Technical Information
LNGmass

Coriolis flowmeter

The flowmeter for refueling applications with simple system integration

Application

- Measuring principle operates independently of physical fluid properties such as viscosity or density
- Accurate measurement of cryogenic gases in refueling applications

Device properties

- Flow rates up to 18 000 kg/h (660 lb/min)
- Medium temperature up to −196 °C (−321 °F)
- Nominal diameter: DN 8 to 25 (⅜ to 1")
- Robust, compact transmitter housing
- Modbus RS485
- Designed to meet application needs

Your benefits

- Excellent operational safety – reliable under extreme ambient conditions
- Fewer process measuring points – multivariable measurement (flow, density, temperature)
- Space-saving installation – no in/outlet run needs
- Space-saving transmitter – full functionality on smallest footprint
- Fast commissioning – preconfigured devices
- Automatic recovery of data for servicing

Endress+Hauser
People for Process Automation

Table of contents

Document information

Symbols used

Electrical symbols

Symbol	Meaning
A0011197	**Direct current** A terminal to which DC voltage is applied or through which direct current flows.
 A0011198	**Alternating current** A terminal to which alternating voltage is applied or through which alternating current flows.
 A0017381	**Direct current and alternating current** ▪ A terminal to which alternating voltage or DC voltage is applied. ▪ A terminal through which alternating current or direct current flows.
 A0011200	**Ground connection** A grounded terminal which, as far as the operator is concerned, is grounded via a grounding system.
 A0011199	**Protective ground connection** A terminal which must be connected to ground prior to establishing any other connections.
 A0011201	**Equipotential connection** A connection that has to be connected to the plant grounding system: This may be a potential equalization line or a star grounding system depending on national or company codes of practice.

Symbols for certain types of information

Symbol	Meaning
 A0011182	**Allowed** Indicates procedures, processes or actions that are allowed.
 A0011183	**Preferred** Indicates procedures, processes or actions that are preferred.
 A0011184	**Forbidden** Indicates procedures, processes or actions that are forbidden.
 A0011193	**Tip** Indicates additional information.
 A0011194	**Reference to documentation** Refers to the corresponding device documentation.
 A0011195	**Reference to page** Refers to the corresponding page number.
 A0011196	**Reference to graphic** Refers to the corresponding graphic number and page number.
 A0015502	**Visual inspection**

Symbols in graphics

Symbol	Meaning
1, 2, 3,...	Item numbers
1. , 2. , 3. ...	Series of steps
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

Symbol	Meaning
 A0013441	Flow direction
 A0011187	**Hazardous area** Indicates a hazardous area.
 A0011188	**Safe area (non-hazardous area)** Indicates a non-hazardous area.

Function and system design

Measuring principle

The measuring principle is based on the controlled generation of Coriolis forces. These forces are always present in a system when both translational and rotational movements are superimposed.

$$F_c = 2 \cdot \Delta m\ (v \cdot \omega)$$

F_c = Coriolis force

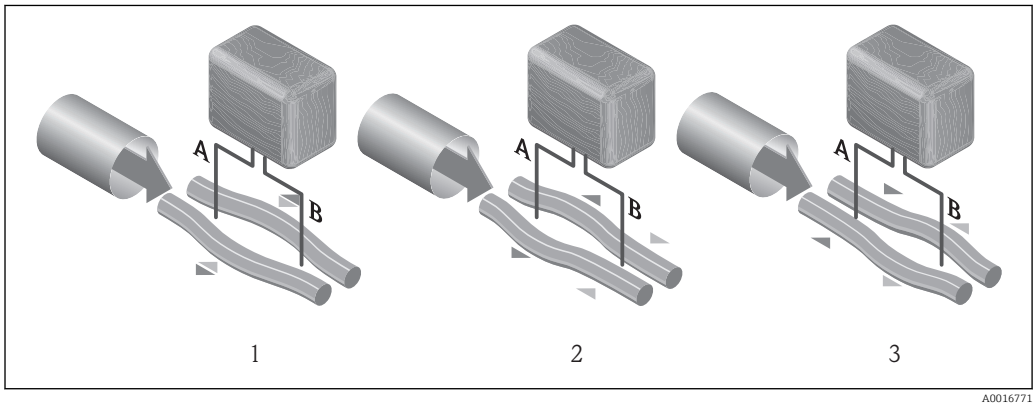
Δm = moving mass

ω = rotational velocity

v = radial velocity in rotating or oscillating system

The amplitude of the Coriolis force depends on the moving mass Δm, its velocity v in the system and thus on the mass flow. Instead of a constant rotational velocity ω, the sensor uses oscillation.

In the sensor, two parallel measuring tubes containing flowing fluid oscillate in antiphase, acting like a tuning fork. The Coriolis forces produced at the measuring tubes cause a phase shift in the tube oscillations (see illustration):
- At zero flow (when the fluid is at a standstill) the two tubes oscillate in phase (1).
- Mass flow causes deceleration of the oscillation at the inlet of the tubes (2) and acceleration at the outlet (3).



A0016771

The phase difference (A-B) increases with increasing mass flow. Electrodynamic sensors register the tube oscillations at the inlet and outlet. System balance is ensured by the antiphase oscillation of the two measuring tubes. The measuring principle operates independently of temperature, pressure, viscosity, conductivity and flow profile.

Density measurement
The measuring tube is continuously excited at its resonance frequency. A change in the mass and thus the density of the oscillating system (comprising measuring tube and fluid) results in a corresponding, automatic adjustment in the oscillation frequency. Resonance frequency is thus a function of medium density. The microprocessor utilizes this relationship to obtain a density signal.

Volume measurement
Together with the measured mass flow, this is used to calculate the volume flow.

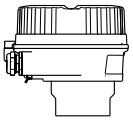
Temperature measurement
The temperature of the measuring tube is determined in order to calculate the compensation factor due to temperature effects. This signal corresponds to the process temperature and is also available as an output signal.

Measuring system

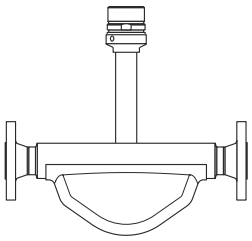
The device consists of a transmitter and a sensor. If a device with Modbus RS485 intrinsically safe is ordered, the Safety Barrier Promass 100 is part of the scope of supply and must be implemented to operate the device.

One device version is available: compact version, transmitter and sensor form a mechanical unit.

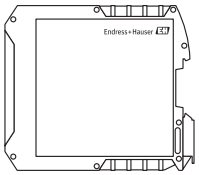
Transmitter

LNGmass  A0016693	Device versions and materials: Compact, aluminum coated: Coated aluminum AlSi10Mg Configuration: Via operating tools (e.g. FieldCare)

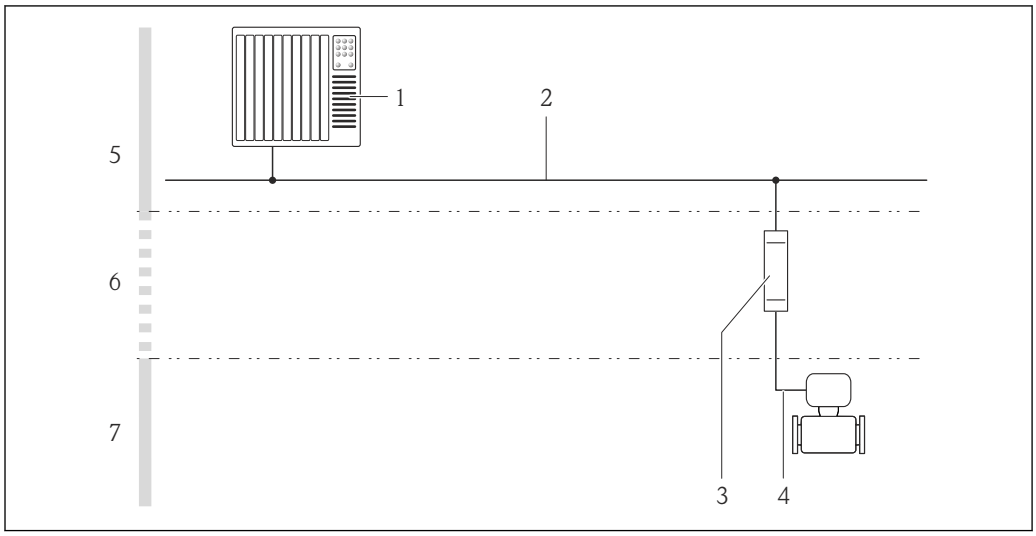
Sensor

LNGmass  A0021741	▪ Simultaneous measurement of flow, volume flow, density and temperature (multivariable) ▪ Immune to process influences ▪ Nominal diameter range: DN 8 to 25 ($^{3}/_{8}$ to 1") ▪ Materials: – Sensor: stainless steel 1.4301 (304) – Measuring tubes: stainless steel 1.4539 (904L) – Process connections: stainless steel 1.4404 (316/316L)

Safety Barrier Promass 100

 A0016763	▪ Dual-channel safety barrier for installation in non-hazardous locations or Zone 2/Div. 2: – Channel 1: DC 24 V power supply – Channel 2: Modbus RS485 ▪ In addition to current, voltage and power limitation, it offers galvanic isolation of circuits for explosion protection. ▪ Easy top-hat rail mounting (DIN 35mm) for installation in control cabinets

Device architecture



1 Possibilities for integrating measuring devices into a system

1 Control system (e.g. PLC)
2 Modbus RS485
3 Safety Barrier Promass 100
4 Modbus RS485 intrinsically safe
5 Non-hazardous area
6 Non-hazardous area and Zone 2/Div. 2
7 Intrinsically safe area and Zone 1/Div. 1

Input

Measured variable

Direct measured variables

- Mass flow
- Density
- Temperature

Calculated measured variables

- Volume flow
- Corrected volume flow
- Reference density

Measuring range

Measuring ranges for liquids

DN		Measuring range full scale values $\dot{m}_{min(F)}$ to $\dot{m}_{max(F)}$	
[mm]	[in]	[kg/h]	[lb/min]
8	⅜	0 to 2 000	0 to 73.5
15	½	0 to 6 500	0 to 238
25	1	0 to 18 000	0 to 660

Recommended measuring range

"Flow limit" section (→ 21)

Operable flow range

Over 1000 : 1.

Flow rates above the preset full scale value are not overridden by the electronics unit, with the result that the totalizer values are registered correctly.

Output

Output signal

Modbus RS485

Physical interface	In accordance with EIA/TIA-485-A standard
Terminating resistor	Integrated, can be activated via DIP switch on the transmitter electronics module

Signal on alarm

Depending on the interface, failure information is displayed as follows:

Modbus RS485

Failure mode	Choose from: ▪ NaN value instead of current value ▪ Last valid value

Operating tool

Via service interface

Plain text display	With information on cause and remedial measures

Additional information on remote operation (→ 28)

Light emitting diodes (LED)

Status information	Status indicated by various light emitting diodes The following information is displayed depending on the device version: ▪ Supply voltage active ▪ Data transmission active ▪ Device alarm/error has occurred

Ex connection data

These values only apply for the following device version:
Order code for "Output", option **M**: Modbus RS485, for use in intrinsically safe areas

Safety Barrier Promass 100

Safety-related values

Terminal numbers			
Supply voltage		**Signal transmission**	
2 (L-)	**1 (L+)**	**26 (A)**	**27 (B)**
U_{nom} = DC 24 V U_{max} = AC 260 V		U_{nom} = DC 5 V U_{max} = AC 260 V	

Intrinsically safe values

Terminal numbers			
Supply voltage		**Signal transmission**	
20 (L-)	**10 (L+)**	**62 (A)**	**72 (B)**
U_o = 16.24 V I_o = 623 mA P_o = 2.45 W For IIC*: L_o = 92.8 µH, C_o = 0.433 µF, L_o/R_o = 14.6 µH/Ω			
* The gas group depends on the sensor and nominal diameter. For an overview and for information on the interdependencies between the gas group - sensor - nominal diameter, see the "Safety Instructions" (XA) document for the measuring device			

Transmitter

Intrinsically safe values

Order code for "Approvals"	Terminal numbers			
	Supply voltage		Signal transmission	
	20 (L-)	10 (L+)	62 (A)	72 (B)
▪ Option **BM**: ATEX II2G + IECEx Z1 Ex ia, II2D Ex tb ▪ Option **BU**: ATEX II2G + IECEx Z1 Ex ia ▪ Option **C2**: CSA C/US IS Cl. I, II, III Div. 1 ▪ Option **85**: ATEX II2G + IECEx Z1 Ex ia + CSA C/US IS Cl. I, II, III Div. 1	U_i = 16.24 V I_i = 623 mA P_i = 2.45 W L_i = 0 µH C_i = 6 nF			
* The gas group depends on the sensor and nominal diameter. For an overview and for information on the interdependencies between the gas group - sensor - nominal diameter, see the "Safety Instructions" (XA) document for the measuring device				

Low flow cut off

The switch points for low flow cut off are user-selectable.

Galvanic isolation

The following connections are galvanically isolated from each other:
- Outputs
- Power supply

Protocol-specific data

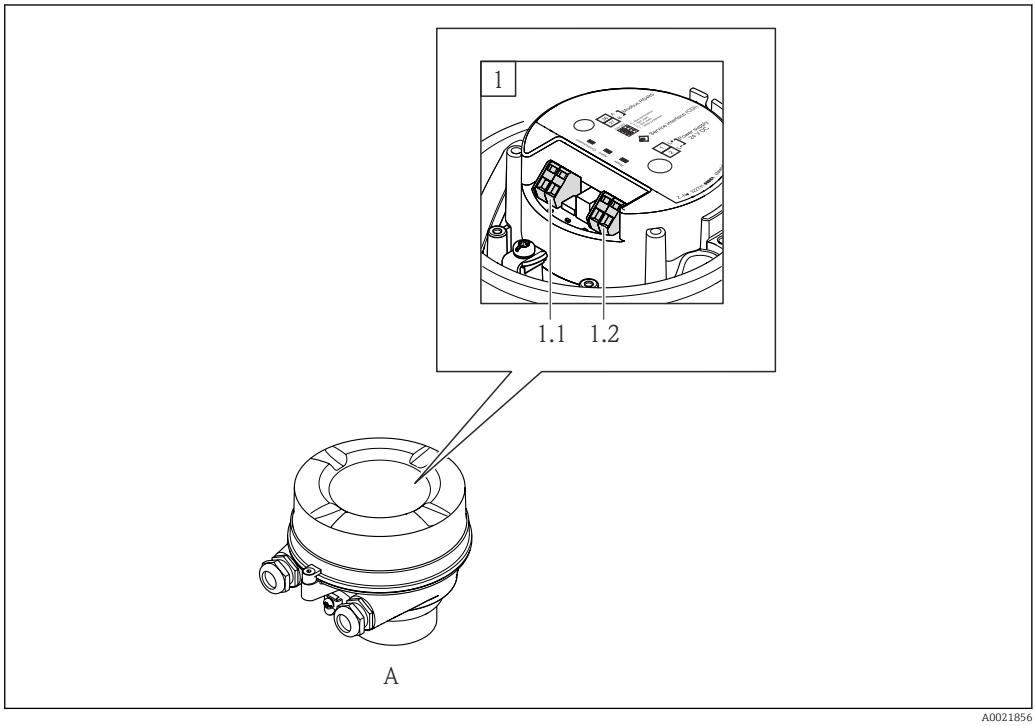
Modbus RS485

Protocol	Modbus Applications Protocol Specification V1.1
Device type	Slave
Slave address range	1 to 247
Broadcast address range	0
Function codes	▪ 03: Read holding register ▪ 04: Read input register ▪ 06: Write single registers ▪ 08: Diagnostics ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Broadcast messages	Supported by the following function codes: ▪ 06: Write single registers ▪ 16: Write multiple registers ▪ 23: Read/write multiple registers
Supported baud rate	▪ 1200 BAUD ▪ 2400 BAUD ▪ 4800 BAUD ▪ 9600 BAUD ▪ 19200 BAUD ▪ 38400 BAUD ▪ 57600 BAUD ▪ 115200 BAUD
Data transfer mode	▪ ASCII ▪ RTU
Data access	Each device parameter can be accessed via Modbus RS485. For Modbus register information (→ 30)

Power supply

Terminal assignment

Overview: housing version



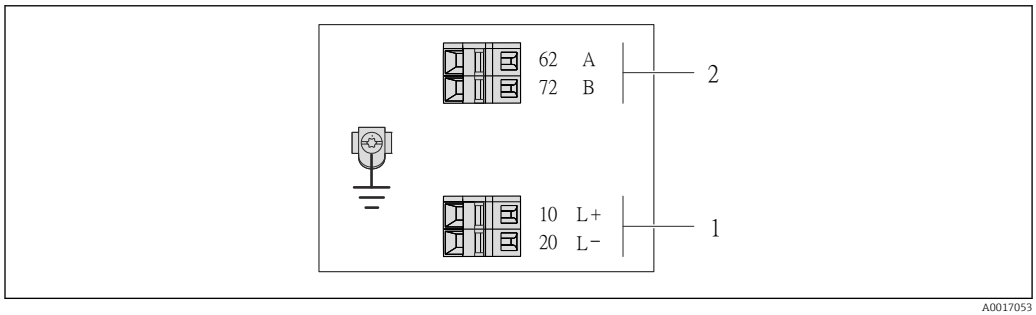
A Housing version: compact, aluminum coated
1 Connection version: Modbus RS485
1.1 Signal transmission
1.2 Supply voltage

Transmitter

Modbus RS485 connection version, for use in intrinsically safe areas

Order code for "Output", option **M** (connection via Safety Barrier Promass 100)

Order code for "Housing"	Connection methods available		Possible options for order code "Electrical connection"
	Output	Power supply	
Options **A**	Terminals	Terminals	▪ Option **B**: thread M20x1 ▪ Option **C**: thread G ½" ▪ Option **D**: thread NPT ½"
Order code for "Housing": Option **A**: compact, coated aluminum			

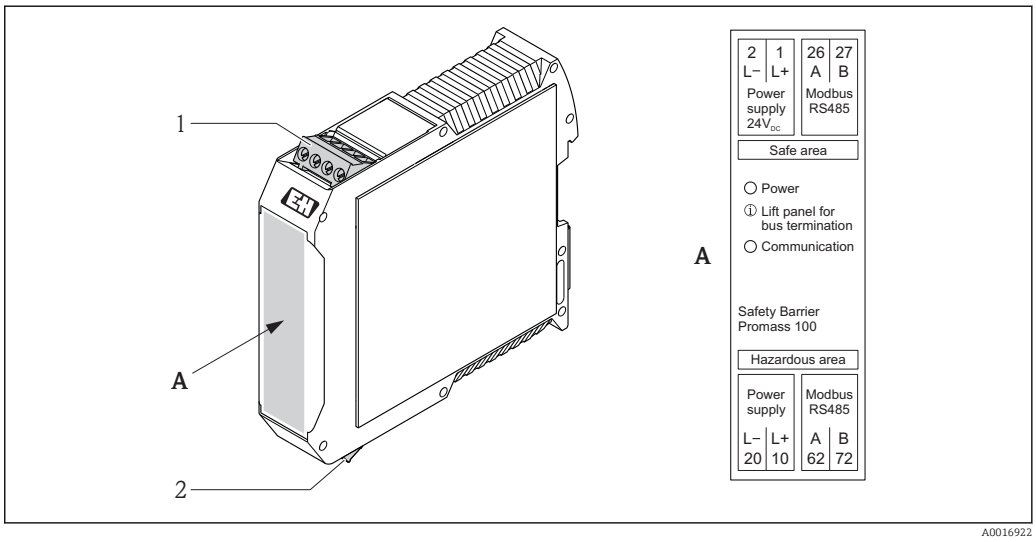


2 Modbus RS485 terminal assignment, connection version for use in intrinsically safe areas (connection via Safety Barrier Promass 100)

1 Intrinsically safe power supply
2 Modbus RS485

Order code for "Output"	20 (L-)	10 (L+)	72 (B)	62 (A)
Option **M**	Intrinsically safe supply voltage		Modbus RS485 intrinsically safe	
Order code for "Output": Option **M**: Modbus RS485, for use in intrinsically safe areas (connection via Safety Barrier Promass 100)				

Safety Barrier Promass 100



3 Safety Barrier Promass 100 with terminals

1 Non-hazardous area and Zone 2/Div. 2
2 Intrinsically safe area

Supply voltage

Transmitter

- For device version with all communication types except Modbus RS485 intrinsically safe: DC 20 to 30 V
- For device version with Modbus RS485 intrinsically safe: power supply via Safety Barrier Promass 100

The power unit must be tested to ensure it meets safety requirements (e.g. PELV, SELV).

Safety Barrier Promass 100

DC 20 to 30 V

Power consumption

Transmitter

Order code for "Output"	Maximum Power consumption
Option **M**: Modbus RS485, for use in intrinsically safe areas	2.45 W

Safety Barrier Promass 100

Order code for "Output"	Maximum Power consumption
Option **M**: Modbus RS485, for use in intrinsically safe areas	4.8 W

Current consumption

Transmitter

Order code for "Output"	Maximum Current consumption	Maximum switch-on current
Option **M**: Modbus RS485, for use in intrinsically safe areas	145 mA	16 A (<0.4 ms)

Safety Barrier Promass 100

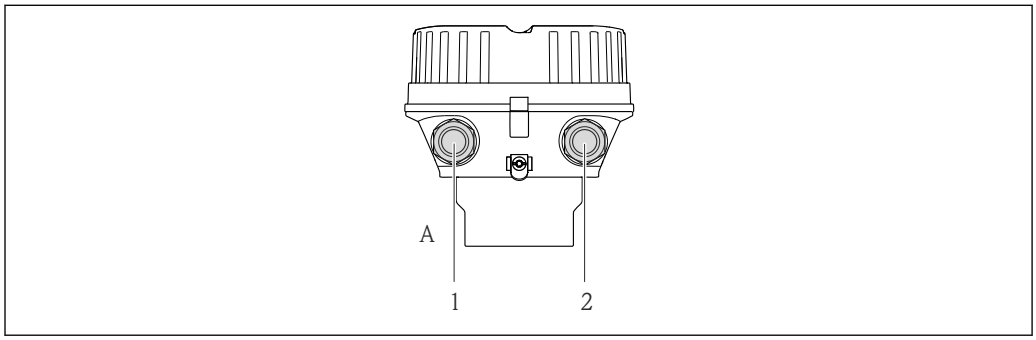
Order code for "Output"	Maximum Current consumption	Maximum switch-on current
Option **M**: Modbus RS485, for use in intrinsically safe areas	230 mA	10 A (<0.8 ms)

Power supply failure

- Totalizers stop at the last value measured.
- Configuration is retained in the device memory.
- Error messages (incl. total operated hours) are stored.

Electrical connection

Connecting the transmitter

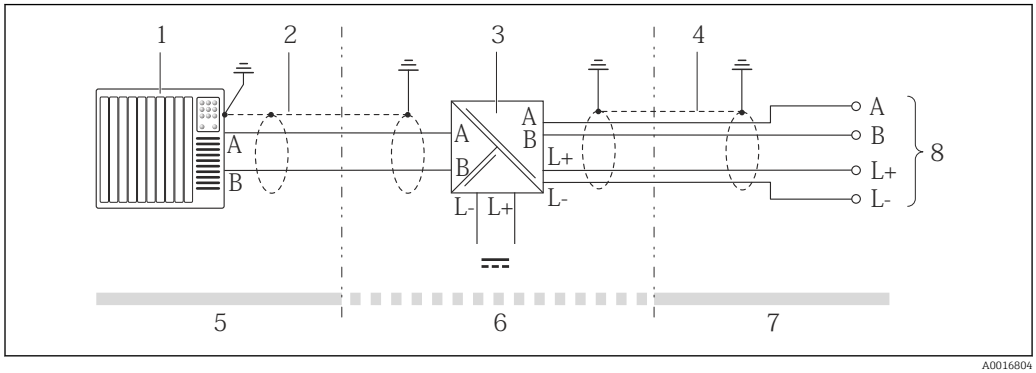


A Housing version: compact, aluminum coated
1 Cable entry for signal transmission
2 Cable entry for supply voltage

Terminal assignment (→ 10)

Connection examples

Modbus RS485



4 *Connection example for Modbus RS485 intrinsically safe*

1 Control system (e.g. PLC)
2 Cable shield, observe cable specifications (→ 13)
3 Safety Barrier Promass 100
4 Observe cable specifications (→ 13)
5 Non-hazardous area
6 Non-hazardous area and Zone 2/Div. 2
7 Intrinsically safe area
8 Transmitter

Potential equalization

No special measures for potential equalization are required.

For devices intended for use in hazardous locations, please observe the guidelines in the Ex documentation (XA).

Terminals

Transmitter
Spring terminals for wire cross-sections0.5 to 2.5 mm² (20 to 14 AWG)

Safety Barrier Promass 100
Plug-in screw terminals for wire cross-sections0.5 to 2.5 mm² (20 to 14 AWG)

Cable entries

- Cable gland: M20 × 1.5 with cable Φ6 to 12 mm (0.24 to 0.47 in)
- Thread for cable entry:
  - NPT ½"
  - G ½"
  - M20

Cable specification

Permitted temperature range

- −40 °C (−40 °F) to +80 °C (+176 °F)
- Minimum requirement: cable temperature range ≥ ambient temperature +20 K

Power supply cable

Standard installation cable is sufficient.

Signal cable

Modbus RS485

The EIA/TIA-485 standard specifies two types of cable (A and B) for the bus line which can be used for every transmission rate. Cable type A is recommended.

Cable type	A
Characteristic impedance	135 to 165 Ωat a measuring frequency of 3 to 20 MHz
Cable capacitance	<30 pF/m
Wire cross-section	>0.34 mm² (22 AWG)
Cable type	Twisted pairs
Loop resistance	≤110 Ω/km
Signal damping	Max. 9 dB over the entire length of the cable cross-section
Shielding	Copper braided shielding or braided shielding with foil shield. When grounding the cable shield, observe the grounding concept of the plant.

Connecting cable between Safety Barrier Promass 100 and measuring device

Cable type	Shielded twisted-pair cable with 2x2 wires. When grounding the cable shield, observe the grounding concept of the plant.
Maximum cable resistance	2.5 Ω, one side

► Comply with the maximum cable resistance specifications to ensure the operational reliability of the measuring device.

The maximum cable length for individual wire cross-sections is specified in the table below. Observe the maximum capacitance and inductance per unit length of the cable and connection values for hazardous areas (→ 🖹 7).

Wire cross-section		Maximum cable length	
[mm²]	[AWG]	[m]	[ft]
0.5	20	70	230
0.75	18	100	328
1.0	17	100	328

Wire cross-section		Maximum cable length	
[mm²]	[AWG]	[m]	[ft]
1.5	16	200	656
2.5	14	300	984

Performance characteristics

Reference operating conditions

- Error limits based on ISO 11631
- Water with +15 to +45 °C (+59 to +113 °F) at2 to 6 bar (29 to 87 psi)
- Specifications as per calibration protocol
- Accuracy based on accredited calibration rigs that are traced to ISO 17025.

To obtain measured errors, use the *Applicator* sizing tool (→ 30)

Maximum measured error

o.r. = of reading; 1 g/cm³ = 1 kg/l; T = medium temperature

Base accuracy

Mass flow and volume flow (liquids)
±0.15 % o.r.

Design fundamentals (→ 16)

Density (liquids)
- Reference conditions:±0.0005 g/cm³
- Standard density calibration:±0.02 g/cm³
  (valid over the entire temperature range and density range)

Temperature
±0.5 °C ± 0.005 · T °C (±0.9 °F ± 0.003 · (T − 32) °F)

Zero point stability

DN		Zero point stability	
[mm]	[in]	[kg/h]	[lb/min]
8	⅜	0.2	0.0074
15	½	0.65	0.0239
25	1	1.8	0.0662

Flow values

Flow values as turndown parameter depending on nominal diameter.

SI units

DN [mm]	1:1 [kg/h]	1:10 [kg/h]	1:20 [kg/h]	1:50 [kg/h]	1:100 [kg/h]	1:500 [kg/h]
8	2 000	200	100	40	20	4
15	6 500	650	325	130	65	13
25	18 000	1 800	900	360	180	36

US units

DN	1:1	1:10	1:20	1:50	1:100	1:500
[inch]	[lb/min]	[lb/min]	[lb/min]	[lb/min]	[lb/min]	[lb/min]
⅜	73.5	7.35	3.675	1.47	0.735	0.147
½	238	23.8	11.9	4.76	2.38	476
1	660	66	33	13.2	6.6	1.32

Repeatability

o.r. = of reading; 1 g/cm³ = 1 kg/l; T = medium temperature

Base repeatability

Mass flow and volume flow (liquids)
±0.075 % o.r.

Design fundamentals (→ 16)

Density (liquids)
±0.00025 g/cm³

Temperature
±0.25 °C ± 0.0025 · T °C (±0.45 °F±0.0015 · (T–32) °F)

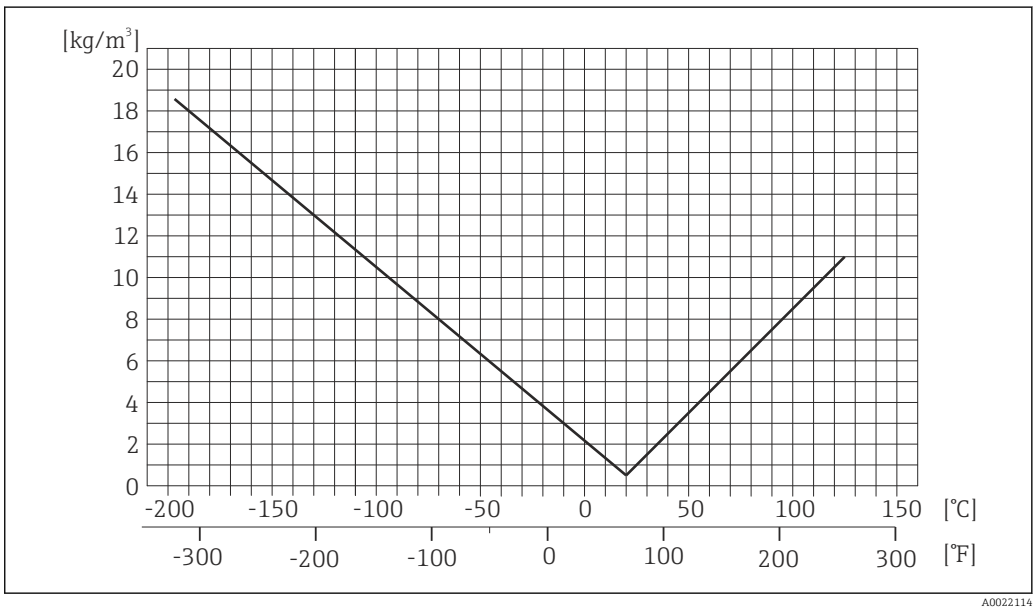
Response time

- The response time depends on the configuration (damping).
- Response time in the event of erratic changes in the measured variable (only mass flow): after 100 ms, 95 % of the full scale value

Influence of medium temperature

Mass flow and volume flow
When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of the sensor is ±0.0002 % of the full scale value/°C (±0.0001 % of the full scale value/°F).

Density
When there is a difference between the density calibration temperature and the process temperature, the typical measured error of the sensor is ±0.0001 g/cm³ /°C (±0.00005 g/cm³ /°F). Field density calibration is possible.



5 *Field density calibration, for example at +20 °C (+68 °F)*

Temperature
±0.005 · T °C (±0.005 · (T – 32) °F)

Influence of medium pressure

A difference between the calibration pressure and process pressure does not affect accuracy.

Design fundamentals

o.r. = of reading, o.f.s. = of full scale value

BaseAccu = base accuracy in % o.r., BaseRepeat = base repeatability in % o.r.

MeasValue = measured value; ZeroPoint = zero point stability

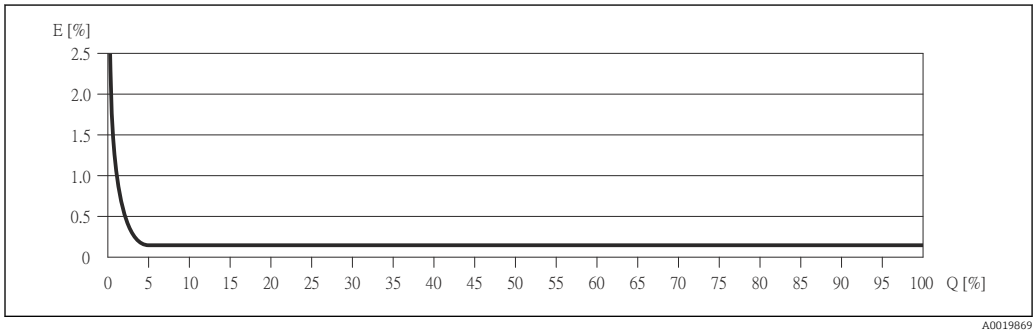
Calculation of the maximum measured error as a function of the flow rate

Flow rate	Maximum measured error in % o.r.
$\geq \frac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$ A0021332	$\pm$ BaseAccu A0021339
$< \frac{\text{ZeroPoint}}{\text{BaseAccu}} \cdot 100$ A0021333	$\pm \frac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$ A0021334

Calculation of the maximum repeatability as a function of the flow rate

Flow rate	Maximum repeatability in % o.r.
$\geq \frac{½ \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$ A0021335	$\pm$ BaseRepeat A0021340
$< \frac{½ \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$ A0021336	$\pm ½ \cdot \frac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$ A0021337

Example for max. measured error



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E Error: Maximum measured error as % o.r. (example)
Q Flow rate as %

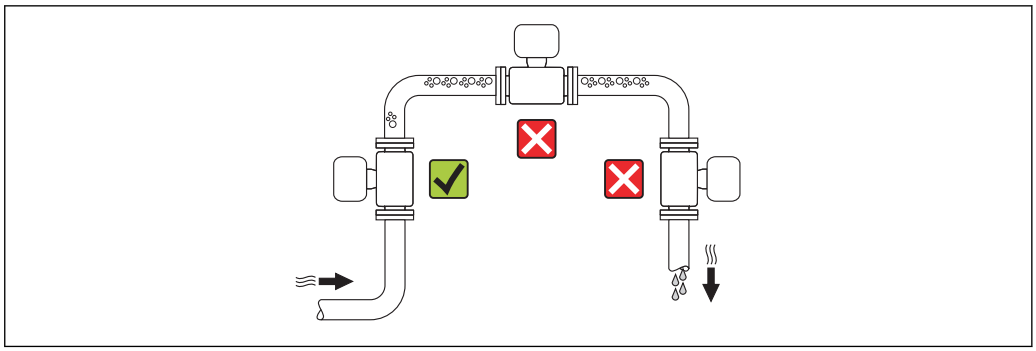
Design fundamentals (→ 16)

Installation

No special measures such as supports are necessary. External forces are absorbed by the construction of the device.

Mounting location

To prevent measuring errors arising from accumulation of gas bubbles in the measuring tube, avoid the following mounting locations in the pipe:
- Highest point of a pipeline.
- Directly upstream of a free pipe outlet in a down pipe.



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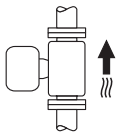
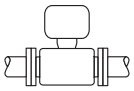
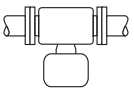
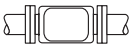
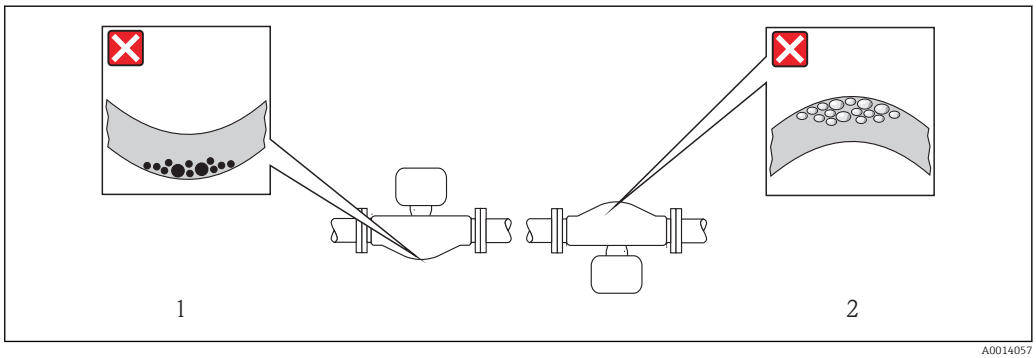
Orientation

The direction of the arrow on the sensor nameplate helps you to install the sensor according to the flow direction (direction of medium flow through the piping).

Orientation			Recommendation
A	Vertical orientation	 A0015591	✓✓
B	Horizontal orientation, transmitter head up	 A0015589	✓✓ 1) Exception: (→ 6, 17)
C	Horizontal orientation, transmitter head down	 A0015590	✓✓ 2) Exception: (→ 6, 17)
D	Horizontal orientation, transmitter head at side	 A0015592	✗

1) Applications with low process temperatures may reduce the ambient temperature. To maintain the minimum ambient temperature for the transmitter, this orientation is recommended.
2) Applications with high process temperatures may increase the ambient temperature. To maintain the maximum ambient temperature for the transmitter, this orientation is recommended.

If a sensor is installed horizontally with a curved measuring tube, match the position of the sensor to the fluid properties.



A0014057

6 *Orientation of sensor with curved measuring tube*

1 Avoid this orientation for fluids with entrained solids: Risk of solids accumulating.
2 Avoid this orientation for outgassing fluids: Risk of gas accumulating.

Inlet and outlet runs

No special precautions need to be taken for fittings which create turbulence, such as valves, elbows or T-pieces, as long as no cavitation occurs (→ 21).

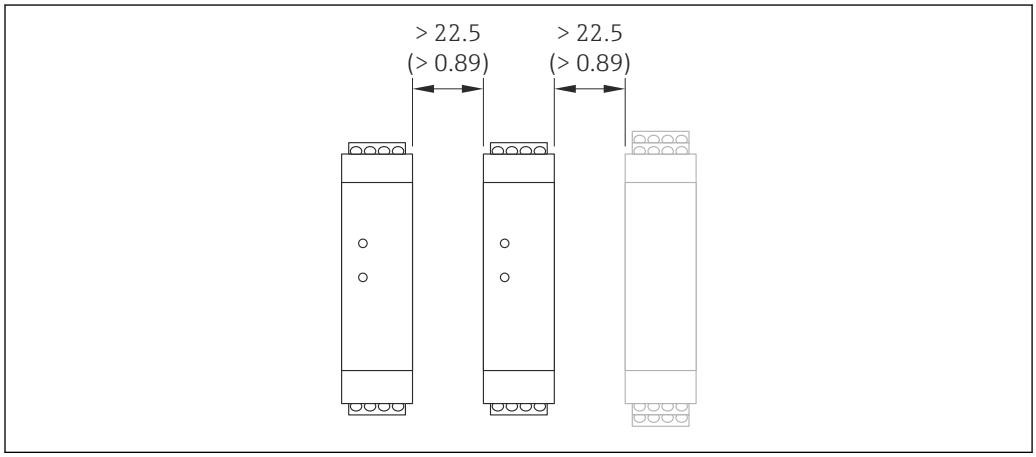
Special mounting instructions

Zero point adjustment

All measuring devices are calibrated in accordance with state-of-the-art technology. Calibration takes place under reference conditions (→ 14). Therefore, a zero point adjustment in the field is generally not required.

Experience shows that zero point adjustment is advisable only in special cases:
- To achieve maximum measuring accuracy even with low flow rates
- Under extreme process or operating conditions (e.g. very high process temperatures or very high-viscosity fluids).

Mounting Safety Barrier Promass 100



7 Minimum distance between additional Safety Barrier Promass 100 or other modules.Engineering unit mm (in)

Environment

Ambient temperature range

Measuring device	–40 to +60 °C (–40 to +140 °F)
Safety Barrier Promass 100	–40 to +60 °C (–40 to +140 °F)

► If operating outdoors:
Avoid direct sunlight, particularly in warm climatic regions.

Temperature tables

In the following tables, the following interdependencies between the maximum medium temperature for T1-T6 and the maximum ambient temperature T_a apply when operating the device in hazardous areas.

Ex ia, $_{C}CSA_{US}$ IS

SI units

Order code for "Housing"	T_a [°C]	T6 [85 °C]	T5 [100 °C]	T4 [135 °C]	T3 [200 °C]	T2 [300 °C]	T1 [450 °C]
Option A "Compact coated alu"	35	50	85	120	125	125	125
	50	–	85	120	125	125	125
	60	–	–	120	125	125	125

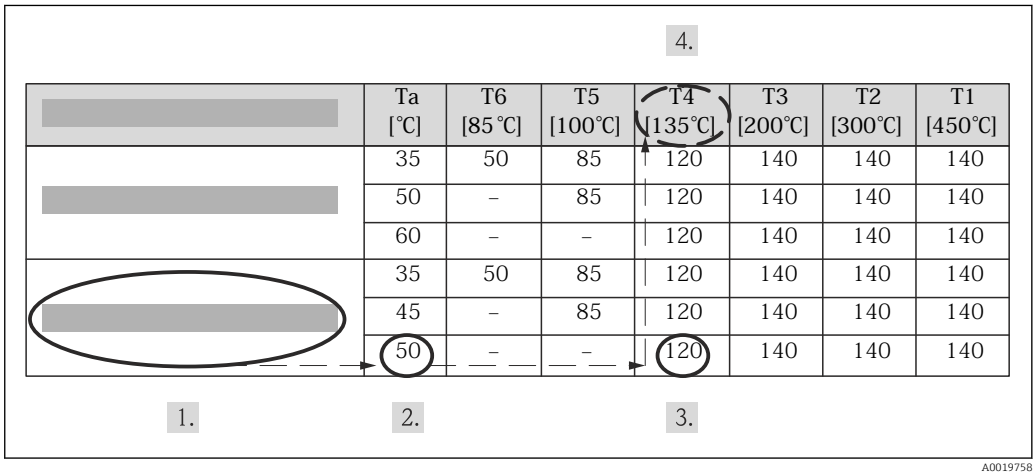
US units

Order code for "Housing"	T_a [°F]	T6 [185 °F]	T5 [212 °F]	T4 [275 °F]	T3 [392 °F]	T2 [572 °F]	T1 [842 °F]
Option A "Compact coated alu"	95	122	185	248	257	257	257
	122	–	185	248	257	257	257
	140	–	–	248	257	257	257

Explosion hazards arising from dust and gas

Determine the temperature class and surface temperature using the temperature table
- For gas: determine the temperature class depending on the ambient temperature T_a and medium temperature T_m.
- For dust: determine the maximum surface temperature depending on the maximum ambient temperature T_a and the maximum medium temperature T_m.

Example
- Maximum ambient temperature: T_a = 50 °C
- Measured maximum medium temperature: T_{mm} = 108 °C



8 Procedure for determining the temperature class and surface temperature

1. Select the order code of the device: nominal diameter, housing option, etc.
2. Select the ambient temperature T_a (50 °C).
   ↳ The row containing the maximum medium temperature is determined.
3. Select the maximum medium temperature T_m in this row that is directly larger than or equal to the measured maximum medium temperature T_{mm}.
   ↳ The column with the temperature class for gas is determined: 108 °C ≤ 120°C → T4.
4. The maximum temperature of the temperature class determined corresponds to the maximum surface temperature for dust: T4 = 135 °C.

Storage temperature

–40 to +80 °C (–40 to +176 °F), preferably at +20 °C (+68 °F)

Climate class

DIN EN 60068-2-38 (test Z/AD)

Degree of protection

Transmitter and sensor
- As standard: IP66/67, type 4X enclosure
- When housing is open: IP20, type 1 enclosure

Safety Barrier Promass 100
IP20

Shock resistance

As per IEC/EN 60068-2-31

Vibration resistance

Acceleration up to 1 g, 10 to 150 Hz, based on IEC/EN 60068-2-6

Electromagnetic compatibility (EMC)

- As per IEC/EN 61326 and NAMUR Recommendation 21 (NE 21)
- Complies with emission limits for industry as per EN 55011 (Class A)

Details are provided in the Declaration of Conformity.

Process

Medium temperature range

Sensor
−196 to +125 °C (−320 to +257 °F)

Seals
No internal seals

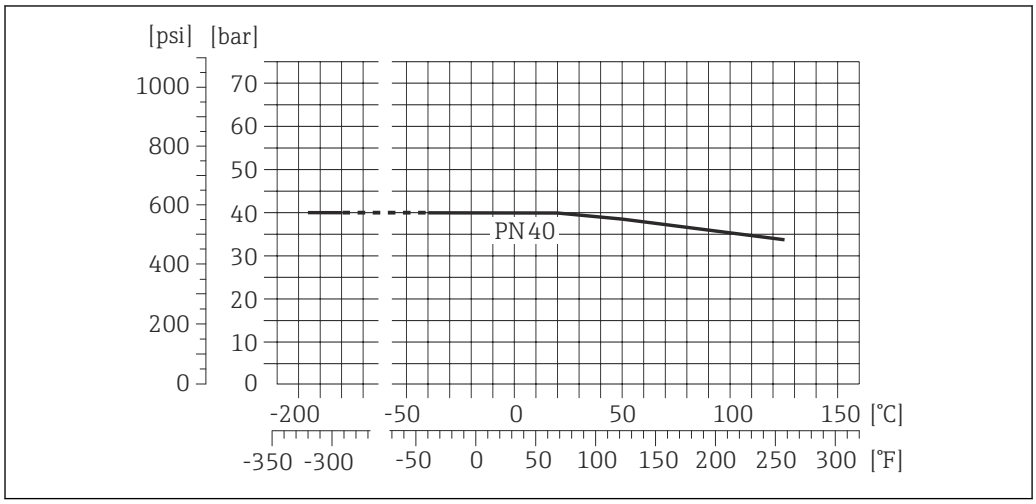
Medium density

0 to 5 000 kg/m³ (0 to 312 lb/cf)

Pressure-temperature ratings

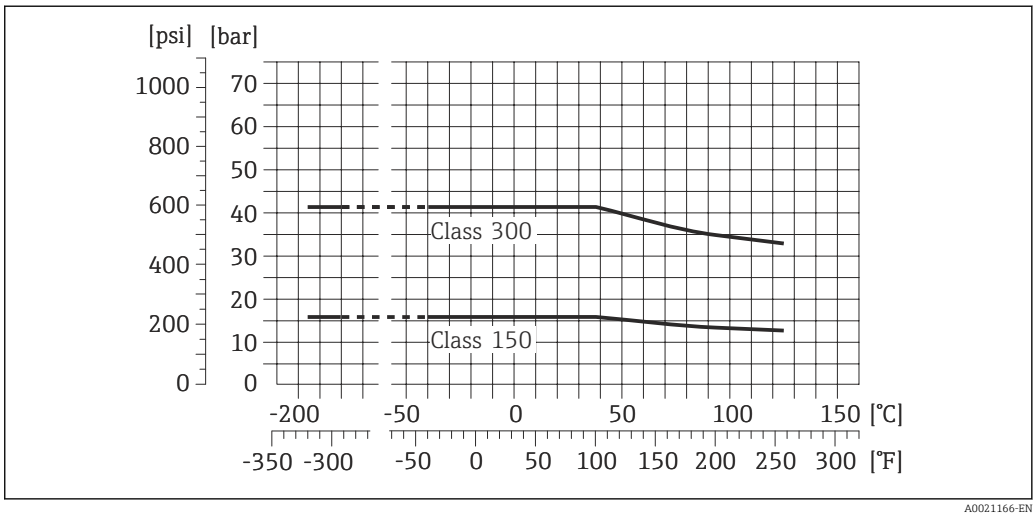
The following material load diagrams refer to the entire device and not just the process connection.

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



9 With flange material 1.4404 (316/316L)

Flange connection according to ASME B16.5



10 With flange material 1.4404 (316/316L)

Secondary containment pressure range

The sensor housing is filled with helium and protects the electronics and mechanics inside.

The housing does not have pressure vessel classification.

Reference value for the pressure loading capacity of the sensor housing: 16 bar (232 psi)

Flow limit

Select the nominal diameter by optimizing between the required flow range and permissible pressure loss.

For an overview of the measuring range full scale values, see the "Measuring range" section (→ 6)

- The minimum recommended full scale value is approx. 1/20 of the maximum full scale value
- In most applications, 20 to 50 % of the maximum full scale value can be considered ideal
- Select a lower full scale value for abrasive substances (such as liquids with entrained solids): flow velocity <1 m/s (<3 ft/s).

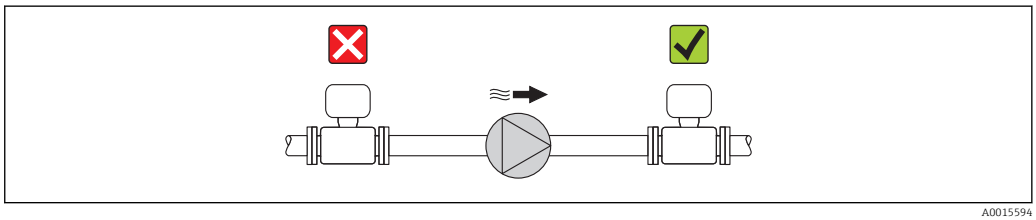
Pressure loss

To calculate the pressure loss, use the *Applicator* sizing tool (→ 30)

System pressure

It is important that cavitation does not occur, or that gases entrained in the liquids do not outgas. This is prevented by means of a sufficiently high system pressure.

For this reason, the following mounting locations are recommended:
- At the lowest point in a vertical pipe
- Downstream from pumps (no danger of vacuum)



Vibrations

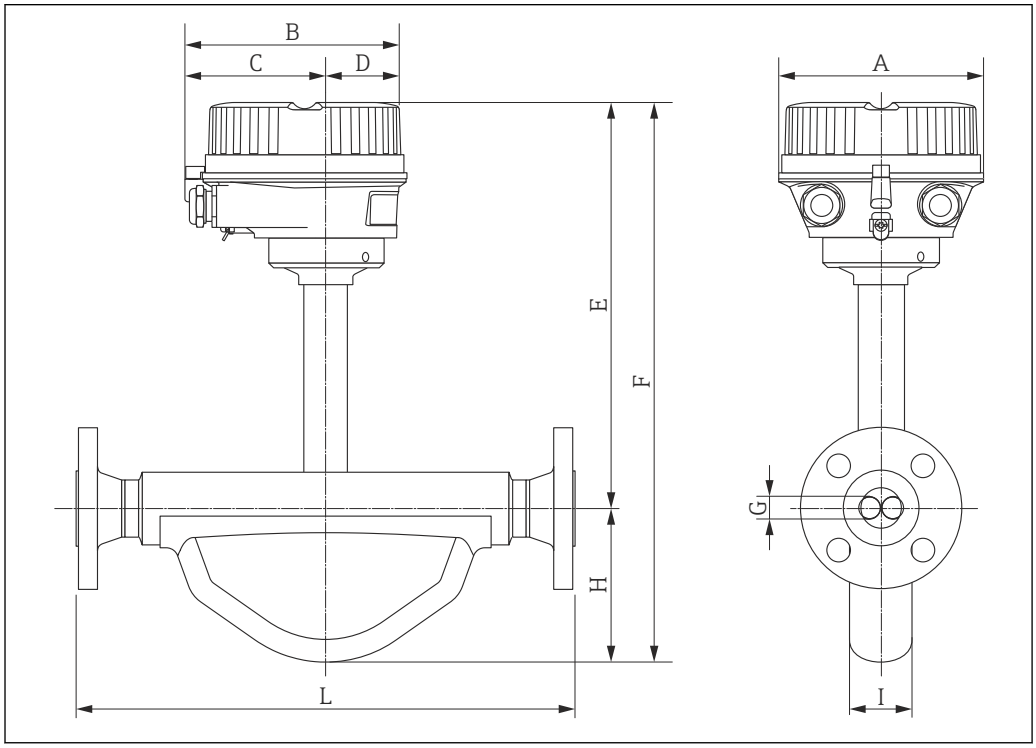
The high oscillation frequency of the measuring tubes ensures that the correct operation of the measuring system is not influenced by plant vibrations.

Mechanical construction

Design, dimensions

Compact version

Order code for "Housing", option A "Alu"



Dimensions SI units

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]	G [mm]	H [mm]	I [mm]	L [mm]
8	136	147.5	93.5	54	273	362	5.35	89	40	1)
15	136	147.5	93.5	54	273	373	8.30	100	38	1)
25	136	147.5	93.5	54	270	372	12.0	102	48	1)

1) dependent on respective process connection

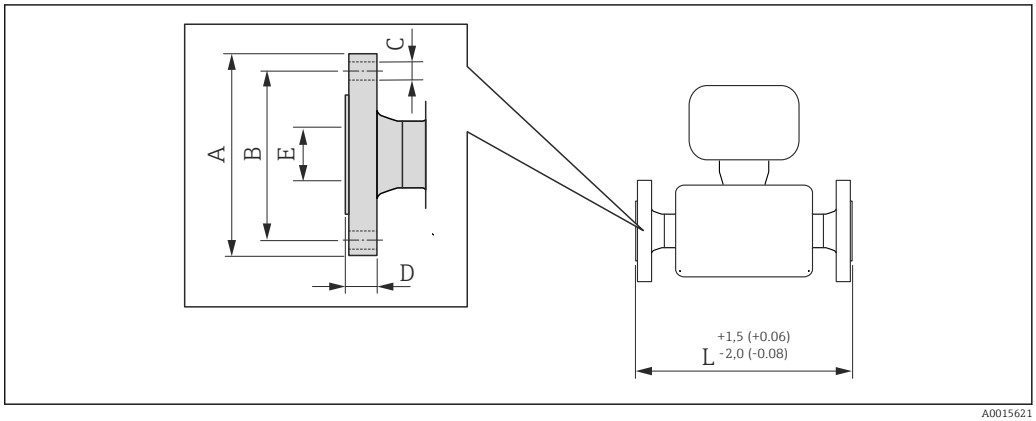
Dimensions US units

DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	F [in]	G [in]	H [in]	I [in]	L [in]
3/8	5.35	5.81	3.68	2.13	10.7	14.3	0.21	3.50	1.57	1)
½	5.35	5.81	3.68	2.13	10.7	14.7	0.33	3.94	1.50	1)
1	5.35	5.81	3.68	2.13	10.6	14.6	0.47	4.02	1.89	1)

1) dependent on respective process connection

Process connections in SI units

Flange connections EN (DIN)

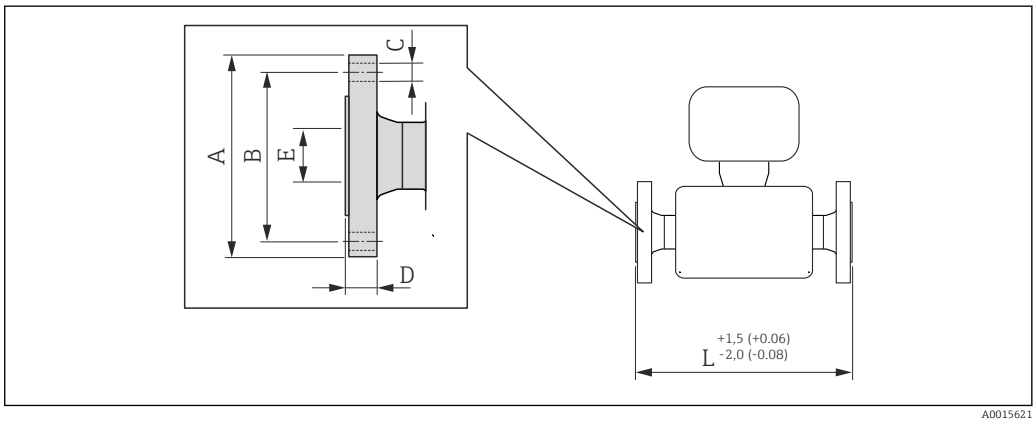


11 Engineering unit mm (in)

Flange according to EN 1092-1 (DIN 2501 / DIN 2512N) / PN 40: 1.4404 (316/316L) (order code for "Process connection", option D2S) Surface roughness (flange): EN 1092-1 Form B1 (DIN 2526 Form C), Ra 3.2 to 12.5 µm						
DN [mm]	**A [mm]**	**B [mm]**	**C [mm]**	**D [mm]**	**E [mm]**	**L [mm]**
8 [1)]	95	65	4 × Ø14	16	17.3	232
15	95	65	4 × Ø14	16	17.3	279
25	115	85	4 × Ø14	18	28.5	329

1) DN 8 with DN 15 flanges as standard

Flange connections ASME B16.5



12 Engineering unit mm (in)

Flange according to ASME B16.5 / Cl 150: 1.4404 (316/316L) (order code for "Process connection", option AAS)						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
8 [1)]	88.9	60.5	4 × Ø15.7	11.2	15.7	232
15	88.9	60.5	4 × Ø15.7	11.2	15.7	279
25	108.0	79.2	4 × Ø15.7	14.2	26.7	329

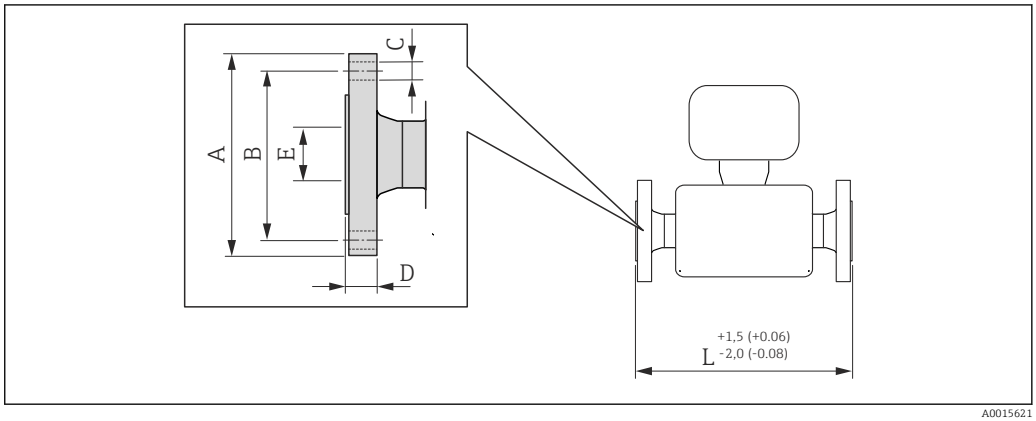
1) DN 8 with DN 15 flanges as standard

Flange according to ASME B16.5 / Cl 300: 1.4404 (316/316L) (order code for "Process connection", option ABS)						
DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
8 [1)]	95.2	66.5	4 × Ø15.7	14.2	15.7	232
15	95.2	66.5	4 × Ø15.7	14.2	15.7	279
25	123.9	88.9	4 × Ø19.0	17.5	26.7	329

1) DN 8 with DN 15 flanges as standard

Process connections in US units

Flange connections ASME B16.5



13 Engineering unit mm (in)

Flange according to ASME B16.5 / Cl 150: 1.4404 (316/316L) (order code for "Process connection", option AAS)						
DN [in]	**A [in]**	**B [in]**	**C [in]**	**D [in]**	**E [in]**	**L [in]**
⅜ 1)	3.50	2.38	4 × Ø0.62	0.44	0.62	9.13
½	3.50	2.38	4 × Ø0.62	0.44	0.62	11.0
1	4.25	3.12	4 × Ø0.62	0.56	1.05	13.0

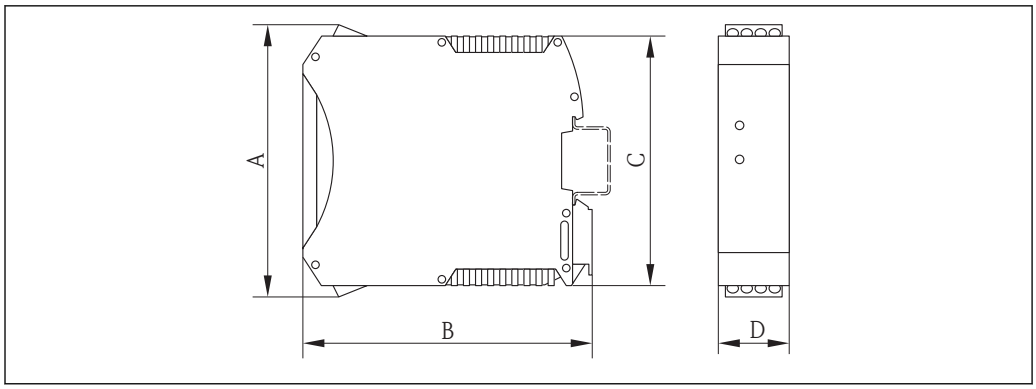
1) DN ⅜" with DN ½" flanges as standard

Flange according to ASME B16.5 / Cl 300: 1.4404 (316/316L) (order code for "Process connection", option ABS)						
DN [in]	**A [in]**	**B [in]**	**C [in]**	**D [in]**	**E [in]**	**L [in]**
⅜ 1)	3.75	2.62	4 × Ø0.62	0.56	0.62	9.13
½	3.75	2.62	4 × Ø0.62	0.56	0.62	11.0
1	4.88	3.50	4 × Ø0.75	0.69	1.05	13.0

1) DN ⅜" with DN ½" flanges as standard

Safety Barrier Promass 100

Top-hat rail EN 60715:
- TH 35 x 7.5
- TH 35 x 15



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A		B		C		D	
[mm]	[in]	[mm]	[in]	[mm]	[in]	[mm]	[in]
108	4.25	114.5	4.51	99	3.9	22.5	0.89

Weight

Compact version

Weight in SI units

All values (weight) refer to devices with EN/DIN PN 40 flanges. Weight information in [kg].

DN [mm]	Weight [kg]
8	6
15	6
25	8

Weight in US units

All values (weight) refer to devices with EN/DIN PN 40 flanges. Weight information in [lbs].

DN [in]	Weight [lbs]
⅜	13
½	13
1	18

Safety Barrier Promass 100

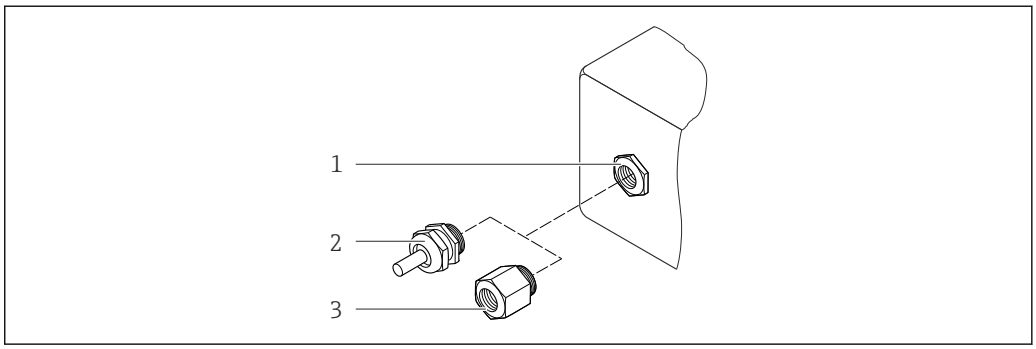
49 g (1.73 ounce)

Materials

Transmitter housing

Order code for "Housing", option **A** "Compact, aluminum coated":
Coated aluminum AlSi10Mg

Cable entries/cable glands



14 *Possible cable entries/cable glands*

1 *Cable entry in transmitter housing, wall-mount housing or connection housing with internal thread M20 x 1.5*
2 *Cable gland M20 x 1.5*
3 *Adapter for cable entry with internal thread G ½" or NPT ½"*

Order code for "Housing", option A "Compact, coated aluminum"

The various cable entries are suitable for hazardous and non-hazardous areas.

Cable entry/cable gland	Material
Cable gland M20 × 1.5	Nickel-plated brass
Adapter for cable entry with internal thread G ½"	
Adapter for cable entry with internal thread NPT ½"	

Sensor housing

- Acid and alkali-resistant outer surface
- Stainless steel 1.4301 (304)

Measuring tubes

- Stainless steel 1.4539 (904L); manifold: 1.4404 (316L)
- Surface quality:
  - Not polished
  - Ra_{max} = 0.8 µm (32 µin)

Process connections

For all process connections:
Stainless steel 1.4404 (316/316L)

List of all available process connections (→ 27)

Seals

Welded process connections without internal seals

Safety Barrier Promass 100

Housing: Polyamide

Process connections

Flanges:
- EN 1092-1 (DIN 2501)
- ASME B16.5

For information on the materials of the process connections (→ 27)

Operability

Operating concept

Operator-oriented menu structure for user-specific tasks
- Commissioning
- Operation
- Diagnostics
- Expert level

Quick and safe commissioning
- Individual menus for applications
- Menu guidance with brief explanations of the individual parameter functions

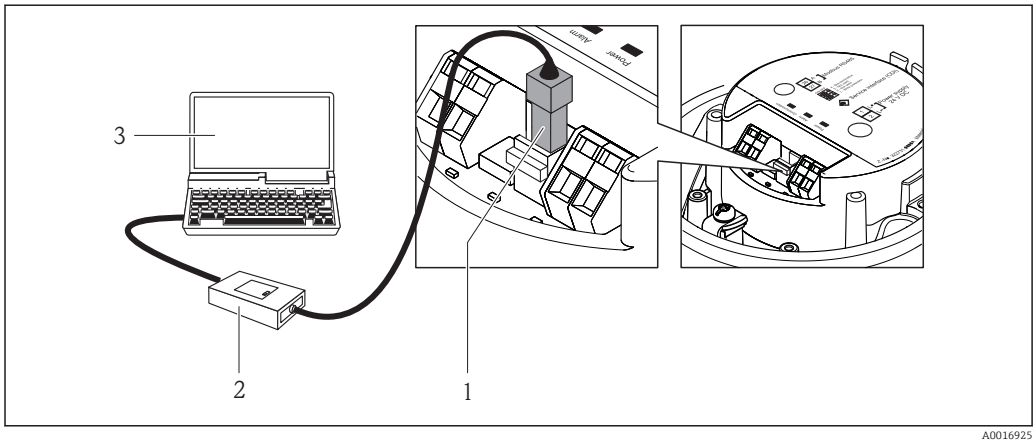
Reliable operation
Operation in the following languages:
Via "FieldCare" operating tool:
English, German

Efficient diagnostics increase measurement availability
- Troubleshooting measures can be called up via the operating tools and Web browser
- Diverse simulation options
- Status indicated by several light emitting diodes (LEDs) on the electronic module in the housing compartment

Remote operation

Via service interface (CDI)

This communication interface is present in the following device version:
Order code for "Output", option **M**: Modbus RS485



1 Service interface (CDI) of the measuring device
2 Commubox FXA291
3 Computer with "FieldCare" operating tool with COM DTM "CDI Communication FXA291"

Certificates and approvals

CE mark

The measuring system is in conformity with the statutory requirements of the applicable EC Directives. These are listed in the corresponding EC Declaration of Conformity along with the standards applied.

Endress+Hauser confirms successful testing of the device by affixing to it the CE mark.

C-Tick symbol

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

Ex approval

The measuring device is certified for use in hazardous areas and the relevant safety instructions are provided in the separate "Safety Instructions" (XA) document. Reference is made to this document on the nameplate.

The separate Ex documentation (XA) containing all the relevant explosion protection data is available from your Endress+Hauser sales center.

ATEX/IECEx

Currently, the following versions for use in hazardous areas are available:

Ex ia

Category (ATEX)	Type of protection
II2G	Ex ia IIC T6-T1 Gb
II2G	Ex ia IIC T6-T1 Gb or Ex ia IIB T6-T1 Gb
II1/2G, II2D	Ex ia IIC T6-T1 Ga/Gb or Ex ia IIB T6-T1 Ga/Gb Ex tb IIIC T* Db
II2G, II2D	Ex ia IIC T6-T1 Gb or Ex ia IIB T6-T1 Gb Ex tb IIIC T* Db

Modbus RS485 certification

The measuring device meets all the requirements of the MODBUS/TCP conformity test and has the "MODBUS/TCP Conformance Test Policy, Version 2.0". The measuring device has successfully passed all the test procedures carried out and is certified by the “MODBUS/TCP Conformance Test Laboratory” of the University of Michigan.

Ordering information

Detailed ordering information is available from the following sources:
- In the Product Configurator on the Endress+Hauser website: www.endress.com → Select country → Instruments → Select device → Product page function: Configure this product
- From your Endress+Hauser Sales Center: www.endress.com/worldwide

Product Configurator - the tool for individual product configuration
- Up-to-the-minute configuration data
- Depending on the device: Direct input of measuring point-specific information such as measuring range or operating language
- Automatic verification of exclusion criteria
- Automatic creation of the order code and its breakdown in PDF or Excel output format
- Ability to order directly in the Endress+Hauser Online Shop

Accessories

Various accessories, which can be ordered with the device or subsequently from Endress+Hauser, are available for the device. Detailed information on the order code in question is available from your local Endress+Hauser sales center or on the product page of the Endress+Hauser website: www.endress.com.

Communication-specific accessories

Accessories	Description
Commubox FXA291	Connects Endress+Hauser field devices with a CDI interface (= Endress+Hauser Common Data Interface) and the USB port of a computer or laptop. For details, see "Technical Information" TI00405C

Service-specific accessories

Accessories	Description
Applicator	Software for selecting and sizing Endress+Hauser measuring devices: ▪ Calculation of all the necessary data for identifying the optimum flowmeter: e.g. nominal diameter, pressure loss, accuracy or process connections. ▪ Graphic illustration of the calculation results Administration, documentation and access to all project-related data and parameters over the entire life cycle of a project. Applicator is available: ▪ Via the Internet: https://wapps.endress.com/applicator ▪ On CD-ROM for local PC installation.
W@M	Life cycle management for your plant W@M supports you with a wide range of software applications over the entire process: from planning and procurement, to the installation, commissioning and operation of the measuring devices. All the relevant device information, such as the device status, spare parts and device-specific documentation, is available for every device over the entire life cycle. The application already contains the data of your Endress+Hauser device. Endress +Hauser also takes care of maintaining and updating the data records. W@M is available: ▪ Via the Internet: www.endress.com/lifecyclemanagement ▪ On CD-ROM for local PC installation.
FieldCare	FDT-based plant asset management tool from Endress+Hauser. It can configure all smart field units in your system and helps you manage them. By using the status information, it is also a simple but effective way of checking their status and condition. For details, see Operating Instructions BA00027S and BA00059S

Supplementary documentation

For an overview of the scope of the associated Technical Documentation, refer to the following:
- The CD-ROM provided for the device (depending on the device version, the CD-ROM might not be part of the delivery!)
- The *W@M Device Viewer* : Enter the serial number from the nameplate (www.endress.com/deviceviewer)
- The *Endress+Hauser Operations App*: Enter the serial number from the nameplate or scan the 2-D matrix code (QR code) on the nameplate.

Standard documentation

Communication	Document type	Documentation code
- - - -	Brief Operating Instructions	KA01153D
Modbus RS485	Operating Instructions	BA01261D

Supplementary device-dependent documentation

Document type	Contents	Documentation code
Safety Instructions	ATEX/IECEx Ex i	XA01217D
	cCSAus IS	XA01218D
	INMETRO	XA01246D
	NEPSI	XA01247D
Special Documentation	Modbus RS485 Register Information	SD01165D
Installation Instructions		Specified for each individual accessory (→ 29)

Registered trademarks

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www.addresses.endress.com

Endress+Hauser

People for Process Automation