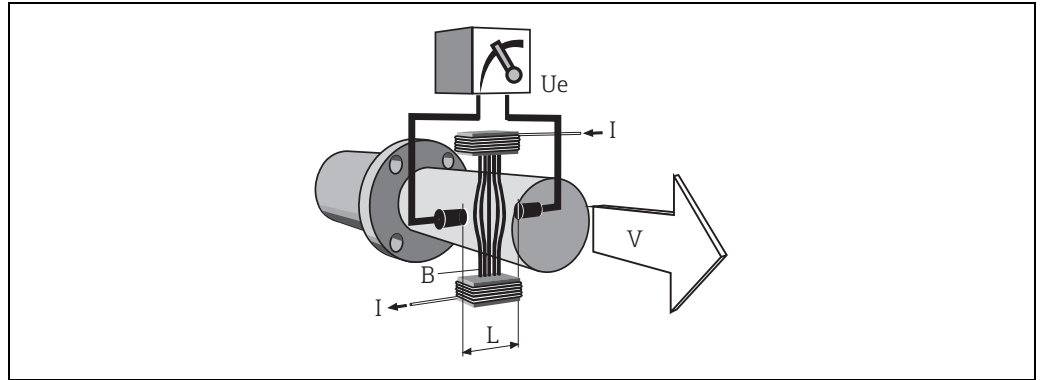
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## Function and system design

### Measuring principle

Following *Faraday's law of magnetic induction*, a voltage is induced in a conductor moving through a magnetic field.

In the electromagnetic measuring principle, the flowing medium is the moving conductor. The voltage induced is proportional to the flow velocity and is supplied to the amplifier by means of two measuring electrodes. The flow volume is calculated by means of the pipe cross-sectional area. The DC magnetic field is created through a switched direct current of alternating polarity.



$$U_e = B \cdot L \cdot v$$

$$Q = A \cdot v$$

$U_e$	Induced voltage
$B$	Magnetic induction (magnetic field)
$L$	Electrode spacing
$v$	Flow velocity
$Q$	Volume flow
$A$	Pipe cross-section
$I$	Current strength

### Measuring system

The measuring system consists of a transmitter and a sensor.

Two versions are available:

- Compact version: Transmitter and sensor form a mechanical unit.
- Remote version: Sensor is mounted separate from the transmitter.

Transmitter:

- Promag 10 (key operation, two-line, unilluminated display)

Sensor:

- Promag P (DN 25 to 600 / 1 to 24")

## Input

### Measured variable

Flow velocity (proportional to induced voltage)

### Measuring ranges

Measuring ranges for liquids  
Typically  $v = 0.01$  to  $10$  m/s ( $0.03$  to  $33$  ft/s) with the specified accuracy

### Operable flow range

Over 1000 : 1

## Output

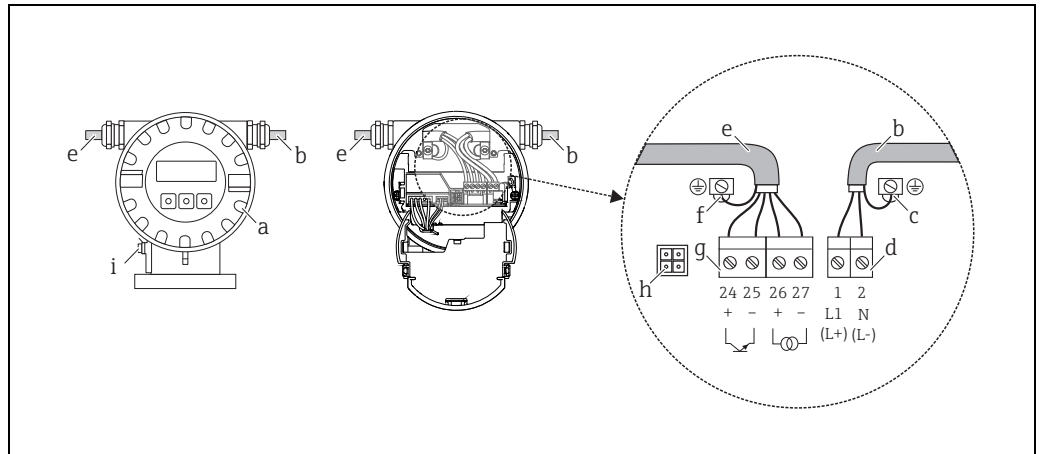
<b>Output signal</b>	<p><b>Current output</b></p> <ul style="list-style-type: none"> <li>▪ Galvanically isolated</li> <li>▪ Active: 4 to 20 mA, <math>R_L &lt; 700 \Omega</math> (for HART: <math>R_L \geq 250 \Omega</math>)</li> <li>▪ Full scale value adjustable</li> <li>▪ Temperature coefficient: typ. <math>2 \mu\text{A}/^\circ\text{C}</math>, resolution: <math>1.5 \mu\text{A}</math></li> </ul> <p><b>Pulse/status output</b></p> <ul style="list-style-type: none"> <li>▪ Galvanically isolated</li> <li>▪ Passive: 30 V DC/250 mA</li> <li>▪ Open collector</li> <li>▪ Can be configured as:           <ul style="list-style-type: none"> <li>– Pulse output: Pulse value and pulse polarity can be selected, max. pulse width adjustable (5 to 2000 ms), pulse frequency max. 100 Hz</li> <li>– Status output: for example, can be configured for error messages, empty pipe detection, flow recognition, limit value</li> </ul> </li> </ul>
<b>Signal on alarm</b>	<ul style="list-style-type: none"> <li>▪ Current output → Failsafe mode can be selected</li> <li>▪ Pulse output → Failsafe mode can be selected</li> <li>▪ Status output → "Not conductive" in the event of fault or power supply failure</li> </ul>
<b>Load</b>	See "output signal"
<b>Low flow cutoff</b>	Switch-on points for low flow are selectable.
<b>Galvanic isolation</b>	All circuits for inputs, outputs and power supply are galvanically isolated from each other

## Power supply

<b>Terminal assignment</b>	Terminal No.						
	Order code for "Input / Output"	24 (+)	25 (-)	26 (+)	27 (-)	1 (L1/L+)	2 (N/L-)
	A	Pulse/status output		HART current output		Power supply	
Functional values	→ 4, Section "output signal"				→ 4 Section "Supply voltage"		

<b>Supply voltage</b>	<ul style="list-style-type: none"> <li>▪ 85 to 250 V AC, 45 to 65 Hz</li> <li>▪ 20 to 28 V AC, 45 to 65 Hz</li> <li>▪ 11 to 40 V DC</li> </ul>
<b>Power consumption</b>	<ul style="list-style-type: none"> <li>▪ 85 to 250 V AC: &lt; 12 VA (incl. sensor)</li> <li>▪ 20 to 28 V AC: &lt; 8 VA (incl. sensor)</li> <li>▪ 11 to 40 V DC: &lt; 6 W (incl. sensor)</li> </ul> <p>Switch-on current:</p> <ul style="list-style-type: none"> <li>▪ Max. 16 A (&lt; 5 ms) for 250 V AC</li> <li>▪ Max. 5.5 A (&lt; 5 ms) for 28 V AC</li> <li>▪ Max. 3.3 A (&lt; 5 ms) for 24 V DC</li> </ul>
<b>Power supply failure</b>	Lasting min. ½ cycle frequency: EEPROM saves measuring system data

**Electrical connection, measuring unit**

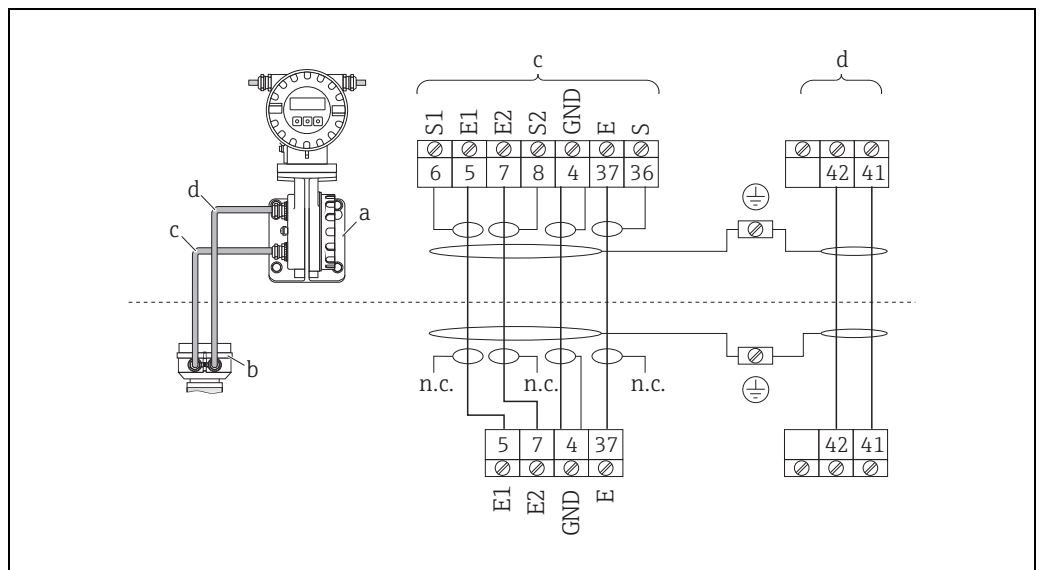


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Connecting the transmitter (aluminum field housing), cable cross-section max. 2.5 mm<sup>2</sup> (14 AWG)

- a Electronics compartment cover
- b Power supply cable
- c Ground terminal for power supply cable
- d Terminal connector for power supply cable
- e Electrode cable
- f Ground terminal for electrode cable
- g Terminal connector for electrode cable
- h Service connector for connecting service interface FXA 193 (Fieldcheck, FieldCare)
- i Ground terminal for potential equalization

**Electrical connection, remote version**



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Connecting the remote version

- a Wall-mount housing connection compartment
- b Sensor connection housing cover
- c Electrode cable
- d Coil current cable
- n.c. Not connected, insulated cable shields

Terminal numbers and cable colours:  
5/6 = brown, 7/8 = white, 4 = green, 37/36 = yellow

## Potential equalization



### Note!


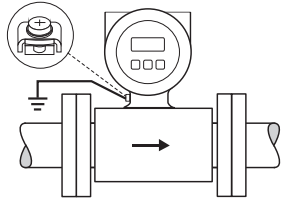
The measuring system must be included in the potential equalization.

Perfect measurement is only ensured when the fluid and the sensor have the same electrical potential. This is ensured by the reference electrode integrated in the sensor as standard.


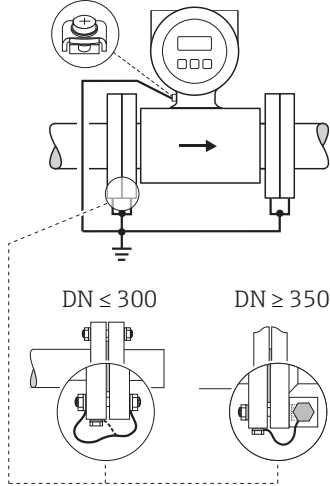
The following should also be taken into consideration for potential equalization:

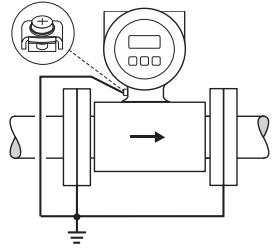
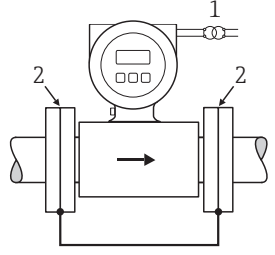
- Internal grounding concepts in the company
- Operating conditions, such as the material/ grounding of the pipes (see table)

### Standard situation

Operating conditions	Potential equalization
<p>When using the measuring device in a:</p> <ul style="list-style-type: none"> <li>■ Metal, grounded pipe</li> </ul> <p>Potential equalization takes place via the ground terminal of the transmitter.</p> <p> <b>Note!</b> When installing in metal pipes, we recommend you connect the ground terminal of the transmitter housing with the piping.</p>	 <p style="text-align: right;">A0010831</p> <p style="text-align: center;"><i>Via the ground terminal of the transmitter</i></p>

### Special situations

Operating conditions	Potential equalization
<p>When using the measuring device in a:</p> <ul style="list-style-type: none"> <li>■ Metal pipe that is not grounded</li> </ul> <p>This connection method also applies in situations where:</p> <ul style="list-style-type: none"> <li>■ Customary potential equalization cannot be ensured.</li> <li>■ Excessively high equalizing currents can be expected.</li> </ul> <p>Both sensor flanges are connected to the pipe flange by means of a ground cable (copper wire, at least 6 mm<sup>2</sup> / 0.0093 in<sup>2</sup>) and grounded. Connect the transmitter or sensor connection housing, as applicable, to ground potential by means of the ground terminal provided for the purpose.</p> <ul style="list-style-type: none"> <li>■ DN ≤ 300 (12"): the ground cable is mounted directly on the conductive flange coating with the flange screws.</li> <li>■ DN ≥ 350 (14"): the ground cable is mounted directly on the transportation metal support.</li> </ul> <p> <b>Note!</b> The ground cable for flange-to-flange connections can be ordered separately as an accessory from Endress+Hauser.</p>	 <p style="text-align: right;">A0010832</p> <p style="text-align: center;"><i>Via the ground terminal of the transmitter and the flanges of the pipe</i></p>

Operating conditions	Potential equalization
<p>When using the measuring device in a:</p> <ul style="list-style-type: none"> <li>■ Plastic pipe</li> <li>■ Pipe with insulating lining</li> </ul> <p>This connection method also applies in situations where:</p> <ul style="list-style-type: none"> <li>■ Customary potential equalization cannot be ensured.</li> <li>■ Excessively high equalizing currents can be expected.</li> </ul> <p>Potential equalization takes place using additional ground disks, which are connected to the ground terminal via a ground cable (copper wire, at least 6 mm<sup>2</sup> / 0.0093 in<sup>2</sup>). When installing the ground disks, please comply with the enclosed Installation Instructions.</p>	 <p style="text-align: right; font-size: small;">A0010833</p> <p><i>Via the ground terminal of the transmitter and the optionally available ground disks</i></p>
<p>When using the measuring device in a:</p> <ul style="list-style-type: none"> <li>■ Pipe with a cathodic protection unit</li> </ul> <p>The device is installed potential-free in the pipe. Only the two flanges of the pipe are connected with a ground cable (copper wire, at least 6 mm<sup>2</sup> / 0.0093 in<sup>2</sup>). Here, the ground cable is mounted directly on the conductive flange coating with flange screws.</p> <p>Note the following when installing:</p> <ul style="list-style-type: none"> <li>■ The applicable regulations regarding potential-free installation must be observed.</li> <li>■ There should be <b>no</b> electrically conductive connection between the pipe and the device.</li> <li>■ The mounting material must withstand the applicable torques.</li> </ul>	 <p style="text-align: right; font-size: small;">A0010834</p> <p><i>Potential equalization and cathodic protection</i></p> <p>1 Power supply isolation transformer 2 Electrically isolated</p>

**Cable entries**

Power supply and electrode cables (inputs/ outputs):

- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Thread for cable entries, ½" NPT, G ½"

Connecting cable for remote version:

- Cable entry M20 × 1.5 (8 to 12 mm / 0.31 to 0.47")
- Thread for cable entries, ½" NPT, G ½"

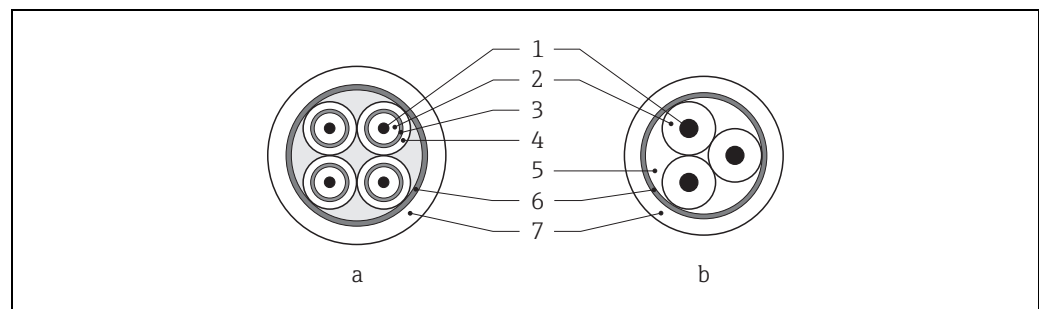
### Remote version cable specifications

#### Coil current cable

- $2 \times 0.75 \text{ mm}^2$  (18 AWG) PVC cable with common, braided copper shield ( $\varnothing \sim 7 \text{ mm} / 0.28''$ )
- Conductor resistance:  $\leq 37 \text{ } \Omega/\text{km}$  ( $\leq 0.011 \text{ } \Omega/\text{ft}$ )
- Capacitance core/core, shield grounded:  $\leq 120 \text{ pF/m}$  ( $\leq 37 \text{ pF/ft}$ )
- Operating temperature:  $-20$  to  $+80 \text{ } ^\circ\text{C}$  ( $-68$  to  $+176 \text{ } ^\circ\text{F}$ )
- Cable cross-section: max.  $2.5 \text{ mm}^2$  (14 AWG)
- Test voltage for cable insulation:  $\leq 1433 \text{ AC r.m.s. } 50/60 \text{ Hz}$  or  $\geq 2026 \text{ V DC}$

#### Electrode cable

- $3 \times 0.38 \text{ mm}^2$  (20 AWG) PVC cable with common, braided copper shield ( $\varnothing \sim 7 \text{ mm} / 0.28''$ ) and individual shielded cores
- With empty pipe detection (EPD):  $4 \times 0.38 \text{ mm}^2$  (20 AWG) PVC cable with common, braided copper shield ( $\varnothing \sim 7 \text{ mm} / 0.28''$ ) and individual shielded cores
- Conductor resistance:  $\leq 50 \text{ } \Omega/\text{km}$  ( $\leq 0.015 \text{ } \Omega/\text{ft}$ )
- Capacitance core/shield:  $\leq 420 \text{ pF/m}$  ( $\leq 128 \text{ pF/ft}$ )
- Operating temperature:  $-20$  to  $+80 \text{ } ^\circ\text{C}$  ( $-68$  to  $+176 \text{ } ^\circ\text{F}$ )
- Cable cross-section: max.  $2.5 \text{ mm}^2$  (14 AWG)



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- a Electrode 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

#### Operation in zones of severe electrical interference

The measuring device complies with the general safety requirements in accordance with EN 61010 and the EMC requirements of IEC/EN 61326.



#### Note!

Grounding is by means of the ground terminals provided for the purpose inside the connection housing. Ensure that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible.



## Performance characteristics

### Reference operating conditions

As per DIN EN 29104 and VDI/VDE 2641:

- Fluid temperature:  $+28\text{ °C} \pm 2\text{ K}$  ( $+82\text{ °F} \pm 2\text{ K}$ )
- Ambient temperature:  $+22\text{ °C} \pm 2\text{ K}$  ( $+72\text{ °F} \pm 2\text{ K}$ )
- Warm-up period: 30 minutes

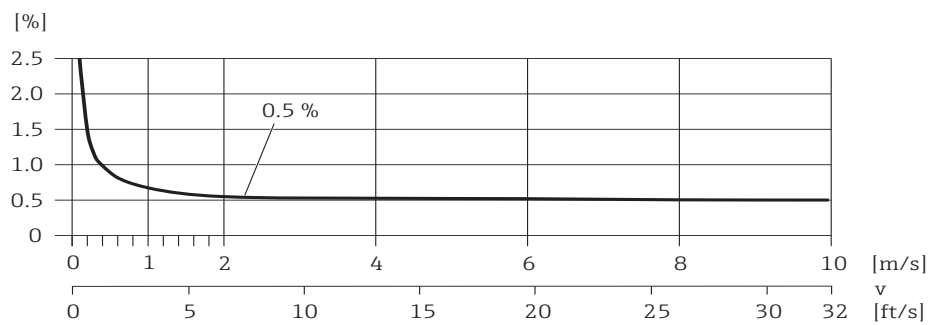
Installation conditions:

- Inlet run  $> 10 \times \text{DN}$
- Outlet run  $> 5 \times \text{DN}$
- Sensor and transmitter grounded.
- The sensor is centered in the pipe.

### Maximum measured error

- Current output: also typically  $\pm 5\ \mu\text{A}$
- Pulse output:  $\pm 0.5\%$  o.r.  $\pm 2\text{ mm/s}$  ( $\pm 0.5\%$  o.r.  $\pm 0.08\text{ in/s}$ ) (o.r. = of reading)

Fluctuations in the supply voltage do not have any effect within the specified range.



Max. measured error in % of reading

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### Repeatability

Max.  $\pm 0.2\%$  o.r.  $\pm 2\text{ mm/s}$  ( $\pm 0.2\%$  o.r.  $\pm 0.08\text{ in/s}$ ) (o.r. = of reading)

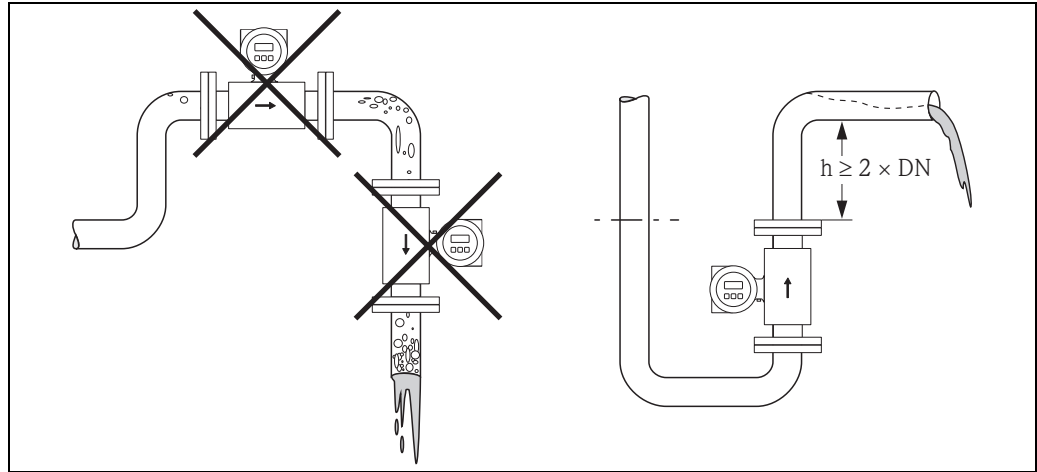
## Installation

### Mounting location

Entrained air or gas bubble formation in the measuring tube can result in an increase in measuring errors.

**Avoid** the following installation locations in the pipe:

- Highest point of a pipeline. Risk of air accumulating!
- Directly upstream from a free pipe outlet in a vertical pipeline.

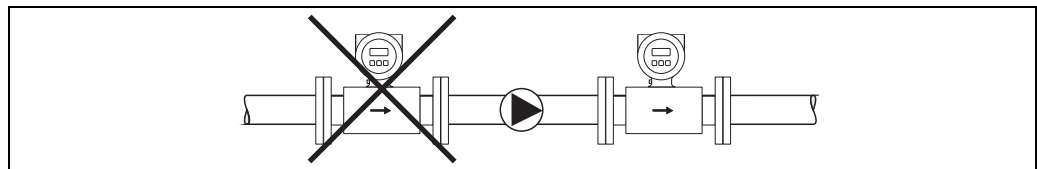


Mounting location

### Installation of pumps

Sensors may not be installed on the pump suction side. This precaution is to avoid low pressure and the consequent risk of damage to the lining of the measuring tube. Information on the pressure tightness of the measuring tube lining → 18, Section "Pressure tightness".

Pulsation dampers may be needed when using piston pumps, piston diaphragm pumps or hose pumps. Information on the shock and vibration resistance of the measuring system → 14, Section "Shock and vibration resistance".



Installation of pumps

### Partially filled pipes

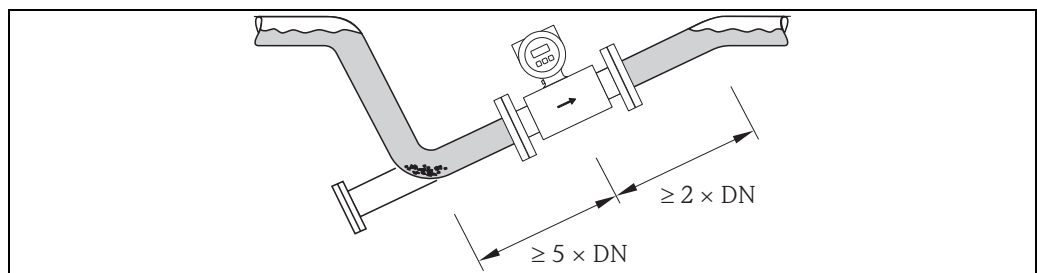
Partially filled pipes with gradients necessitate a drain-type configuration.

The empty pipe detection function (EPD) provides additional security in detecting empty or partially filled pipes.



Note!

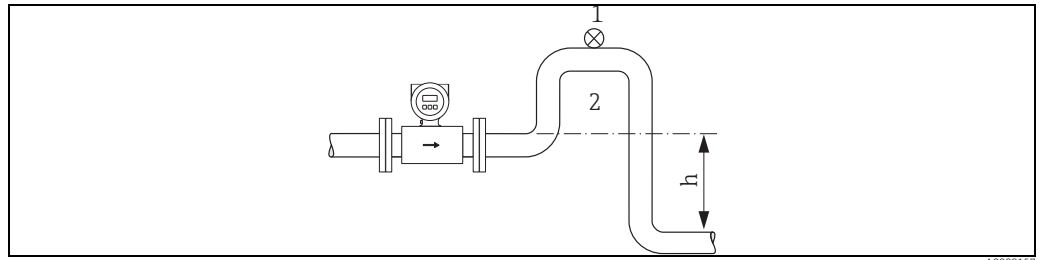
Risk of solids accumulating. Do not install the sensor at the lowest point in the drain. It is advisable to install a cleaning valve.



Installation with partially filled pipes

### Down pipes

Install a siphon or a vent valve downstream of the sensor in down pipes  $h \geq 5$  m (16.4 ft). 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 liquid current stopping in the pipe which could cause air locks. Information on the pressure tightness of the measuring tube lining → 18, "Pressure tightness".



Installation measures for vertical pipes

- 1 Vent valve
- 2 Pipe siphon
- h Length of the down pipe

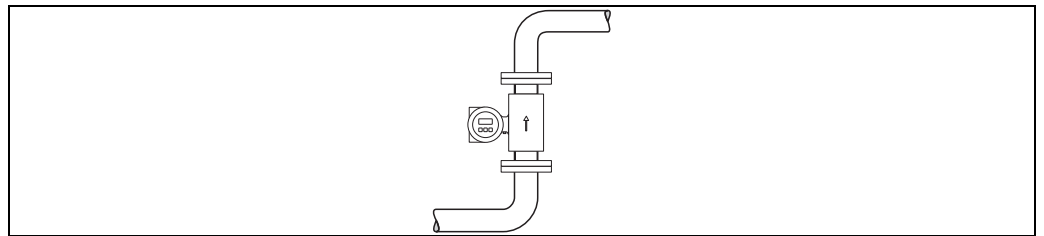
### Orientation

#### Orientation

An optimum orientation helps avoid gas and air accumulations and deposits in the measuring tube. However, the measuring device also offers the additional function of empty pipe detection (EPD) for detecting partially filled measuring tubes or if outgassing fluids or fluctuating operating pressures are present.

#### Vertical orientation

This is the ideal orientation for self-emptying piping systems and for use in conjunction with empty pipe detection.



Vertical orientation

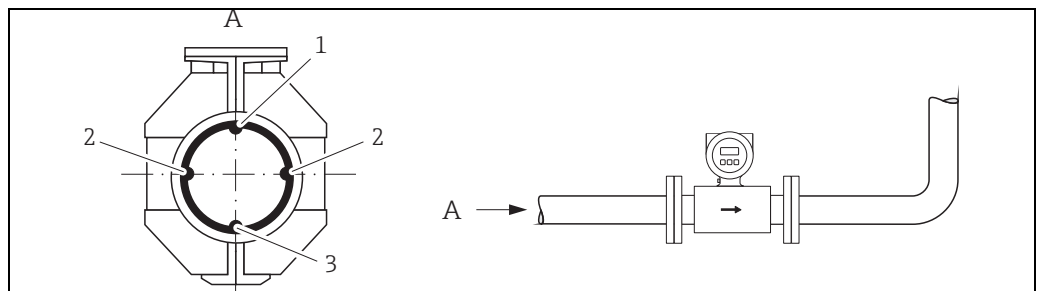
#### Horizontal orientation

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



#### Note!

Empty pipe detection only works correctly with horizontal orientation if the transmitter housing is facing upwards. Otherwise there is no guarantee that empty pipe detection will respond if the measuring tube is only partially filled or empty.



Horizontal orientation

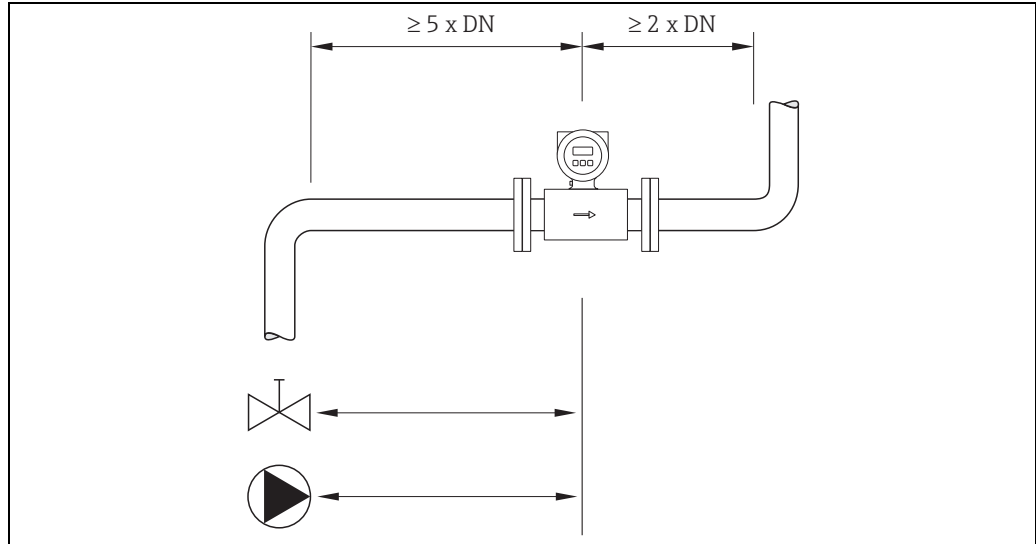
- 1 EPD electrode for empty pipe detection
- 2 Measuring electrodes for signal detection
- 3 Reference electrode for potential equalization

**Inlet and outlet runs**

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

Note the following inlet and outlet runs to comply with measuring accuracy specifications:

- Inlet run:  $\geq 5 \times \text{DN}$
- Outlet run:  $\geq 2 \times \text{DN}$



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Inlet and outlet run

**Adapters**

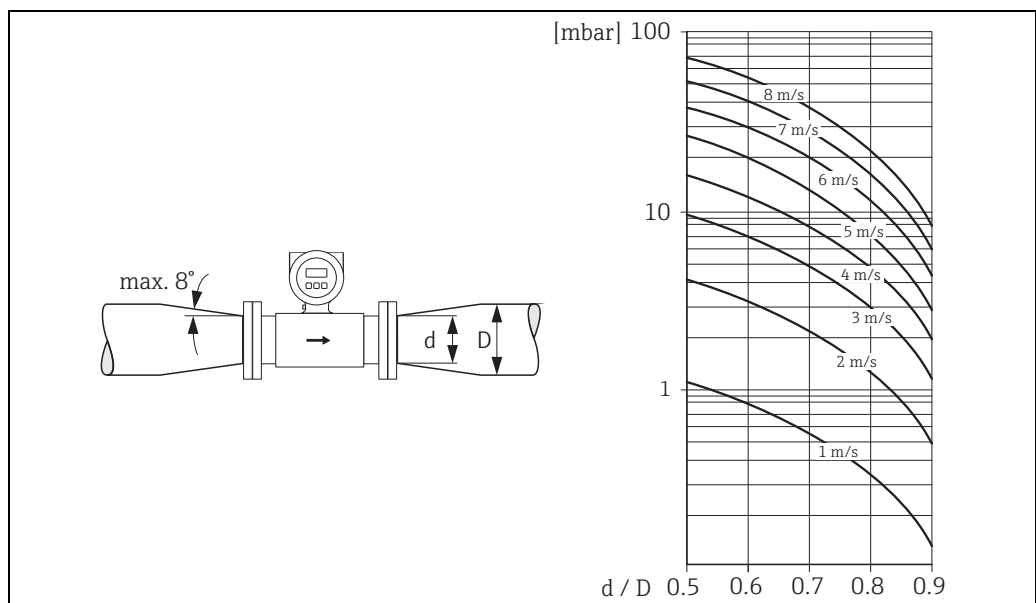
Suitable adapters to DIN EN 545 (double-flange reducers) can be used to install the sensor in larger-diameter pipes. The resultant increase in the rate of flow improves measuring accuracy with very slow-moving fluids. The nomogram shown here can be used to calculate the pressure loss caused by reducers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



Note!

The nomogram only applies to liquids 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 flow velocity (downstream from the reduction) and the  $d/D$  ratio.



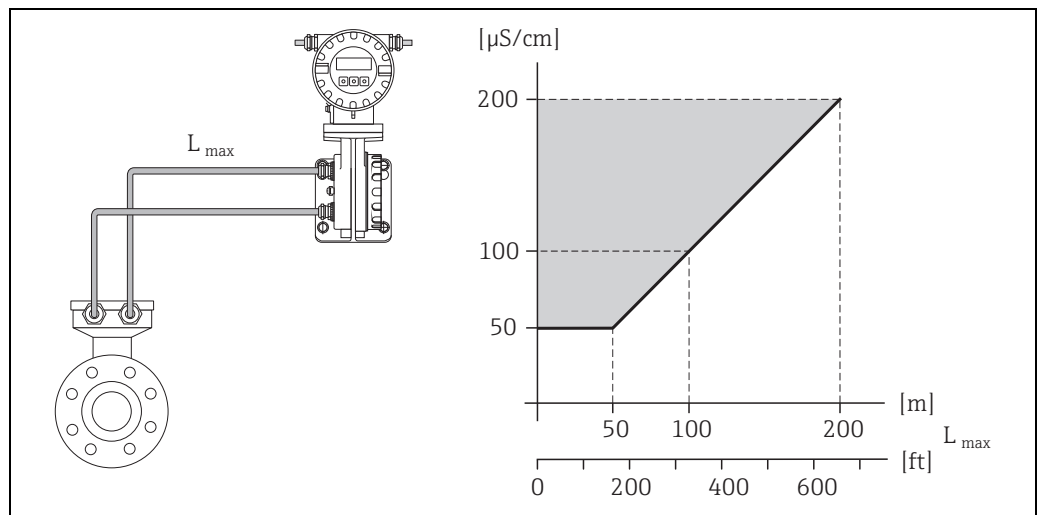
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Pressure loss due to adapters

**Length of connecting cable**

When mounting the remote version, please note the following to achieve correct measuring results:

- Fix cable run or lay in armored conduit. Cable movements can falsify the measuring signal especially in the case of low fluid conductivities.
- Route the cable well clear of electrical machines and switching elements.
- If necessary, ensure potential equalization between sensor and transmitter.
- The permitted cable length  $L_{max}$  is determined by the fluid conductivity. A minimum conductivity of  $50 \mu\text{S}/\text{cm}$  is needed for all fluids.
- When the empty pipe detection function is switched on (EPD), the maximum connecting cable length is 10 m (33 ft).






Permitted length of connecting cable for remote version

Area marked in gray = permitted range;  $L_{max}$  = length of connecting cable in [m] ([ft]); fluid conductivity in  $[\mu\text{S}/\text{cm}]$

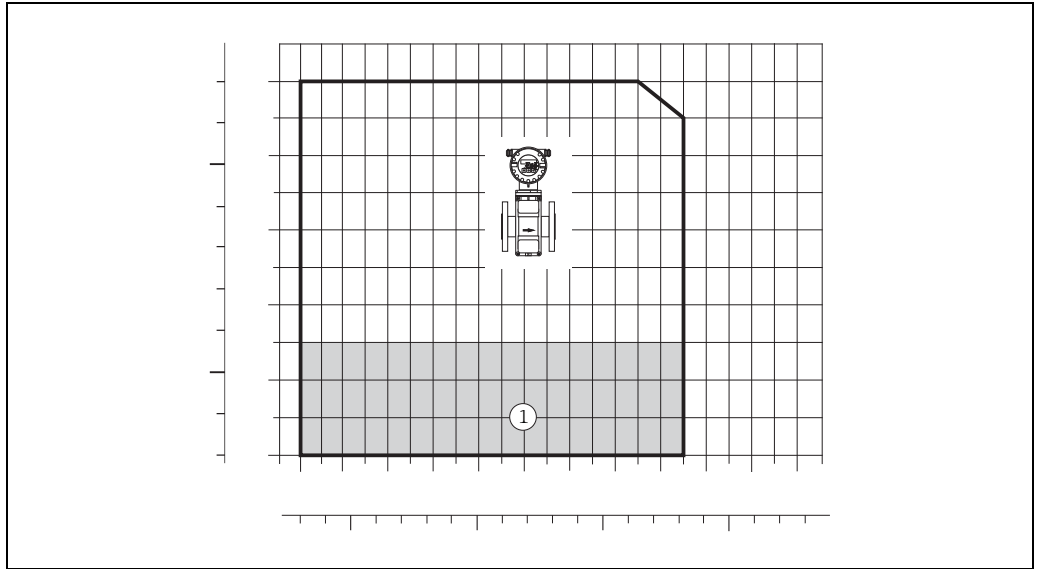
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## Environment

<b>Ambient temperature range</b>	<p><b>Transmitter</b></p> <ul style="list-style-type: none"> <li>▪ -20 to +60 °C (-4 to +140 °F)</li> </ul> <p><b>Sensor</b></p> <ul style="list-style-type: none"> <li>▪ Flange material carbon steel: -10 to +60 °C (14 to +140 °F)</li> <li>▪ Flange material stainless steel: -40 to +60 °C (-40 to +140 °F)</li> </ul> <p> Note!</p> <p>The permitted temperature range of the measuring tube lining may not be undershot or overshoot (-&gt;  15, Section "Medium temperature range").</p> <p>Please note the following points:</p> <ul style="list-style-type: none"> <li>▪ Install the device in a shady location. Avoid direct sunlight, particularly in warm climatic regions.</li> <li>▪ The transmitter must be mounted separate from the sensor if both the ambient and fluid temperatures are high.</li> </ul>
<b>Storage temperature</b>	<p>The storage temperature corresponds to the operating temperature range of the measuring transmitter and the appropriate measuring sensors.</p> <p> Note!</p> <ul style="list-style-type: none"> <li>▪ The measuring device must be protected against direct sunlight during storage in order to avoid unacceptably high surface temperatures.</li> <li>▪ A storage location must be selected where moisture does not collect in the measuring device. This will help prevent fungus and bacteria infestation which can damage the liner.</li> </ul>
<b>Degree of protection</b>	<ul style="list-style-type: none"> <li>▪ Standard: IP 67 (NEMA 4X) for transmitter and sensor.</li> <li>▪ Optional: IP 68 (NEMA 6P) for sensor for remote version.</li> <li>▪ For information regarding applications where the device is buried directly in the soil or is installed in a flooded wastewater basin please contact your local Endress+Hauser Sales Center.</li> </ul>
<b>Shock and vibration resistance</b>	<p>Acceleration up to 2 g following IEC 600 68-2-6</p>
<b>Electromagnetic compatibility (EMC)</b>	<ul style="list-style-type: none"> <li>▪ As per IEC/EN 61326</li> <li>▪ Emission: to limit value for industry EN 55011</li> </ul>

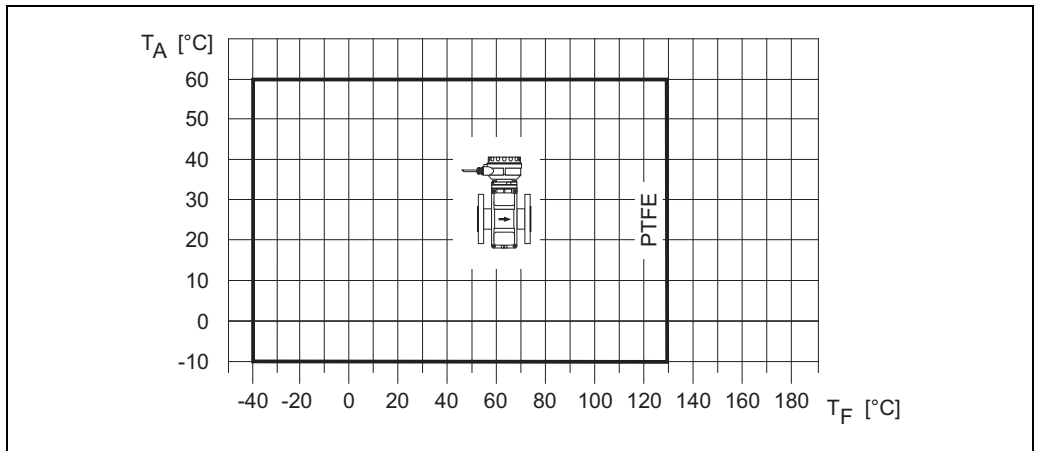
## Process

**Medium temperature range** PTFE: -40 to +130 °C (-40 to +266 °F) (DN 25 to 600 / 1 to 24"), restrictions → see diagrams



Compact version ( $T_A$  = ambient temperature range,  $T_F$  = fluid temperature)

Å = gray area → temperature range from -10 to -40 °C (-14 to -40 °F) applies only to stainless steel flanges



Remote version ( $T_A$  = ambient temperature range,  $T_F$  = fluid temperature)

### Conductivity



The minimum conductivity is:  $\geq 50 \mu\text{S}/\text{cm}$

Note!

In the remote version, the necessary minimum conductivity also depends on the cable length (→ 13, Section "Length of connecting cable").

### Pressure-temperature ratings

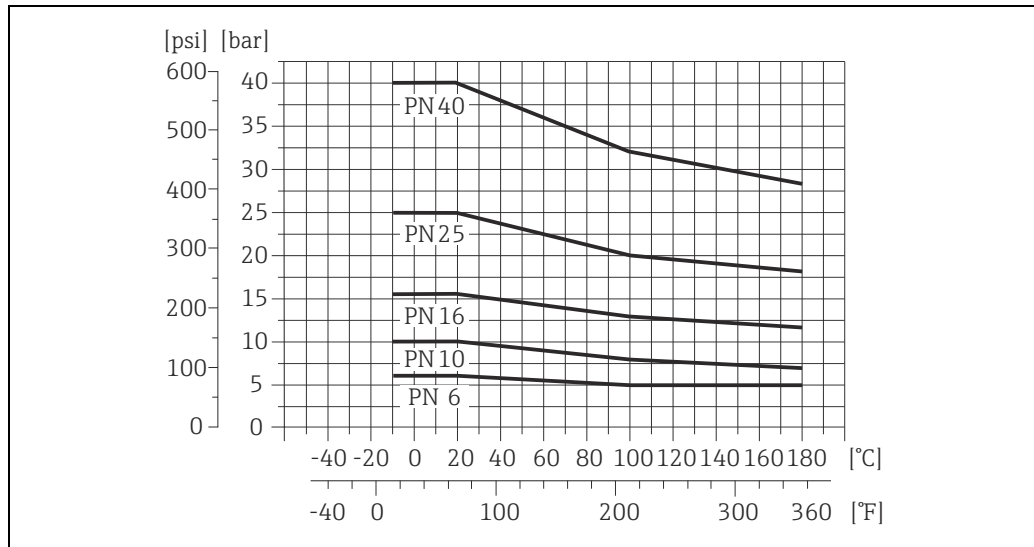


Note!

The following diagrams contain material load diagrams (reference curves) for flange materials with regard to the medium temperature. However, the maximum medium temperatures permitted always depend on the lining material of the sensor and/or the sealing material (→ 15).

**Flange connection to EN 1092-1 (DIN 2501)**

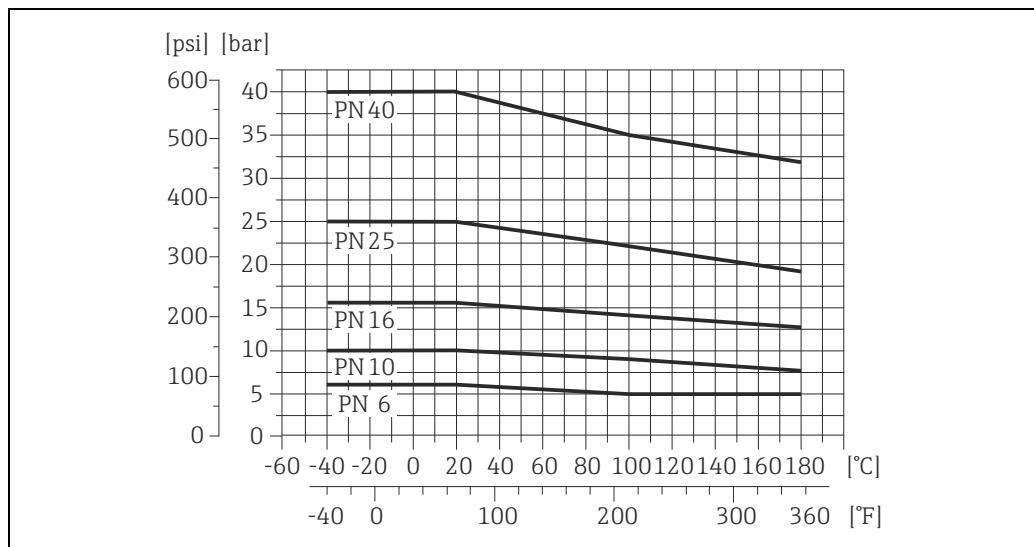
Material: S235JRG2, S235JR+N, P250GH, P245GH, E250C, A105



A0021188-EN

**Flange connection to EN 1092-1 (DIN 2501)**

Material: 1.4571, 1.4404, F316L

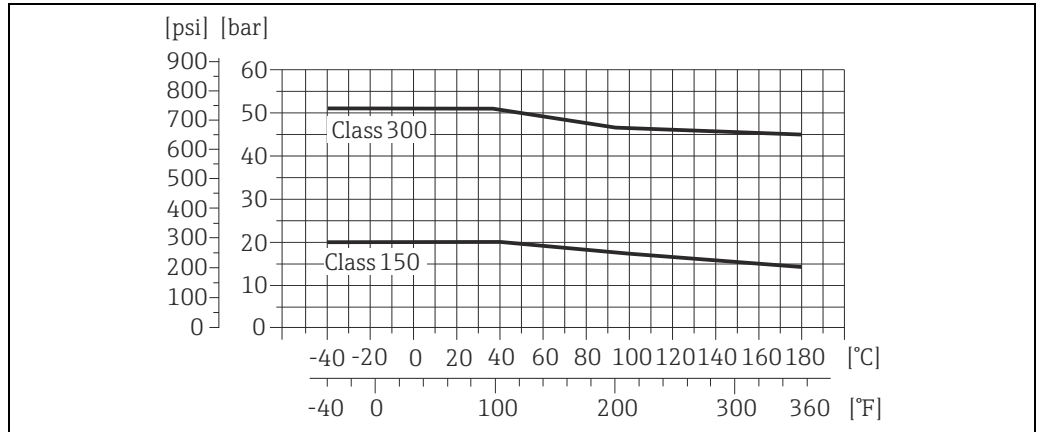


A0021184-EN



**Flange connection to ASME B16.5**

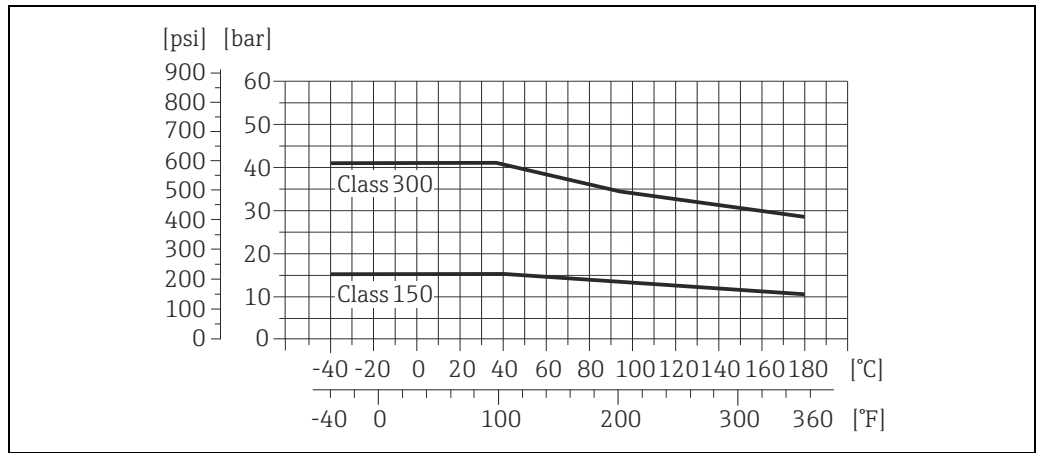
Material: A 105



A0021182-EN

**Flange connection to ASME B16.5**

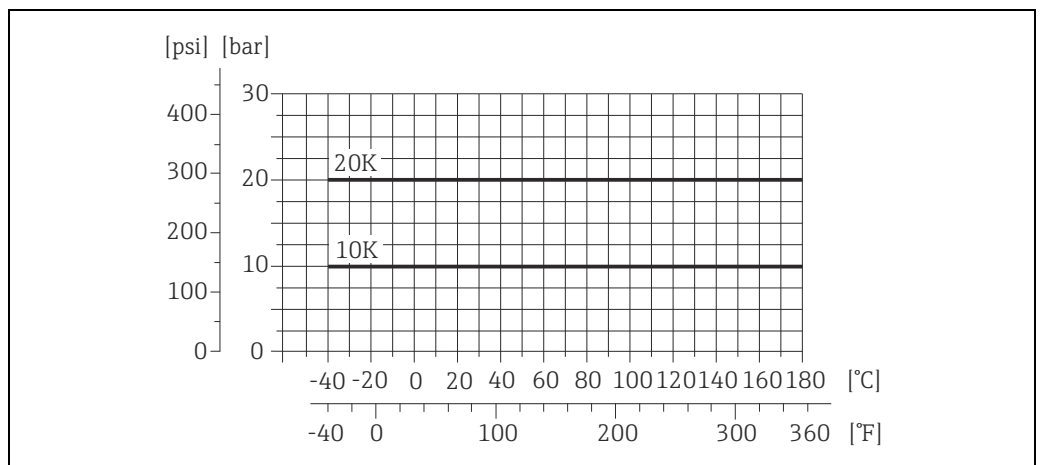
Material: F316L



A0021185-EN

**Flange connection to JIS B2220**

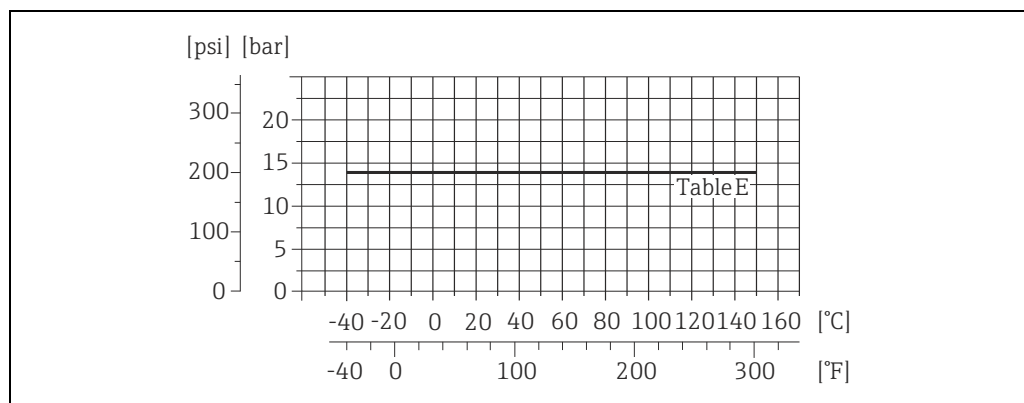
Material: A105, A350 LF2, F316L



A0021183-EN

**Flange connection to AS 2129 Table E**

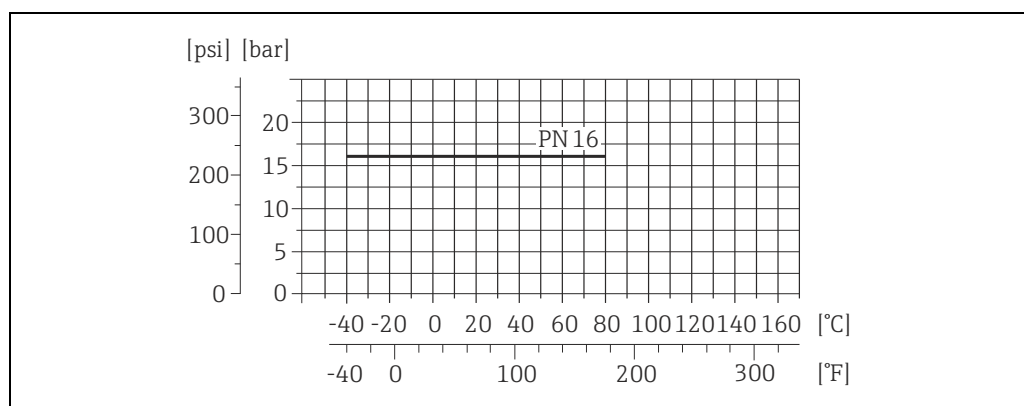
Material: A105, P235GH, P265GH, S235JRG2



A0021189-EN

**Flange connection to AS 4087 PN 16**

Material: A105, P265GH, S275JR



A0023077-EN

**Medium pressure range  
(nominal pressure)**

- EN 1092-1 (DIN 2501)
  - PN 10 (DN 200 to 600 / 8 to 24")
  - PN 16 (DN 65 to 600 / 3 to 24")
  - PN 25 (DN 200 to 600 / 8 to 24")
  - PN 40 (DN 25 to 150 / 1 to 6")
- ASME B 16.5
  - Class 150 (DN 1 to 24")
  - Class 300 (DN 1 to 6")
- JIS B2220
  - 10 K (DN 50 to 600 / 2 to 24")
  - 20 K (DN 25 to 600 / 2 to 24")
- AS 2129
  - Table E (DN 25, 50 / 1", 2")
- AS 4087
  - PN 16 (DN 50 / 2")

**Pressure tightness***Measuring tube lining: PTFE*

Nominal diameter		Limit values for abs. pressure [mbar] ([psi]) at fluid temperatures:							
		25 °C (77 °F)		80 °C (176 °F)		100 °C (212 °F)		130 °C (266 °F)	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]
25	1"	0	0	0	0	0	0	100	1.45
32	-	0	0	0	0	0	0	100	1.45

Nominal diameter		Limit values for abs. pressure [mbar] ([psi]) at fluid temperatures:							
		25 °C (77 °F)		80 °C (176 °F)		100 °C (212 °F)		130 °C (266 °F)	
[mm]	[inch]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]	[mbar]	[psi]
40	1½"	0	0	0	0	0	0	100	1.45
50	2"	0	0	0	0	0	0	100	1.45
65	-	0	0	*	*	40	0.58	130	1.89
80	3"	0	0	*	*	40	0.58	130	1.89
100	4"	0	0	*	*	135	1.96	170	2.47
125	-	135	1.96	*	*	240	3.48	385	5.58
150	6"	135	1.96	*	*	240	3.48	385	5.58
200	8"	200	2.90	*	*	290	4.21	410	5.95
250	10"	330	4.79	*	*	400	5.80	530	7.69
300	12"	400	5.80	*	*	500	7.25	630	9.14
350	14"	470	6.82	*	*	600	8.70	730	10.6
400	16"	540	7.83	*	*	670	9.72	800	11.6
450	18"	Partial vacuum is impermissible!							
500	20"								
600	24"								

\* No value can be specified.

**Limiting flow**

The diameter of the pipe and the flow rate determine the nominal diameter of the sensor. The optimum flow velocity is between 2 to 3 m/s (6.5 to 9.8 ft/s). The velocity of flow (v), moreover, has to be matched to the physical properties of the fluid:


- v < 2 m/s (6.5 ft/s): for abrasive fluids such as potter's clay, lime milk, ore slurry etc.
- v > 2 m/s (6.5 ft/s): for fluids causing build-up such as wastewater sludges etc.

Flow characteristic values (SI units)					
Diameter		Recommended flow rate Min./max. full scale value (v ~ 0.3 or 10 m/s)	Factory settings		
[mm]	[inch]		Full scale value, current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulses/s)	Low flow cut off (v ~ 0.04 m/s)
25	1"	9 to 300 dm³/min	75 dm³/min	0.50 dm³	1.00 dm³/min
32	-	15 to 500 dm³/min	125 dm³/min	1.00 dm³	2.00 dm³/min
40	1½"	25 to 700 dm³/min	200 dm³/min	1.50 dm³	3.00 dm³/min
50	2"	35 to 1100 dm³/min	300 dm³/min	2.50 dm³	5.00 dm³/min
65	-	60 to 2000 dm³/min	500 dm³/min	5.00 dm³	8.00 dm³/min
80	3"	90 to 3000 dm³/min	750 dm³/min	5.00 dm³	12.0 dm³/min
100	4"	145 to 4700 dm³/min	1200 dm³/min	10.0 dm³	20.0 dm³/min
125	-	220 to 7500 dm³/min	1850 dm³/min	15.0 dm³	30.0 dm³/min
150	6"	20 to 600 m³/h	150 m³/h	0.03 m³	2.50 m³/h
200	8"	35 to 1100 m³/h	300 m³/h	0.05 m³	5.00 m³/h
250	10"	55 to 1700 m³/h	500 m³/h	0.05 m³	7.50 m³/h
300	12"	80 to 2400 m³/h	750 m³/h	0.10 m³	10.0 m³/h
350	14"	110 to 3300 m³/h	1000 m³/h	0.10 m³	15.0 m³/h
400	16"	140 to 4200 m³/h	1200 m³/h	0.15 m³	20.0 m³/h
450	18"	180 to 5400 m³/h	1500 m³/h	0.25 m³	25.0 m³/h
500	20"	220 to 6600 m³/h	2000 m³/h	0.25 m³	30.0 m³/h

Flow characteristic values (SI units)					
Diameter		Recommended flow rate Min./max. full scale value (v ~ 0.3 or 10 m/s)	Factory settings		
[mm]	[inch]		Full scale value, current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulses/s)	Low flow cut off (v ~ 0.04 m/s)
600	24"	310 to 9600 m <sup>3</sup> /h	2500 m <sup>3</sup> /h	0.30 m <sup>3</sup>	40.0 m <sup>3</sup> /h

Flow characteristic values (US units)					
Diameter		Recommended flow rate Min./max. full scale value (v ~ 0.3 or 10 m/s)	Factory settings		
[inch]	[mm]		Full scale value, current output (v ~ 2.5 m/s)	Pulse value (~ 2 pulses/s)	Low flow cut off (v ~ 0.04 m/s)
1"	25	2.5 to 80 gal/min	18 gal/min	0.20 gal	0.25 gal/min
1½"	40	7 to 190 gal/min	50 gal/min	0.50 gal	0.75 gal/min
2"	50	10 to 300 gal/min	75 gal/min	0.50 gal	1.25 gal/min
3"	80	24 to 800 gal/min	200 gal/min	2.00 gal	2.50 gal/min
4"	100	40 to 1250 gal/min	300 gal/min	2.00 gal	4.00 gal/min
6"	150	90 to 2650 gal/min	600 gal/min	5.00 gal	12.0 gal/min
8"	200	155 to 4850 gal/min	1200 gal/min	10.0 gal	15.0 gal/min
10"	250	250 to 7500 gal/min	1500 gal/min	15.0 gal	30.0 gal/min
12"	300	350 to 10600 gal/min	2400 gal/min	25.0 gal	45.0 gal/min
14"	350	500 to 15000 gal/min	3600 gal/min	30.0 gal	60.0 gal/min
16"	400	600 to 19000 gal/min	4800 gal/min	50.0 gal	60.0 gal/min
18"	450	800 to 24000 gal/min	6000 gal/min	50.0 gal	90.0 gal/min
20"	500	1000 to gal/min 30000	7500 gal/min	75.0 gal	120. gal/min 0
24"	600	1400 to gal/min 44000	10500 gal/min	100.0 gal	180. gal/min 0

### Pressure loss


- No pressure loss if the sensor is installed in a pipe with the same nominal diameter.
- Pressure losses for configurations incorporating adapters according to DIN EN 545 (→  12, Section "Adapters").

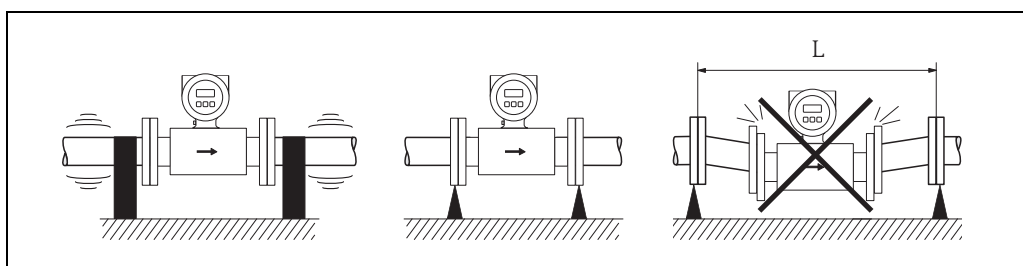
### Vibrations



Secure the piping and the sensor if vibration is severe.

Note!

If vibrations are too severe, we recommend the sensor and transmitter be mounted separately. Information on the permitted shock and vibration resistance →  14, Section "Shock and vibration resistance".



Measures to prevent vibration of the measuring device

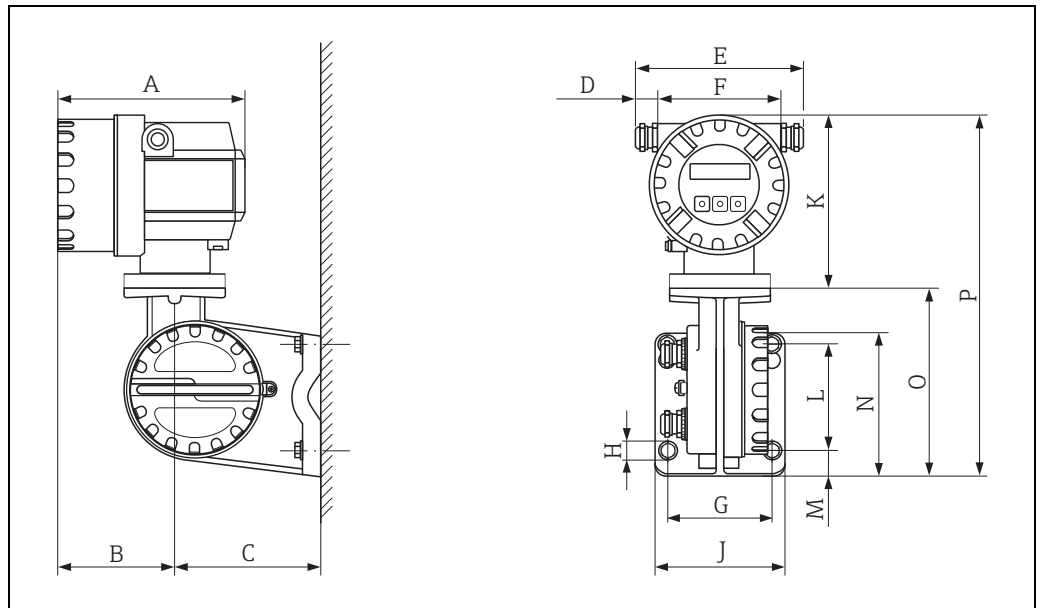
L > 10 m (33 ft)

A0003208

## Mechanical construction

### Design, dimensions

### Transmitter, remote version



A0010718

Transmitter dimensions, remote version

#### Dimensions in SI units

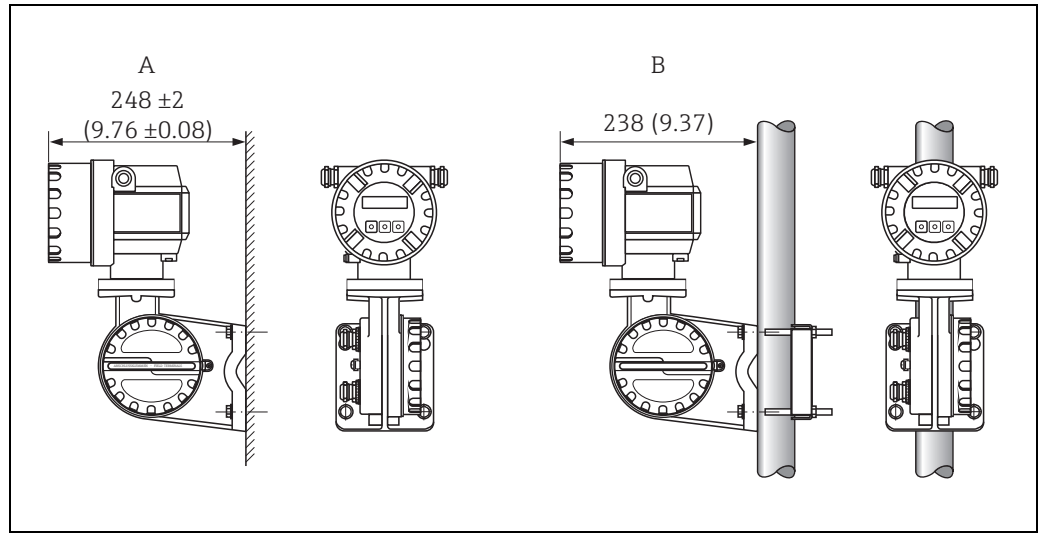
A	B	C	D	E	F	G	Ø H
178	113	135	20 to 30	161 to 181	121	100	8.6 (M8)
J	K	L	M	N	O	P	
123	150	100	25	133	177.5	327.5	

All dimensions in [mm]

#### Dimensions in US units

A	B	C	D	E	F	G	Ø H
7.00	4.45	5.31	0.79 to 1.81	6.34 to 7.13	4.76	3.94	0.34 (M8)
J	K	L	M	N	O	P	
4.84	5.90	3.94	0.98	5.24	6.99	12.89	

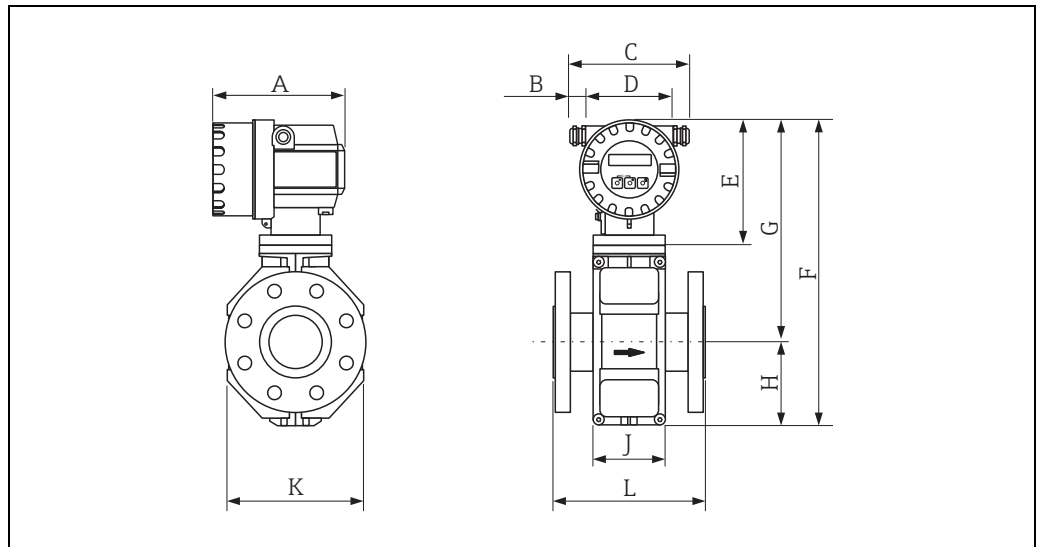
All dimensions in [inch]



Transmitter mounting, remote version. Engineering unit mm (in)

- A Direct wall mounting
- B Pipe mounting

Compact version



A0012464

Dimensions in SI units

DN EN (DIN) / JIS / AS <sup>2)</sup>	L <sup>1)</sup>	A	B	C	D	E	F	G	H	J	K
25	200	178	20 to 30	161 to 181	113	150	341	257	84	94	120
32	200						341	257	84	94	120
40	200						341	257	84	94	120
50	200						341	257	84	94	120
65	200						391	282	109	94	180
80	200						391	282	109	94	180
100	250						391	282	109	94	180
125	250						472	322	150	140	260
150	300						472	322	150	140	260
200	350						527	347	180	156	324
250	450						577	372	205	156	400
300	500						627	397	230	166	460
350	550						738.5	456.5	282	276	564
400	600						790.5	482.5	308	276	616
450	650						840.5	507.5	333	292	666
500	650						891.5	533.5	358.5	292	717
600	780	995.5	585.5	410.5	402	821					

<sup>1)</sup> The length (L) is regardless of the pressure rating selected. Fitting length to DVGW.

<sup>2)</sup> Only DN 80, 100 and 150 to 300 are available for flanges according to AS.

All dimensions in [mm]

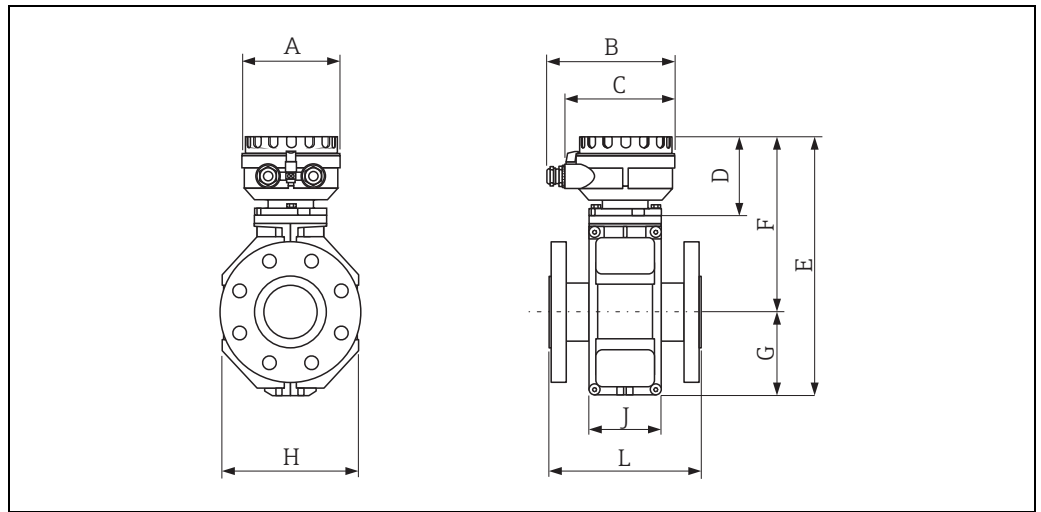
## Dimensions in US units

DN ASME	L <sup>1)</sup>	A	B	C	D	E	F	G	H	J	K
1"	7.87	7.01	0.79 to 1.81	6.34 to 7.13	4.45	5.91	13.4	10.1	3.32	3.70	4.72
1½"	7.87						13.4	10.1	3.32	3.70	4.72
2"	7.87						13.4	10.1	3.32	3.70	4.72
3"	7.87						15.4	11.1	4.30	3.70	7.10
4"	9.84						15.4	11.1	4.30	3.70	7.10
6"	11.8						18.6	12.7	5.91	5.51	10.2
8"	13.8						20.8	13.7	7.10	6.14	12.8
10"	17.7						22.7	14.7	8.08	6.14	15.8
12"	19.7						24.7	15.6	9.06	6.54	18.1
14"	21.7						29.1	18.0	11.1	10.9	22.2
16"	23.6						31.1	19.0	12.1	10.9	24.3
18"	25.6						33.1	20.0	13.1	11.5	26.2
20"	25.6						35.1	21.0	13.1	11.5	28.2
24"	30.7						39.2	23.1	16.2	15.8	32.3

<sup>1)</sup> The length (L) is regardless of the pressure rating selected. Fitting length to DVGW.  
All dimensions in [inch]



Sensor, remote version



A0012462

Dimensions in SI units

DN EN (DIN) / JIS / AS <sup>2)</sup>	L <sup>1)</sup>	A	B	C	D	E	F	G	H	J
25	200	129	163	143	102	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
350	550					683.5	401.5	282	564	276
400	600					735.5	427.5	308	616	276
450	650					785.5	452.5	333	666	292
500	650					836.5	478	358.5	717	292
600	780	940.5	530	410.5	821	402				

<sup>1)</sup> The length (L) is regardless of the pressure rating selected. Fitting length to DVGW.

<sup>2)</sup> Only DN 80, 100 and 150 to 300 are available for flanges according to AS.

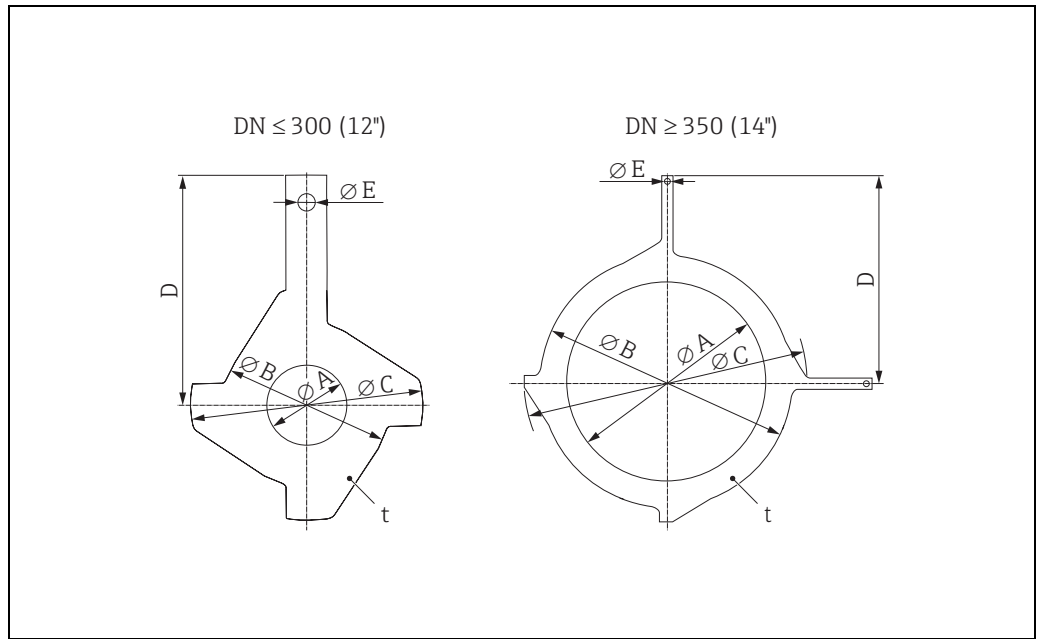
All dimensions in [mm]

*Dimensions in US units*

DN ASME	L <sup>1)</sup>	A	B	C	D	E	F	G	H	J
1"	7.87	5.08	6.42	5.63	4.02	11.3	7.95	3.32	4.72	3.70
1½"	7.87					11.3	7.95	3.32	4.72	3.70
2"	7.87					11.3	7.95	3.32	4.72	3.70
3"	7.87					13.2	8.94	4.30	7.10	3.70
4"	9.84					13.2	8.94	4.30	7.10	3.70
6"	11.8					16.4	10.5	5.91	10.2	5.51
8"	13.8					18.6	11.5	7.10	12.8	6.14
10"	17.7					20.6	12.5	8.08	15.8	6.14
12"	19.7					22.5	13.5	9.06	18.1	6.54
14"	21.7					26.9	15.8	11.1	22.2	10.9
16"	23.6					29.0	16.8	12.1	24.3	10.9
18"	25.6					30.9	17.8	13.1	26.2	11.5
20"	25.6					32.9	18.8	13.1	28.2	11.5
24"	30.7					37.0	20.9	16.2	32.3	15.8

<sup>1)</sup> The length (L) is regardless of the pressure rating selected. Fitting length to DVGW.  
All dimensions in [inch]

Ground disk for flange connections



A0003221

Dimensions (SI units)

DN <sup>1)</sup> EN (DIN) / JIS / AS <sup>2)</sup>	A	B	C	D	E	t
25	26	62	77.5	87.5	6.5	2
32	35	80	87.5	94.5		
40	41	82	101	103		
50	52	101	115.5	108		
65	68	121	131.5	118		
80	80	131	154.5	135		
100	104	156	186.5	153		
125	130	187	206.5	160		
150	158	217	256	184		
200	206	267	288	205		
250	260	328	359	240		
300 <sup>3)</sup>	312	375	413	273		
300 <sup>4)</sup>	310	375	404	268		
350 <sup>3)</sup>	343	433	479	365	9.0	
375 <sup>3)</sup>	393	480	542	395		
400 <sup>3)</sup>	393	480	542	395		
450 <sup>3)</sup>	439	538	583	417		
500 <sup>3)</sup>	493	592	650	460		
600 <sup>3)</sup>	593	693	766	522		

<sup>1)</sup> Ground disks at DN 25 to 250 (1 to 10") can be used for all flange standards/pressure ratings.

<sup>2)</sup> Only DN 25 and DN 50 are available for flanges according to AS.

<sup>3)</sup> PN 10/16

<sup>4)</sup> PN 25, JIS 10K/20K

All dimensions in [mm]

*Dimensions (US units)*

DN <sup>1)</sup> ASME	A	B	C	D	E	t
1"	1.02	2.44	3.05	3.44	0.26	0.08
1½"	1.61	3.23	3.98	4.06		
2"	2.05	3.98	4.55	4.25		
3"	3.15	5.16	6.08	5.31		
4"	4.09	6.14	7.34	6.02		
6"	6.22	8.54	10.08	7.24		
8"	8.11	10.5	11.3	8.07		
10"	10.2	12.9	14.1	9.45		
12"	12.3	14.8	16.3	10.8		
14"	13.5	17.1	18.9	14.4		
15"	15.45	18.9	21.3	15.6		
16"	15.45	18.9	21.3	15.6		
18"	17.3	21.2	23.0	16.4		
20"	19.4	23.3	25.6	18.1		
24"	23.4	27.3	30.1	20.6		

<sup>1)</sup> Ground disks can be used for all flange standards/pressure ratings.  
All dimensions in [inch]

## Weight

Weight in SI units

Weight data in kg										
Nominal diameter		Compact version			Remote version (without cable)					
		EN (DIN) / AS <sup>1)</sup>	JIS	ASME / AWWA	Sensor			Transmitter Wall-mount housing		
[mm]	[inch]				EN (DIN) / AS <sup>1)</sup>	JIS	ASME / AWWA			
25	1"	PN 40	7.3	7.3	7.3	PN 40	5.3	5.3	6.0	
32	-		8.0	7.3	-		6.0	5.3		-
40	1½"		9.4	8.3	9.4		7.4	6.3		7.4
50	2"		10.6	9.3	10.6		8.6	7.3		8.6
65	-	PN 16	12.0	11.1	-	PN 16	10.0	9.1		-
80	3"		14.0	12.5	14.0		12.0	10.5		12.0
100	4"		16.0	14.7	16.0		14.0	12.7		14.0
125	-		21.5	21.0	-		19.5	19.0		-
150	6"	PN 10	25.5	24.5	25.5	PN 10	23.5	22.5		23.5
200	8"		45	41.9	45		43	39.9		43
250	10"		65	69.4	75		63	67.4		73
300	12"		70	72.3	110		68	70.3		108
350	14"	PN 10	115	81.0	175	PN 10	113	79.0		173
400	16"		135	102	205		133	100		203
450	18"		175	130	255		173	128		253
500	20"		175	144	285		173	142		283
600	24"	235	190	405	233	188	403			

<sup>1)</sup> For flanges to AS, only DN 25 and 50 are available.

- Transmitter (compact version): 1.8 kg
- Weight data valid for standard pressure ratings and without packaging material.

Weight in US units (only ASME/ AWWA)

Nominal diameter		Compact version		Remote version (without cable)		
[mm]	[inch]	ASME / AWWA		Sensor	Transmitter	
		ASME / AWWA		ASME / AWWA	Wall-mount housing	
25	1"	Class 150	16.1	Class 150	11.7	13.2
40	1½"		20.7		16.3	
50	2"		23.4		19.0	
80	3"		30.9		26.5	
100	4"		35.3		30.9	
150	6"		56.2		51.8	
200	8"		99.2		94.8	
250	10"		165.4		161.0	
300	12"		242.6		238.1	
350	14"		385.9		381.5	
400	16"		452.0		447.6	
450	18"		562.3		557.9	
500	20"		628.4		624.0	
600	24"		893.0		888.6	

- Transmitter (compact version): 3.9 lbs
- Weight data valid for standard pressure ratings and without packaging material.

**Measuring tube specifications**

Diameter		Pressure rating					Internal diameter			
[mm]	[inch]	EN (DIN)	AS 2129	AS 4087	ASME	JIS	PFA		PTFE	
		[bar]			[lbs]		[mm]	[inch]	[mm]	[inch]
25	1"	PN 40	Table E	PN 16	Cl.150	20K	23	0.91	26	1.02
32	-	PN 40	Table E	-	-	20K	32	1.26	35	1.38
40	1½"	PN 40	-	-	Cl.150	20K	36	1.42	41	1.61
50	2"	PN 40	-	-	Cl.150	10K	48	1.89	52	2.05
65	-	PN 16	-	-	-	10K	63	2.48	67	2.64
80	3"	PN 16	-	-	Cl.150	10K	75	2.95	80	3.15
100	4"	PN 16	-	-	Cl.150	10K	101	3.98	104	4.09
125	-	PN 16	-	-	-	10K	126	4.96	129	5.08
150	6"	PN 16	-	-	Cl.150	10K	154	6.06	156	6.14
200	8"	PN 10	-	-	Cl.150	10K	201	7.91	202	7.95
250	10"	PN 10	-	-	Cl.150	10K	-	-	256	10.1
300	12"	PN 10	-	-	Cl.150	10K	-	-	306	12.0
350	14"	PN 10	-	-	Cl.150	10 K	-	-	337	13.3
400	16"	PN 10	-	-	Cl.150	10 K	-	-	387	15.2
450	18"	PN 10	-	-	Cl.150	10 K	-	-	432	17.0
500	20"	PN 10	-	-	Cl.150	10 K	-	-	487	19.2
600	24"	PN 10	-	-	Cl.150	10 K	-	23	593	23.3

<b>Material</b>	<ul style="list-style-type: none"> <li>■ Housing: powder-coated die-cast aluminum</li> <li>■ Sensor housing <ul style="list-style-type: none"> <li>- DN 25 to 300 (1 to 12"): powder-coated die-cast aluminum</li> <li>- DN 350 to 2000 (14 to 78"): with protective lacquering</li> </ul> </li> <li>■ Measuring tube <ul style="list-style-type: none"> <li>- DN ≤ 300 (12"): stainless steel 1.4301 or 1.4306 (304L); (Flange material: carbon steel with Al/Zn protective coating)</li> <li>- DN ≥ 350 (14"): stainless steel 1.4301 or 1.4306 (304L); (Flange material: carbon steel with protective lacquering)</li> </ul> </li> <li>■ Electrodes: 1.4435 (316L), Alloy C-22</li> <li>■ Flange <ul style="list-style-type: none"> <li>- EN 1092-1 (DIN2501): <ul style="list-style-type: none"> <li>- Stainless-steel, 1.4571, F316L</li> <li>- Carbon steel, S235JRG2, S235JR+N, P250GH, P245GH, E250C, A105</li> </ul> </li> <li>- ASME B16.5: A105, F316L (DN ≤ 300 with Al/Zn protective coating; DN ≥ 350 with protective lacquering)</li> <li>- JIS B2220: <ul style="list-style-type: none"> <li>- Stainless-steel, F316L</li> <li>- Carbon steel, A105, A350 LF2</li> </ul> </li> <li>- AS 2129 Carbon steel, A105, P235GH, P265GH, S235JRG2</li> <li>- AS 4087: Carbon steel, A105, P265GH, S275JR</li> </ul> </li> <li>■ Seals: to DIN EN 1514-1</li> <li>■ Ground disks: 1.4435 (316L) or Alloy C-22</li> </ul>
<b>Fitted electrodes</b>	<p>Measuring electrodes, reference electrodes and empty pipe detection electrodes available as standard with:</p> <ul style="list-style-type: none"> <li>■ 1.4435</li> <li>■ Alloy C-22</li> </ul>
<b>Process connections</b>	<p>Flange connection:</p> <ul style="list-style-type: none"> <li>■ EN 1092-1 (DIN 2501), DN ≤ 300 (12") form A, DN ≥ 350 (14") form B (Dimensions to DIN 2501, DN 65 PN 16 and DN 600 (24") PN 16 exclusively to EN 1092-1)</li> <li>■ ASME B16.5</li> <li>■ JIS B2220</li> <li>■ AS 2129 Table E</li> <li>■ AS 4087 PN 16</li> </ul>
<b>Surface roughness</b>	<p>Electrodes with 1.4435 (AISI 316L), Alloy C-22: ≤ 0.3 to 0.5 μm (≤ 11.8 to 19.7 μin) (All data refer to parts in contact with medium)</p>



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## Operability

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**Local operation****Display elements**

- Liquid crystal display: unilluminated, two-line, 16 characters per line
- Display (operating mode) preconfigured: volume flow and totalizer status
- 1 totalizer

**Operating elements**

Local operation via three keys (S, O, F)

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**Remote operation**

Operation via HART protocol and FieldCare

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## Certificates and approvals

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**CE mark**

The measuring system is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

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**C-tick symbol**

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

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**Ex approval**

Information about currently available Ex versions (ATEX, FM, CSA etc.) can be supplied by your Endress+Hauser Sales Center on request. All explosion protection data are given in a separate documentation which is available upon request.

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**Other standards and guidelines**

- EN 60529  
Degrees of protection by housing (IP code)
  - EN 61010  
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)
  - ANSI/ISA-S82.01  
Safety Standard for Electrical and Electronic Test, Measuring, Controlling and related Equipment - General Requirements Pollution degree 2, Installation Category II.
  - CAN/CSA-C22.2 No. 1010.1-92  
Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2, Installation Category II
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**Pressure measuring device approval**

Measuring devices with a nominal diameter smaller than or equal to DN 25 correspond to Article 4 (3) of the EC Directive 2014/68/EU (Pressure Equipment Directive) and have been designed and manufactured according to good engineering practice. Where necessary (depending on the medium and process pressure), there are additional optional approvals to Category II/III for larger nominal diameters.

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## Ordering information

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

## Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter and the sensor. Your Endress+Hauser service organization can provide detailed information on the order codes in question.

## Documentation

- System Information Promag 10 (SI042D/06)
- Operating Instructions Promag 10 (BA082D/06)

## Registered trademarks

HART®

Registered trademark of the HART Communication Foundation, Austin, USA

FieldCare®, Fieldcheck®

Registered or registration-pending trademarks of the Endress+Hauser Group



[www.addresses.endress.com](http://www.addresses.endress.com)

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**Endress+Hauser**   
People for Process Automation

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