

# Technical Information

## Proline Promass K 10

Coriolis flowmeter



Flowmeter for minimum total cost of ownership with simple operating concept

### Application

- Measuring principle operates independently of physical fluid properties such as viscosity or density
- Measurement of liquids and gases in utilities and basic applications

### Device properties

- Compact dual-tube sensor
- Medium temperature up to +150 °C (+302 °F)
- Process pressure up to 100 bar (1450 psi)
- System integration with HART, Modbus RS485
- Flexible operation with app and optional display

### Your benefits

- Cost-effective device for generic use – alternative to mechanical flowmeters
- Fewer process measuring points – multivariable measurement (flow, density, temperature)
- Space-saving installation – no inlet/outlet run needs
- Optimum usability – operation with mobile devices and SmartBlue App or touch screen display
- Easy, time-saving commissioning – guided parameter configuration in advance and in the field
- Integrated verification – Heartbeat Technology

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## About this document

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## Symbols used



### Electronics

-  Direct current
-  Alternating current
-  Direct current and alternating current
-  Protective earthing

### Types of information


-  Preferred procedures, processes or actions
-  Permitted procedures, processes or actions
-  Forbidden procedures, processes or actions
-  Additional information
-  Reference to documentation
-  Reference to page
-  Reference to graphic

### Explosion protection

-  Hazardous area
-  Non-hazardous area

## Associated documentation

Technical Information	Overview of the device with the most important technical data.
Operating Instructions	All the information that is required in the various phases of the life cycle of the device: from product identification, incoming acceptance and storage, to mounting, connection, operation and commissioning through to troubleshooting, maintenance and disposal as well as the technical data and dimensions.
Sensor Brief Operating Instructions	Incoming acceptance, transport, storage and mounting of the device.
Transmitter Brief Operating Instructions	Electrical connection and commissioning of the device.
Description of Parameters	Detailed explanation of the menus and parameters.
Safety Instructions	Documents for the use of the device in hazardous areas.
Special Documentation	Documents with more detailed information on specific topics.
Installation Instructions	Installation of spare parts and accessories.

-  The device documentation is available online on the device product page and in the Downloads area: [www.endress.com](http://www.endress.com)

## Ordering information

Detailed ordering information is available for your nearest sales organization [www.addresses.endress.com](http://www.addresses.endress.com) or in the Product Configurator under [www.endress.com](http://www.endress.com) :

1. Click Corporate
2. Select the country
3. Click Products
4. Select the product using the filters and search field
5. Open the product page

The Configuration button to the right of the product image opens the Product Configurator.



**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

### Registered trademarks

**HART®**

Registered trademark of the FieldComm Group, Austin, USA

**Modbus®**

Registered trademark of SCHNEIDER AUTOMATION, INC.

**Bluetooth®**

The Bluetooth word mark and Bluetooth logos are registered trademarks of Bluetooth SIG, Inc. and any use of such marks by Endress+Hauser is under license. Other trademarks and trade names are those of their respective owners.

**Apple®**

Apple, the Apple logo, iPhone, and iPod touch are trademarks of Apple Inc., registered in the U.S. and other countries. App Store is a service mark of Apple Inc.

**Android®**

Android, Google Play and the Google Play logo are trademarks of Google Inc.

## Function and system design

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## 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

$\Delta m$  = moving mass

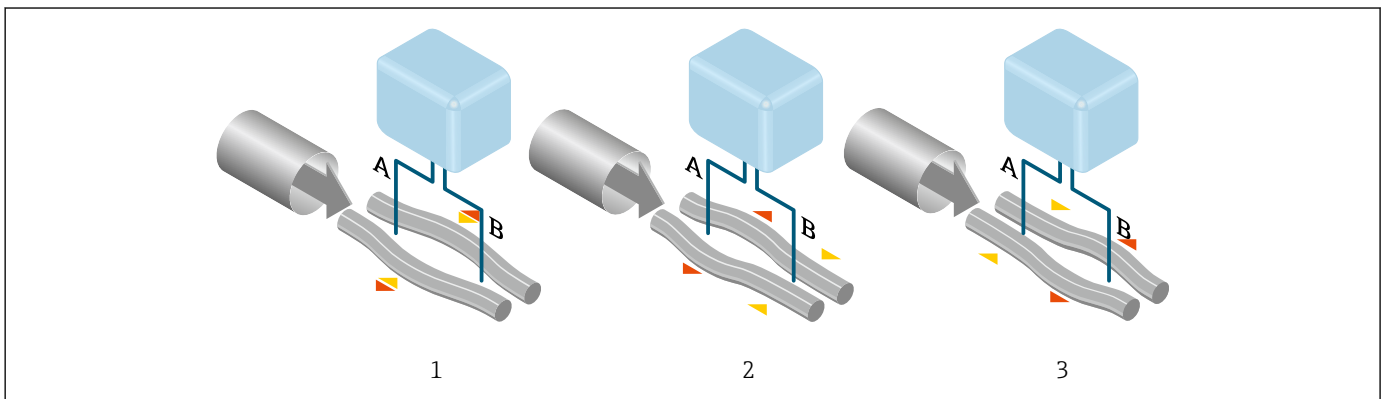
$\omega$  = rotational velocity

$v$  = radial velocity in rotating or oscillating system

The amplitude of the Coriolis force depends on the moving mass  $\Delta m$ , its velocity  $v$  in the system and thus on the mass flow. Instead of a constant rotational velocity  $\omega$ , 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).



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The phase difference (A-B) increases with increasing mass flow. Electrodynamical 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 the 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.

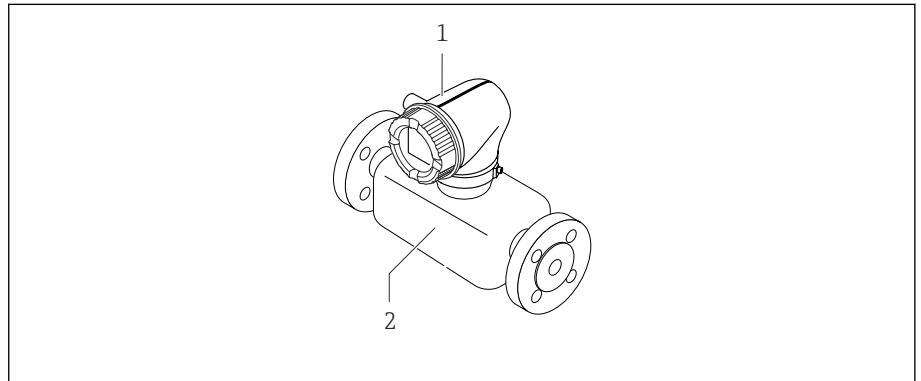
## Product design

The device consists of a transmitter and a sensor. A compact version of the device is available.



### Compact version

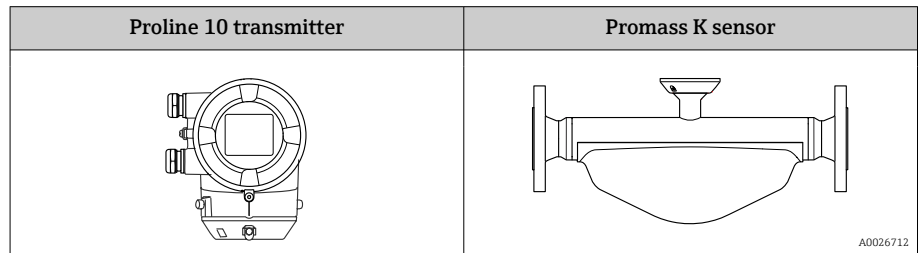
The transmitter and sensor form a mechanical unit.



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- 1 Transmitter
- 2 Sensor

### Measuring system



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### IT security

We only provide a warranty if the device is installed and used as described in the Operating Instructions. The device is equipped with security mechanisms to protect it against any inadvertent changes to the device settings.

IT security measures in line with operators' security standards and designed to provide additional protection for the device and device data transfer must be implemented by the operators themselves.

### Device-specific IT security

#### Access via Bluetooth

Secure signal transmission via Bluetooth uses an encryption method tested by the Fraunhofer Institute.

- Without the SmartBlue App, the device is not visible via Bluetooth.
- Only one point-to-point connection is established between the device and a smartphone or tablet.

#### Access via the SmartBlue App

Two access levels (user roles) are defined for the device: the **Operator** user role and the **Maintenance** user role. The **Maintenance** user role is configured when the device leaves the factory.

If a user-specific access code is not defined (in the Enter access code parameter), the default setting **0000** continues to apply and the **Maintenance** user role is automatically enabled. The device's configuration data are not write-protected and can be edited at all times.

If a user-specific access code has been defined (in the Enter access code parameter), all the parameters are write-protected. The device is accessed with the **Operator** user role.

When the user-specific access code is entered a second time, the **Maintenance** user role is enabled. All parameters can be written to.



For detailed information, see the "Description of Device Parameters" document pertaining to the device.

### Protecting access via a password

There are a variety of ways to protect against write access to the device parameters:

- User-specific access code:  
Protect write access to the device parameters via all the interfaces.
- Bluetooth key:  
The password protects access and the connection between an operating unit, e.g. a smartphone or tablet, and the device via the Bluetooth interface.

#### General notes on the use of passwords

- The access code and Bluetooth key supplied with the device must be defined during commissioning.
- Follow the general rules for generating a secure password when defining and managing the access code and Bluetooth key.
- The user is responsible for the management and careful handling of the access code and Bluetooth key.

### Write protection switch

The entire operating menu can be locked via the write protection switch. The values of the parameters cannot be changed. Write protection is disabled when the device leaves the factory.

Write protection is enabled with the write protection switch on the back of the display module.

## Input

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## Measured variable

### Direct measured variables

- Mass flow
  - Temperature
  - Density\*
- \* Visibility depends on order options or device settings

### Calculated measured variables

- Volume flow
- Corrected volume flow

## Operable flow range

Over 1000 : 1

Flow rates above the set end value do not overload the electronics. The totalized flow volume is measured correctly.

## Measuring range

### Measuring range for liquids

DN		Measuring range full scale values $\dot{m}_{\min(F)}$ to $\dot{m}_{\max(F)}$	
[mm]	[in]	[kg/h]	[lb/min]
8	$\frac{3}{8}$	0 to 2 000	0 to 73.50
15	$\frac{1}{2}$	0 to 6 500	0 to 238.9
25	1	0 to 18 000	0 to 661.5
40	$1\frac{1}{2}$	0 to 45 000	0 to 1 654
50	2	0 to 70 000	0 to 2 573
80	3	0 to 180 000	0 to 6 615

### Measuring range for gases



The full scale value depends on the density and the sound velocity of the gas used and can be calculated with the formula below:

$$\dot{m}_{\max(G)} = \text{minimum} (\dot{m}_{\max(F)} \cdot \rho_G : x ; \rho_G \cdot c_G \cdot \pi/2 \cdot (d_i)^2 \cdot 3600)$$

$\dot{m}_{\max(G)}$	Maximum full scale value for gas [kg/h]
$\dot{m}_{\max(F)}$	Maximum full scale value for liquid [kg/h]
$\dot{m}_{\max(G)} < \dot{m}_{\max(F)}$	$\dot{m}_{\max(G)}$ can never be greater than $\dot{m}_{\max(F)}$
$\rho_G$	Gas density in [kg/m <sup>3</sup> ] at operating conditions
x	Constant dependent on nominal diameter
$c_G$	Sound velocity (gas) [m/s]
$d_i$	Measuring pipe internal diameter [m]

DN		x
[mm]	[in]	[kg/m <sup>3</sup> ]
8	$\frac{3}{8}$	85
15	$\frac{1}{2}$	110
25	1	125
40	$1\frac{1}{2}$	125

DN		x
[mm]	[in]	[kg/m <sup>3</sup> ]
50	2	125
80	3	155

 To calculate the measuring range, use the *Applicator* sizing tool → *Service-specific accessory*,  85

#### Calculation example for gas

- Sensor: Promass K, DN 50
- Gas: Air with a density of 60.3 kg/m<sup>3</sup> (at 20 °C and 50 bar)
- Measuring range (liquid): 70 000 kg/h
- x = 125 kg/m<sup>3</sup> (for Promass K, DN 50)

Maximum possible full scale value:

$$\dot{m}_{\max(G)} = \dot{m}_{\max(F)} \cdot \rho_G : x = 70\,000 \text{ kg/h} \cdot 60.3 \text{ kg/m}^3 : 125 \text{ kg/m}^3 = 33\,800 \text{ kg/h}$$

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## Output

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## Output versions

Order code for 020: output; input	Output version
Option B	<ul style="list-style-type: none"> <li>▪ Current output 4 to 20 mA HART</li> <li>▪ Pulse/frequency/switch output</li> </ul>
Option C	<ul style="list-style-type: none"> <li>▪ Current output 4 to 20 mA HART Ex i</li> <li>▪ Pulse/frequency/switch output Ex i</li> </ul>
Option M	<ul style="list-style-type: none"> <li>▪ Modbus RS485</li> <li>▪ Current output 4 to 20 mA</li> </ul>
Option U	<ul style="list-style-type: none"> <li>▪ Modbus RS485 Ex i</li> <li>▪ Current output 4 to 20 mA Ex i</li> </ul>

## Output signal

### Current output 4 to 20 mA HART

Signal mode	Choose via terminal assignment: <ul style="list-style-type: none"> <li>▪ Active</li> <li>▪ Passive</li> </ul>
Current range	Can be set to: <ul style="list-style-type: none"> <li>▪ 4 to 20 mA NAMUR</li> <li>▪ 4 to 20 mA US</li> <li>▪ 4 to 20 mA</li> <li>▪ Fixed current</li> </ul>
Max. output current	21.5 mA
Open-circuit voltage	DC < 28.8 V (active)
Max. input voltage	DC 30 V (passive)
Max. load	400 Ω
Resolution	1 μA
Damping	Configurable: 0 to 999.9 s
Assignable measured variables	<ul style="list-style-type: none"> <li>▪ Mass flow</li> <li>▪ Volume flow</li> <li>▪ Corrected volume flow</li> <li>▪ Temperature</li> <li>▪ Density*</li> <li>▪ Index inhomogeneous medium</li> <li>▪ Exciter current</li> <li>▪ Oscillation frequency</li> <li>▪ Oscillation amplitude*</li> <li>▪ Frequency fluctuation*</li> <li>▪ Oscillation damping</li> <li>▪ Oscillation damping fluctuation*</li> <li>▪ Signal asymmetry</li> <li>▪ HBSI*</li> <li>▪ Electronic temperature</li> </ul> <p>* Visibility depends on order options or device settings</p>

### Modbus RS485

Physical interface	RS485 in accordance with EIA/TIA-485 standard
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**Current output 4 to 20 mA**

<b>Signal mode</b>	Choose via terminal assignment: <ul style="list-style-type: none"> <li>■ Active</li> <li>■ Passive</li> </ul>
<b>Current range</b>	Can be set to: <ul style="list-style-type: none"> <li>■ 4 to 20 mA NAMUR</li> <li>■ 4 to 20 mA US</li> <li>■ 4 to 20 mA</li> <li>■ Fixed current</li> </ul>
<b>Max. output current</b>	21.5 mA
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<b>Max. input voltage</b>	DC 30 V (passive)
<b>Max. load</b>	400 Ω
<b>Resolution</b>	1 μA
<b>Damping</b>	Configurable: 0 to 999.9 s
<b>Assignable measured variables</b>	<ul style="list-style-type: none"> <li>■ Mass flow</li> <li>■ Volume flow</li> <li>■ Corrected volume flow</li> <li>■ Temperature</li> <li>■ Density*</li> <li>■ Index inhomogeneous medium</li> <li>■ Exciter current</li> <li>■ Oscillation frequency</li> <li>■ Oscillation amplitude*</li> <li>■ Frequency fluctuation*</li> <li>■ Oscillation damping</li> <li>■ Oscillation damping fluctuation*</li> <li>■ Signal asymmetry</li> <li>■ HBSI*</li> <li>■ Electronic temperature</li> </ul> <p>* Visibility depends on order options or device settings</p>

**Pulse/frequency/switch output**

<b>Function</b>	Can be set to: <ul style="list-style-type: none"> <li>■ Pulse output</li> <li>■ Frequency output</li> <li>■ Switch output</li> </ul>
<b>Version</b>	Open collector: Passive
<b>Input values</b>	<ul style="list-style-type: none"> <li>■ DC 10.4 to 30 V</li> <li>■ Max. 140 mA</li> </ul>
<b>Voltage drop</b>	<ul style="list-style-type: none"> <li>■ ≤ DC 2 V @ 100 mA</li> <li>■ ≤ DC 2.5 V @ max. input current</li> </ul>
<b>Pulse output</b>	
<b>Pulse width</b>	Configurable: 0.05 to 2 000 ms
<b>Max. pulse rate</b>	10 000 Impulse/s
<b>Pulse value</b>	Configurable
<b>Assignable measured variables</b>	<ul style="list-style-type: none"> <li>■ Mass flow</li> <li>■ Volume flow</li> <li>■ Corrected volume flow</li> </ul>

Frequency output	
Output frequency	Configurable: end value frequency 2 to 10 000 Hz ( $f_{\max} = 12\,500$ Hz)
Damping	Configurable: 0 to 999.9 s
Pulse/pause ratio	1:1
Assignable measured variables	<ul style="list-style-type: none"> <li>■ Mass flow</li> <li>■ Volume flow</li> <li>■ Corrected volume flow</li> <li>■ Temperature</li> <li>■ Density*</li> <li>■ Index inhomogeneous medium</li> <li>■ Exciter current</li> <li>■ Oscillation frequency</li> <li>■ Oscillation amplitude*</li> <li>■ Frequency fluctuation*</li> <li>■ Oscillation damping</li> <li>■ Oscillation damping fluctuation*</li> <li>■ Signal asymmetry</li> <li>■ HBSI*</li> <li>■ Electronic temperature</li> </ul> <p>* Visibility depends on order options or device settings</p>

Switch output	
Switching behavior	Binary, conductive or non-conductive
Switching delay	Configurable: 0 to 100 s
Number of switching cycles	Unlimited
Assignable functions	<ul style="list-style-type: none"> <li>■ Off</li> <li>■ On</li> <li>■ Diagnostic behavior: <ul style="list-style-type: none"> <li>■ Alarm</li> <li>■ Warning</li> <li>■ Warning and alarm</li> </ul> </li> <li>■ Limit value: <ul style="list-style-type: none"> <li>■ Mass flow</li> <li>■ Volume flow</li> <li>■ Corrected volume flow</li> <li>■ Temperature</li> <li>■ Density*</li> <li>■ Totalizer 1...3</li> <li>■ Oscillation damping</li> </ul> </li> <li>■ Flow direction monitoring</li> <li>■ Status <ul style="list-style-type: none"> <li>■ Partially filled pipe detection</li> <li>■ Low flow cut off</li> </ul> </li> </ul> <p>* Visibility depends on order options or device settings</p>

### Signal on alarm

Output behavior in the event of a device alarm (failure mode)

#### HART

<b>Device diagnostics</b>	Device condition can be read out via HART Command 48
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#### Modbus RS485

<b>Failure mode</b>	Selectable: <ul style="list-style-type: none"> <li>▪ NaN value instead of current value</li> <li>▪ Last valid value</li> </ul>
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#### Current output 4 to 20 mA

<b>4 to 20 mA</b>	Selectable: <ul style="list-style-type: none"> <li>▪ Min. value: 3.59 mA</li> <li>▪ Max. value: 21.5 mA</li> <li>▪ Freely definable value between: 3.59 to 21.5 mA</li> <li>▪ Actual value</li> <li>▪ Last valid value</li> </ul>
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#### Pulse/frequency/switch output

<b>Pulse output</b>	Selectable: <ul style="list-style-type: none"> <li>▪ Actual value</li> <li>▪ No pulses</li> </ul>
<b>Frequency output</b>	Selectable: <ul style="list-style-type: none"> <li>▪ Actual value</li> <li>▪ 0 Hz</li> <li>▪ Defined value: 0 to 12 500 Hz</li> </ul>
<b>Switch output</b>	Selectable: <ul style="list-style-type: none"> <li>▪ Current status</li> <li>▪ Open</li> <li>▪ Closed</li> </ul>

#### Low flow cut off

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

#### Ex connection data

Pay attention to the documentation on Ex connection values .



Safety-related values and intrinsically safe values: Safety Instructions (XA)

#### Galvanic isolation


The outputs are galvanically isolated from one another and from earth.

## Protocol-specific data

### HART

Bus structure	The HART signal overlays the 4 to 20 mA current output.
Manufacturer ID	0x11
Device type ID	0x72
HART protocol revision	7
Device description files (DTM, DD)	Information and files under: <a href="http://www.endress.com">www.endress.com</a>
HART load	At least 250 Ω
System integration	Measured variables via HART protocol

### Modbus RS485

Physical interface	RS485 in accordance with EIA/TIA-485 standard
Terminating resistor	Not integrated
Protocol	Modbus Applications Protocol Specification V1.1
Response times	<ul style="list-style-type: none"> <li>▪ Direct data access: typically 25 to 50 ms</li> <li>▪ Auto-scan buffer (data range): typically 3 to 5 ms</li> </ul>
Device type	Slave
Slave address range	1 to 247
Broadcast address range	0
Function codes	<ul style="list-style-type: none"> <li>▪ 03: Read holding register</li> <li>▪ 04: Read input register</li> <li>▪ 06: Write single registers</li> <li>▪ 08: Diagnostics</li> <li>▪ 16: Write multiple registers</li> <li>▪ 23: Read/write multiple registers</li> </ul>
Broadcast messages	Supported by the following function codes: <ul style="list-style-type: none"> <li>▪ 06: Write single registers</li> <li>▪ 16: Write multiple registers</li> <li>▪ 23: Read/write multiple registers</li> </ul>
Supported baud rate	<ul style="list-style-type: none"> <li>▪ 1 200 BAUD</li> <li>▪ 2 400 BAUD</li> <li>▪ 4 800 BAUD</li> <li>▪ 9 600 BAUD</li> <li>▪ 19 200 BAUD</li> <li>▪ 38 400 BAUD</li> <li>▪ 57 600 BAUD</li> <li>▪ 115 200 BAUD</li> </ul>
Data transfer mode	RTU
Data access	Each parameter can be accessed via Modbus RS485.  For Modbus register information
System integration	Information on system integration . <ul style="list-style-type: none"> <li>▪ Modbus RS485 information</li> <li>▪ Function codes</li> <li>▪ Register information</li> <li>▪ Response time</li> <li>▪ Modbus data map</li> </ul>

## Power supply

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## Terminal assignment



The terminal assignment is documented on an adhesive label.

The following terminal assignment is available:

*Current output 4 to 20 mA HART (active) and pulse/frequency/switch output*

Supply voltage		Output 1				Output 2	
1 (+)	2 (-)	26 (+)	27 (-)	24 (+)	25 (-)	22 (+)	23 (-)
L/+	N/-	Current output 4 to 20 mA HART (active)		-		Pulse/frequency/switch output (passive)	

*Current output 4 to 20 mA HART (passive) and pulse/frequency/switch output*

Supply voltage		Output 1				Output 2	
1 (+)	2 (-)	26 (+)	27 (-)	24 (+)	25 (-)	22 (+)	23 (-)
L/+	N/-	-		Current output 4 to 20 mA HART (passive)		Pulse/frequency/switch output (passive)	

*Modbus RS485 and current output 4 to 20 mA (active)*

Supply voltage		Output 1				Output 2	
1 (+)	2 (-)	26 (+)	27 (-)	24 (+)	25 (-)	22 (B)	23 (A)
L/+	N/-	Current output 4 to 20 mA (active)		-		Modbus RS485	

*Modbus RS485 and current output 4 to 20 mA (passive)*

Supply voltage		Output 1				Output 2	
1 (+)	2 (-)	26 (+)	27 (-)	24 (+)	25 (-)	22 (B)	23 (A)
L/+	N/-	-		Current output 4 to 20 mA (passive)		Modbus RS485	

## Supply voltage

Order code for "Power supply"	Terminal voltage	Frequency range
Option D	DC 24 V	-20 to +30 %
Option E	AC 100 to 240 V	-15 to +10 %
Option I	DC 24 V	-20 to +30 %
	AC 100 to 240 V	-15 to +10 %
Option M non-hazardous area	DC 24 V	-20 to +30 %
	AC 100 to 240 V	-15 to +10 %

## Power consumption

- Transmitter: max. 10 W (active power)
- Switch-on current: max. 36 A (< 5 ms) as per NAMUR Recommendation NE 21

## Current consumption



- Max. 400 mA (24 V)
- Max. 200 mA (110 V, 50/60 Hz; 230 V, 50/60 Hz)

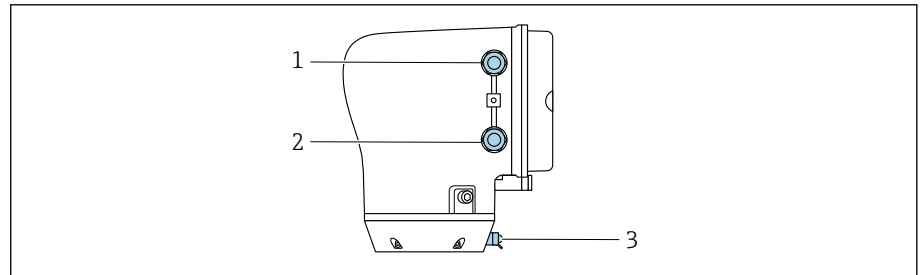
### Power supply failure

- Totalizers stop at the last value measured.
- Device configuration remains unchanged.
- Error messages (incl. total operated hours) are stored.

### Electrical connection

#### Transmitter terminal connections

 Terminal assignment → *Terminal assignment*,  22

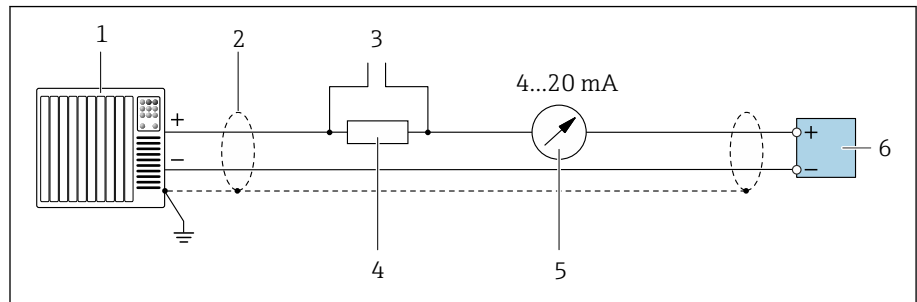


A0045438

- 1 Cable entry for power supply cable: supply voltage
- 2 Cable entry for signal cable
- 3 Ground terminal, outer

### Examples for electric terminals

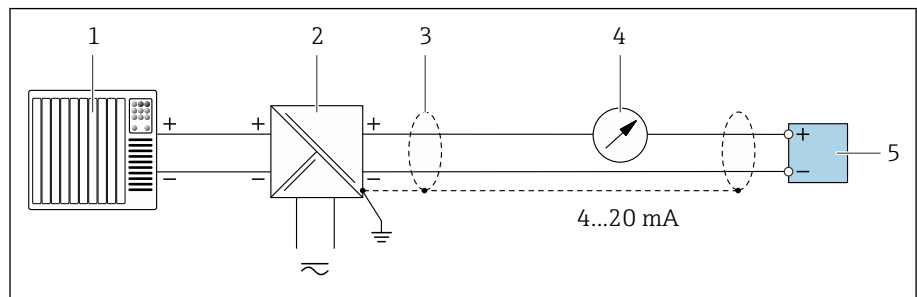
#### Current output 4 to 20 mA HART (active)



A0029055

- 1 Automation system with current input, e.g. PLC
- 2 Cable shield
- 3 Connection for HART operating devices
- 4 Resistor for HART communication ( $\geq 250 \Omega$ ); observe max. load.
- 5 Analog display unit; observe max. load.
- 6 Transmitter

#### Current output 4 to 20 mA HART (passive)

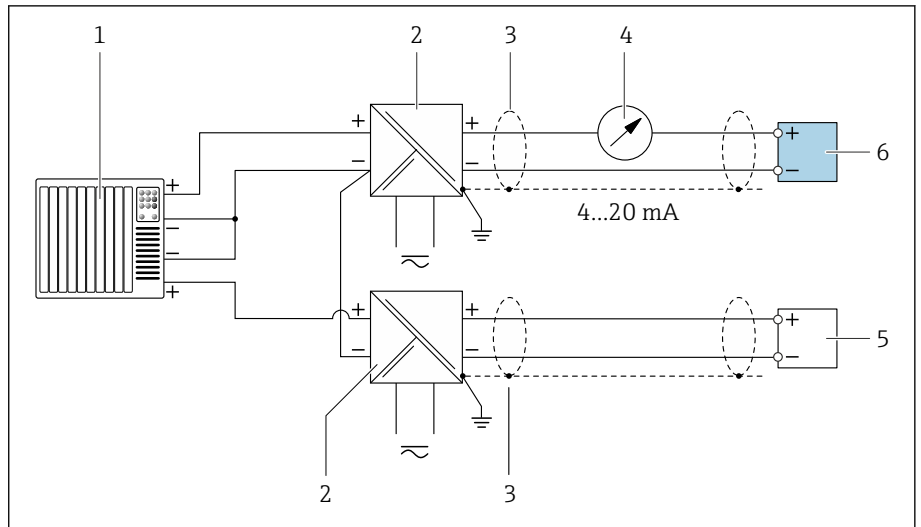


A0028762

- 1 Automation system with current input, e.g. PLC
- 2 Active barrier for supply voltage, e.g. RN221N
- 3 Cable shield
- 4 Analog display unit; observe max. load.
- 5 Transmitter



HART input (passive)

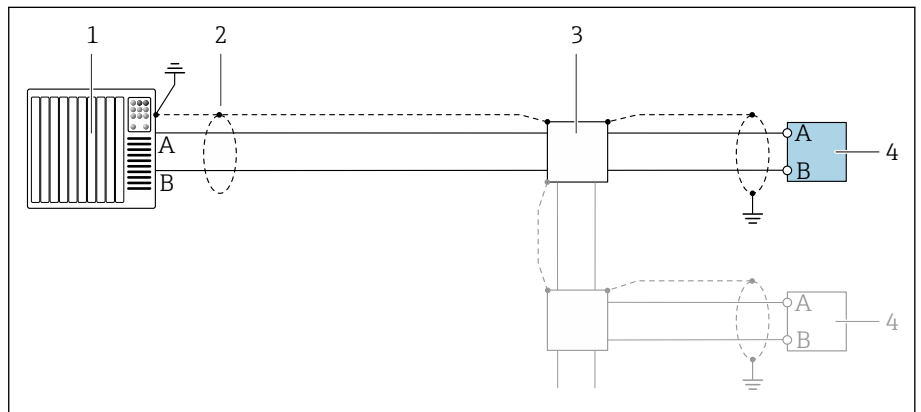


A0028763

1 Connection example for HART input with a common negative (passive)

- 1 Automation system with current input, e.g. PLC
- 2 Active barrier for supply voltage, e.g. RN221N
- 3 Cable shield
- 4 Analog display unit: observe max. load.
- 5 Pressure measuring device, e.g. Cerabar M, Cerabar S: observe requirements
- 6 Transmitter

Modbus RS485

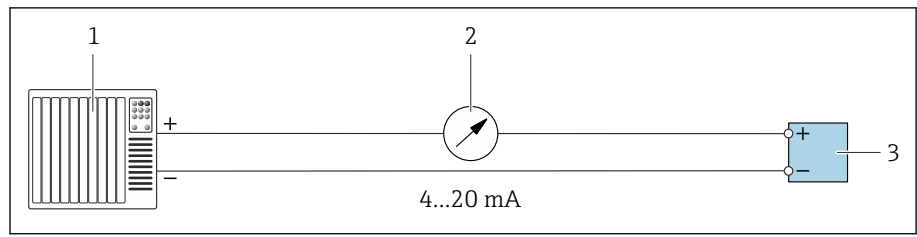


A0028765

2 Connection example for Modbus RS485, non-hazardous area and Zone 2; Class I, Division 2

- 1 Automation system, e.g. PLC
- 2 Cable shield
- 3 Distribution box
- 4 Transmitter

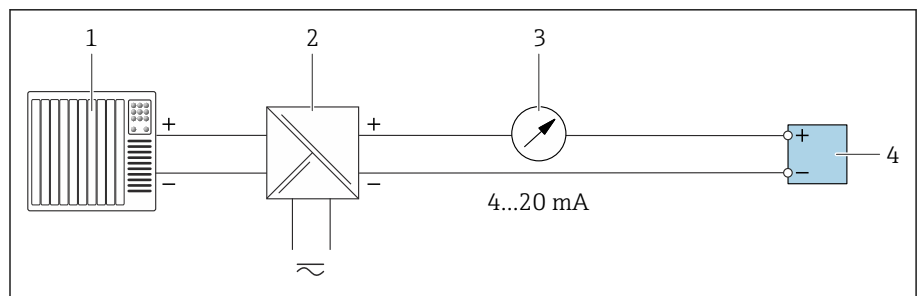
Current output 4 to 20 mA (active)



A0028758

- 1 Automation system with current input, e.g. PLC
- 2 Analog display unit: observe max. load.
- 3 Transmitter

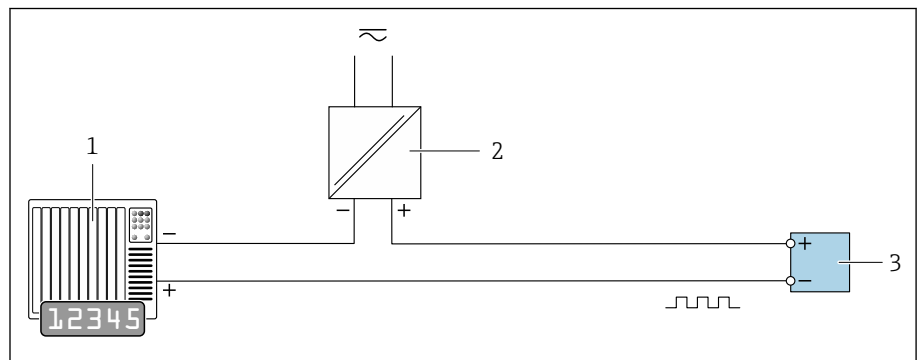
Current output 4 to 20 mA (passive)



A0028759

- 1 Automation system with current input, e.g. PLC
- 2 Active barrier for supply voltage, e.g. RN221N
- 3 Analog display unit: observe max. load.
- 4 Transmitter

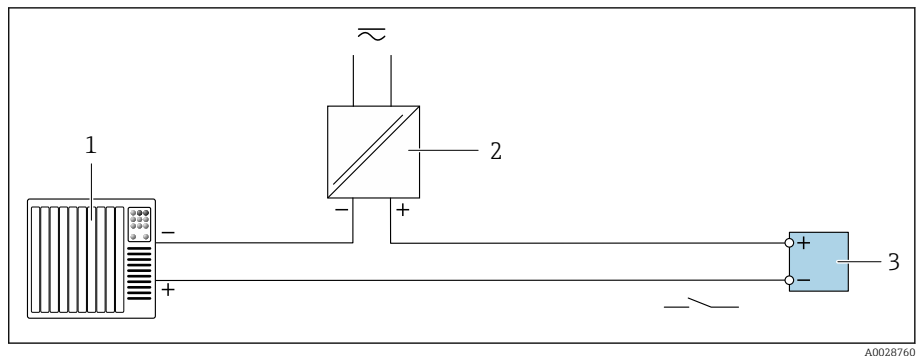
Pulse/frequency output (passive)



A0028761

- 1 Automation system with pulse output and frequency input, e.g. PLC
- 2 Supply voltage
- 3 Transmitter: observe input values.

### Switch output (passive)



- 1 Automation system with switch input, e.g. PLC
- 2 Supply voltage
- 3 Transmitter: observe input values.

### 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

Spring terminals

- Suitable for strands and strands with ferrules.
- Conductor cross-section 0.2 to 2.5 mm<sup>2</sup> (24 to 12 AWG).

### Cable entries

- Cable gland: M20 × 1.5 for cable Ø6 to 12 mm (0.24 to 0.47 in)
- Thread for cable entry:
  - NPT ½"
  - G ½", G ½" Ex d
  - M20

---

## Cable specification

---

Requirements for connecting cable

30

## Requirements for connecting cable

### Electrical safety

As per applicable national regulations.

### Permitted temperature range

- Observe the installation guidelines that apply in the country of installation.
- The cables must be suitable for the minimum temperatures and maximum temperatures to be expected.

### Power supply cable (incl. conductor for the inner ground terminal)

- A standard installation cable is sufficient.
- Provide grounding according to applicable national codes and regulations.

### Signal cable

- Current output 4 to 20 mA HART:  
A shielded cable is recommended, observe the grounding concept of the facility.
- Pulse/frequency/switch output:  
Standard installation cable
- Modbus RS485:  
Cable type A according to EIA/TIA-485 standard is recommended
- Current output 4 to 20 mA:  
Standard installation cable

## Performance characteristics

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Reference operating conditions	32
Maximum measured error	32
Repeatability	33
Response time	33
Influence of ambient temperature	33
Influence of medium temperature	33
Influence of medium pressure	34
Design fundamentals	34

### Reference operating conditions


- Error limits based on ISO 11631
- Water with +15 to +45 °C (+59 to +113 °F) at 2 to 6 bar (29 to 87 psi)
- Data as indicated in the calibration protocol
- Accuracy based on accredited calibration rigs according to ISO 17025

 To obtain measured errors, use the *Applicator* sizing tool → *Service-specific accessory*,  85

### Maximum measured error

o.r. = of reading; 1 g/cm<sup>3</sup> = 1 kg/l; T = medium temperature

### Base accuracy

→ *Design fundamentals*,  34

Mass flow and volume flow (liquids)	±0.5 % o.r. <ul style="list-style-type: none"> <li>▪ Order code for "Calibration flow" option G: ±0.2 %</li> <li>▪ Order code for "Calibration flow" option O: ±0.15 %</li> </ul>
Mass flow (gases)	±1 % o.r.
Density (liquids)	Only devices with the order code for "Application package", option EF <ul style="list-style-type: none"> <li>▪ Under reference operating conditions: ±0.0005 g/cm<sup>3</sup></li> <li>▪ Standard density calibration: ±0.02 g/cm<sup>3</sup> Valid over the entire temperature and density range</li> </ul>
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	$\frac{3}{8}$	0.20	0.007
15	$\frac{1}{2}$	0.65	0.024
25	1	1.80	0.066
40	$1\frac{1}{2}$	4.50	0.165
50	2	7.0	0.257
80	3	18.0	0.6615

### Flow values

Flow values as turndown parameters depending on nominal diameter.

SI units	DN	1:1	1:10	1:20	1:50	1:100	1:500
	[mm]	[kg/h]	[kg/h]	[kg/h]	[kg/h]	[kg/h]	[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
	40	45 000	4 500	2 250	900	450	90
	50	70 000	7 000	3 500	1 400	700	140
	80	180 000	18 000	9 000	3 600	1 800	360



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]
	$\frac{3}{8}$	73.50	7.350	3.675	1.470	0.735	0.147
	$\frac{1}{2}$	238.9	23.89	11.95	4.778	2.389	0.478
	1	661.5	66.15	33.08	13.23	6.615	1.323
	1½	1654	165.4	82.70	33.08	16.54	3.308
	2	2573	257.3	128.7	51.46	25.73	5.146
	3	6615	661.5	330.8	132.3	66.15	13.23

### Accuracy of outputs

Current output	$\pm 5 \mu\text{A}$
Pulse/frequency output	Max. $\pm 100$ ppm o. r. (across the entire ambient temperature range)

### Repeatability

o.r. = of reading; T = medium temperature

→ *Design fundamentals*, 34

Mass flow (liquids)	$\pm 0.1$ % o.r.
Mass flow (gases)	$\pm 0.5$ % o.r.
Density (liquids)	Only devices with the order code for "Application package", option EF $\pm 0.00025 \text{ g/cm}^3$ (1 kg/l)
Temperature	$\pm 0.25 \text{ }^\circ\text{C} \pm 0.0025 \cdot T \text{ }^\circ\text{C}$ ( $\pm 0.45 \text{ }^\circ\text{F} \pm 0.0015 \cdot (T-32) \text{ }^\circ\text{F}$ )

### Response time

The response time depends on the configuration (damping).

### Influence of ambient temperature

Current output	Temperature coefficient max. $1 \mu\text{A}/^\circ\text{C}$
Pulse/frequency output	No additional effect. Is included in the accuracy.

### Influence of medium temperature

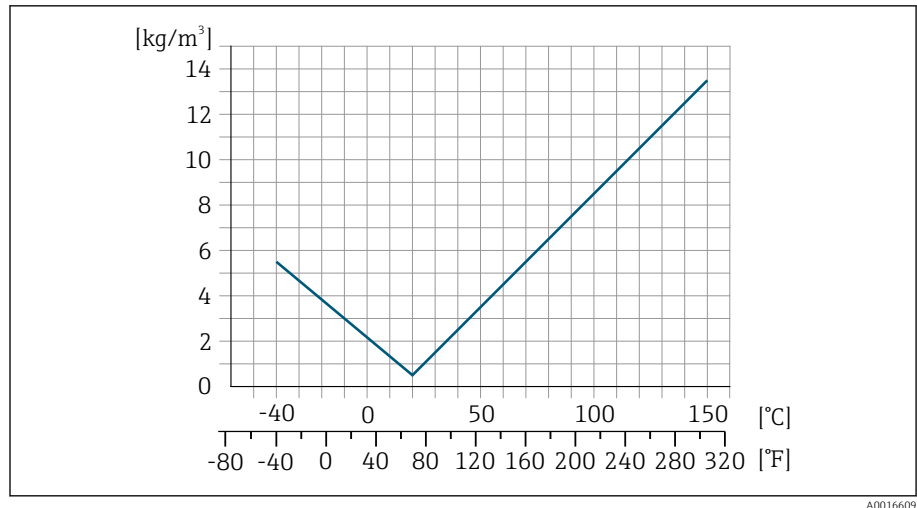
o.f.s. = of full scale value

#### Mass flow and volume flow

- When there is a difference between the temperature for zero point adjustment and the process temperature, the additional measured error of the sensor is typically  $\pm 0.0002$  % o.f.s./ $^\circ\text{C}$  ( $\pm 0.0001$  % o. f.s./ $^\circ\text{F}$ ).
- The effect is reduced if zero point adjustment is performed at process temperature.

#### Density

When there is a difference between the density calibration temperature and the process temperature, the typical measured error of the sensor is  $\pm 0.0001 \text{ g/cm}^3 \text{ }^\circ\text{C}$  ( $\pm 0.00005 \text{ g/cm}^3 \text{ }^\circ\text{F}$ ). Field density calibration is possible.



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

### Temperature

$$\pm 0.005 \cdot T \text{ °C } (\pm 0.005 \cdot (T - 32) \text{ °F})$$

### Influence of medium pressure

o.r. = of reading

The table below shows the effect of a difference in pressure between the calibration pressure and process pressure on the accuracy with mass flow.

- i** It is possible to compensate for the effect by:
  - Reading in the current pressure measured value via the current input.
  - Specifying a fixed value for the pressure in the device parameters.

DN		[% o.r./bar]	[% o.r./psi]
[mm]	[in]		
8	3/8	no influence	
15	1/2	no influence	
25	1	no influence	
40	1 1/2	no influence	
50	2	-0.009	-0.0006
80	3	-0.020	-0.0014

### Design fundamentals

o.r. = of reading

BaseAccu = base accuracy as % o.r

BaseRepeat = base repeatability as % o.r.

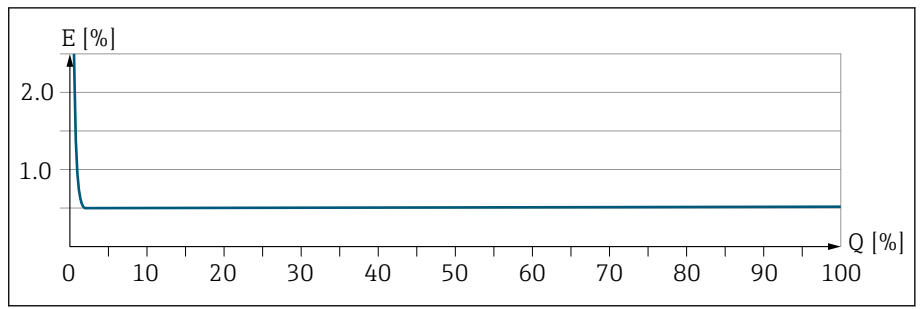
MeasValue = measured value

ZeroPoint = zero point stability

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

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

Example for maximum measured error



A0044672

E Maximum measured error in % o.r. (example)  
 Q Flow rate in % of maximum full scale value

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

Flow rate	$\geq \frac{1/2 \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$	$< \frac{1/2 \cdot \text{ZeroPoint}}{\text{BaseRepeat}} \cdot 100$
Maximum measured error in % o.r.	$\pm \text{BaseRepeat}$	$\pm 1/2 \cdot \frac{\text{ZeroPoint}}{\text{MeasValue}} \cdot 100$

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# Installation

---

Installation conditions

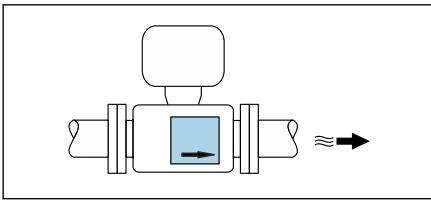
## Installation conditions

### Flow direction

Install the device in the direction of flow.



Note the direction of arrow on the nameplate.

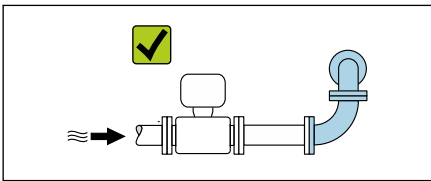


A0041163

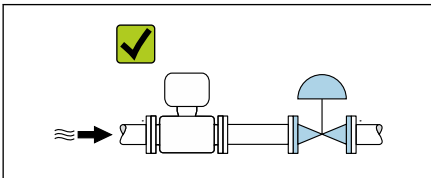
### Inlet runs and outlet runs

If no cavitation effects occur, requirements regarding inlet and outlet runs do not need to be considered during the installation.

To avoid negative pressure, install the sensor upstream from assemblies that produce turbulence (e.g. valves, T-sections) and downstream from pumps .



A0029323

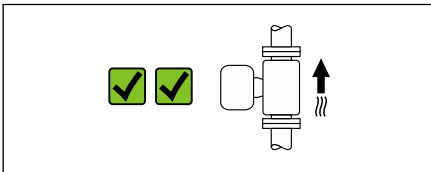


A0029322

### Orientations

#### Vertical orientation, upward direction of flow

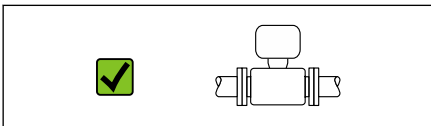
For all applications e.g. self-draining applications



A0041159

#### Horizontal orientation, transmitter at top

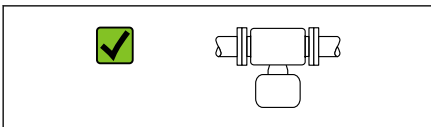
- For applications with low process temperatures in order to maintain the minimum ambient temperature for the transmitter.
- For outgassing media in order to avoid the accumulation of gas.



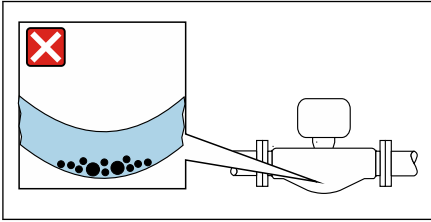
A0041160

#### Horizontal orientation, transmitter at bottom

- For applications with high process temperatures in order to maintain the maximum ambient temperature for the transmitter.
- For media with entrained solids in order to avoid the accumulation of solids.

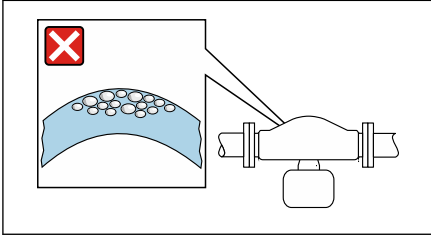


A0041161



A0043063

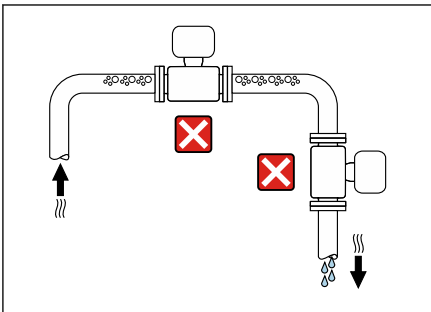
**Horizontal orientation, transmitter with measuring pipe curved downwards**  
Match the sensor position to the medium properties.  
Not suitable for media with entrained solids: solids may accumulate.



A0044717

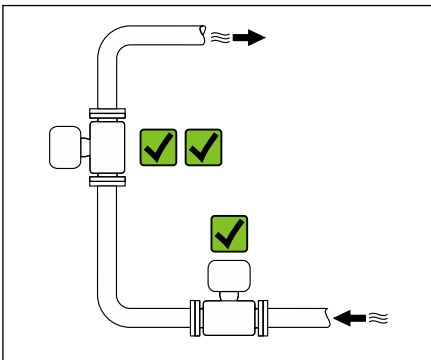
**Horizontal orientation, transmitter with measuring pipe curved upwards**  
Match the sensor position to the medium properties.  
Not suitable for outgassing media: gas may accumulate.

**Mounting locations**



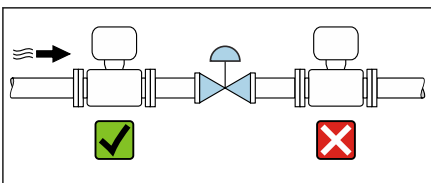
A0042131

- Do not install the device at the highest point of the pipe.
- Do not install the device upstream from a free pipe outlet in a down pipe.



A0042317

**Installation near control valves**

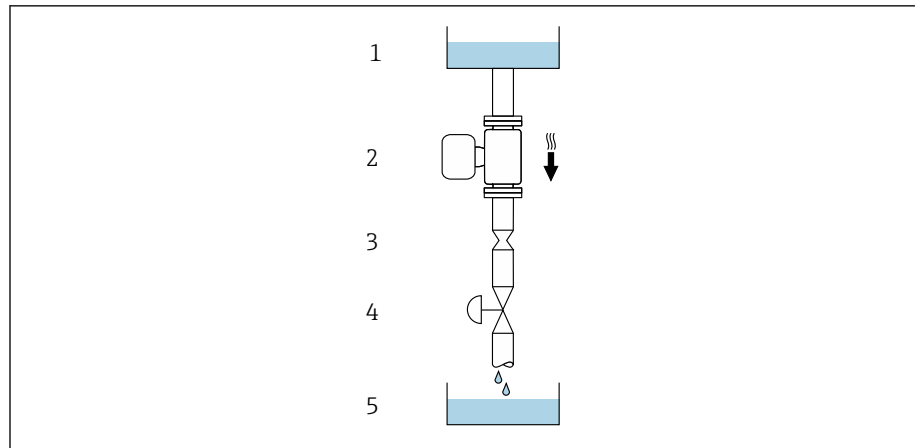


A0041091

Install the device in the direction of flow upstream from the control valve.

**Installation in a down pipe**

Installation suggestion for installation in an open down pipe, e.g. for bottling applications. A pipe restriction or the use of an orifice plate with a smaller cross-section than the nominal diameter prevent the sensor running empty while measurement is in progress.



A0028773

- 1 Supply tank
- 2 Sensor
- 3 Orifice plate or pipe restriction
- 4 Valve
- 5 Filling container

DN		Ø orifice plate, pipe restriction	
[mm]	[in]	[mm]	[in]
8	$\frac{3}{8}$	6	0.24
15	$\frac{1}{2}$	10	0.40
25	1	14	0.55
40	$1\frac{1}{2}$	22	0.87
50	2	28	1.10
80	3	50	1.97

### Rupture disk

Information that is relevant to the process → *Rupture disk*, 49.

#### **⚠ WARNING**

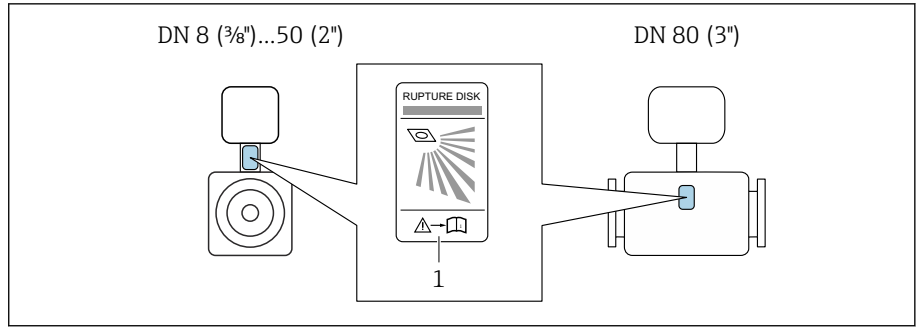
#### **A missing or damaged rupture disk can put staff at risk!**

Medium escaping under pressure can cause serious injury or material damage.

- ▶ Ensure that any danger to persons or material damage is ruled out if the rupture disk is actuated.
- ▶ Observe information on the rupture disk sticker.
- ▶ Make sure that the function and operation of the rupture disk is not impeded during the installation of the device.
- ▶ Do not use a heating jacket.
- ▶ Do not remove or damage the rupture disk.
  
- ▶ After the rupture disk is actuated, do not operate the device any longer.

The position of the rupture disk is indicated by a sticker affixed to the device. If the rupture disk is triggered, the sticker is destroyed. The disk can therefore be visually monitored.

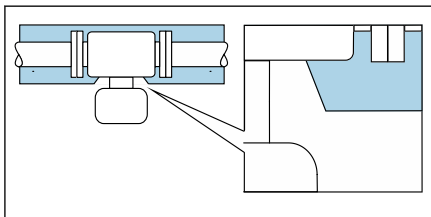




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1 Rupture disk sticker

**Sensor thermal insulation**



A0044122

**NOTICE**

**If the meter electronics overheat this can damage the device!**

- ▶ Keep the housing support completely free (heat dissipation).

- ▶ Provide insulation but make sure it does not go beyond the upper edge of the two sensor half-shells.

**Heating**

**NOTICE**

**Ambient temperature too high!**

If the electronics overheat this can damage the transmitter housing.

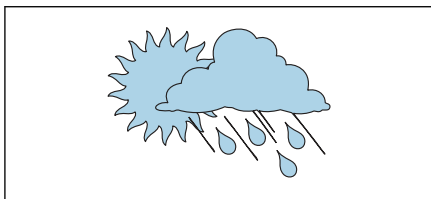
- ▶ Do not exceed the permissible temperature range for the ambient temperature.
- ▶ Use a weather protection cover.
  
- ▶ Mount the device correctly.

**Heating options**

- Electrical heating, e.g. with electric band heaters
- Via pipes carrying hot water or steam
- Via heating jackets

**i** Heating jackets for the sensors can be ordered as accessories from Endress +Hauser: .

**Outdoor use**



A0023989

- Avoid exposure to direct sunlight.
- Install in a location protected from sunlight.
- Avoid direct exposure to weather conditions.
- Use a weather protection cover → *Transmitter*, 84.



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## Environment

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Ambient temperature range	44
Storage temperature	44
Climate class	44
Degree of protection	44
Vibration-resistance and shock-resistance	44
Electromagnetic compatibility (EMC)	44
Interior cleaning	44

## Ambient temperature range

<b>Transmitter and sensor</b>	-40 to +60 °C (-40 to +140 °F)
<b>Local display</b>	-20 to +60 °C (-4 to +140 °F) The readability of the display may be impaired at temperatures outside the temperature range.
	 Dependency of ambient temperature on medium temperature → <i>Medium temperature range</i> , 46
	 If using the device in hazardous areas, observe the "Safety Instructions" documentation.

## Storage temperature

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

## Climate class

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

## Degree of protection

<b>Transmitter</b>	<ul style="list-style-type: none"> <li>▪ IP66/67, type 4X enclosure</li> <li>▪ Open housing: IP20, type 1 enclosure</li> </ul>
<b>Sensor</b>	IP66/67, type 4X enclosure

## Vibration-resistance and shock-resistance

<b>Vibration, sinusoidal</b> <ul style="list-style-type: none"> <li>▪ Following IEC 60068-2-6</li> <li>▪ 20 cycles per axis</li> </ul>	2 to 8.4 Hz	3.5 mm peak
	8.4 to 2 000 Hz	1 g peak
<b>Vibration, broad-band random</b> <ul style="list-style-type: none"> <li>▪ Following IEC 60068-2-64</li> <li>▪ 120 min per axis</li> </ul>	10 to 200 Hz	0.003 g <sup>2</sup> /Hz
	200 to 2 000 Hz	0.001 g <sup>2</sup> /Hz (1.54 g rms)
<b>Shocks, half-sine</b> <ul style="list-style-type: none"> <li>▪ Following IEC 60068-2-27</li> <li>▪ 3 positive and 3 negative shocks</li> </ul>	6 ms 30 g	

### Shock

Due to rough handling according to IEC 60068-2-31.

## Electromagnetic compatibility (EMC)

As per IEC/EN 61326 and NAMUR Recommendation NE 21.



For more information: Declaration of Conformity

## Interior cleaning

Available methods of internal cleaning:

- Cleaning in place (CIP)
- Sterilization in place (SIP)

## Process

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Medium temperature range	46
Density	46
Flow limit	46
Pressure-temperature ratings	46
Sensor housing	49
Rupture disk	49
Pressure loss	50

## Medium temperature range

-40 to +150 °C (-40 to +302 °F)

## Density

0 to 5 000 kg/m<sup>3</sup> (0 to 312 lb/cf)

## Flow limit

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

**i** For an overview of the measuring range full scale values: → *Measuring range*, 12

- The minimum recommended full scale value is approx. 1/20 of the maximum full scale value
- For the most common applications, 20 to 50 % of the maximum full scale value can be considered ideal
- A low full scale value must be selected for abrasive media (such as liquids with entrained solids): flow velocity < 1 m/s (< 3 ft/s).
- For gas measurement the following rules apply:
  - The flow velocity in the measuring pipes should not exceed half the sound velocity (0.5 Mach).
  - The maximum mass flow depends on the density of the gas: formula → *Measuring range for gases*, 12

**i** To calculate the flow limit, use the *Applicator* sizing tool → *Service-specific accessory*, 85

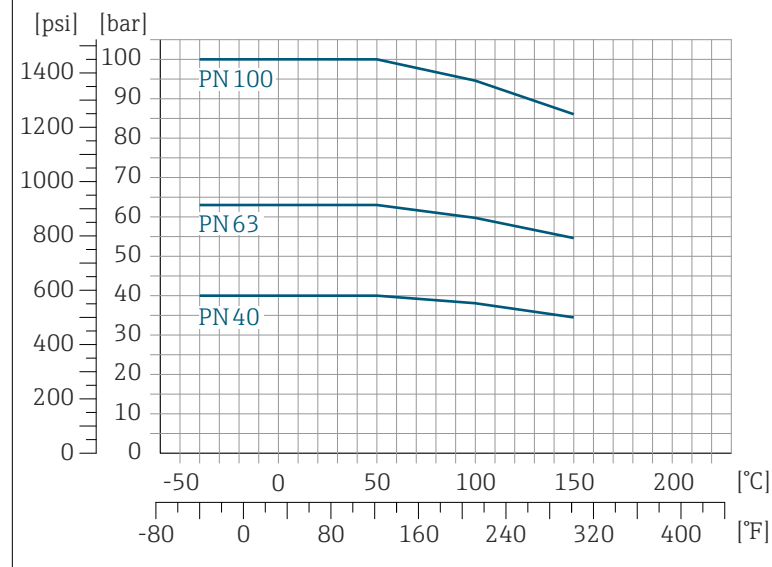
## Pressure-temperature ratings

Maximum permitted medium pressure as a function of the medium temperature.

The data relate to all pressure bearing parts of the device.

### Flange according to EN 1092-1

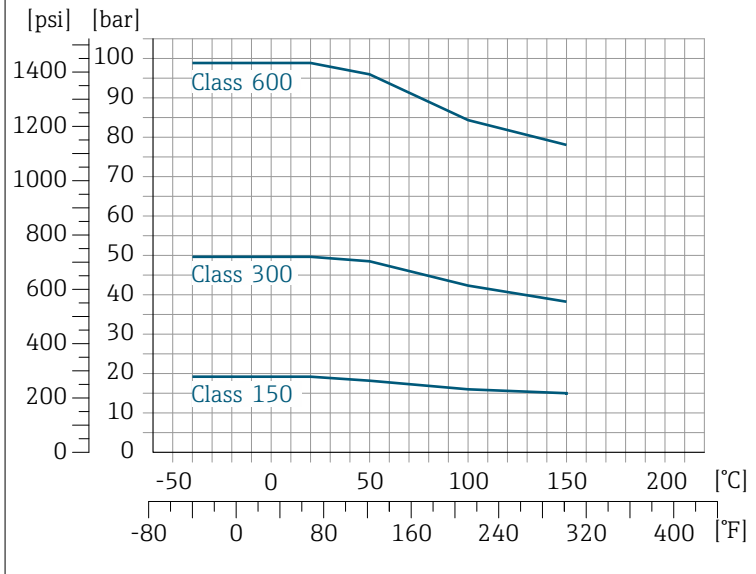
Flange material 1.4404 (F316/F316L)



A0029832-EN

**Flange according to ASME B16.5**

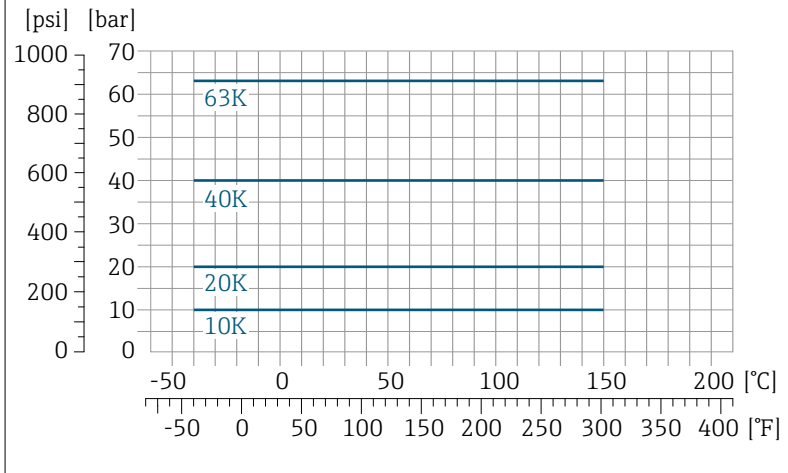
Flange material 1.4404 (F316/F316L)



A0029833-EN

**Fixed flange JIS B2220**

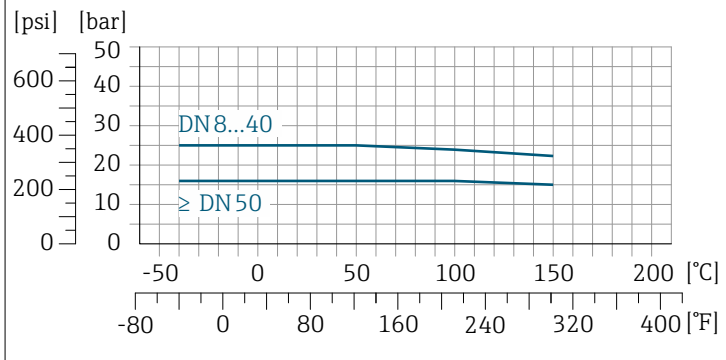
Flange material 1.4404 (F316/F316L)



A0029834-EN

**Flange DIN 11864-2 Form A**

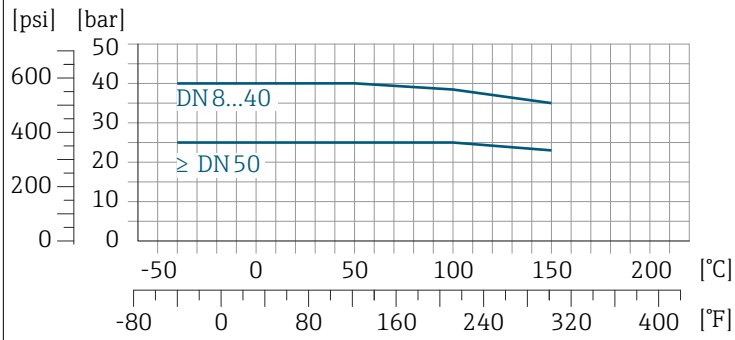
Flange material 1.4404 (F316/F316L)



A0029839-EN

**Thread DIN 11864-1 Form A**

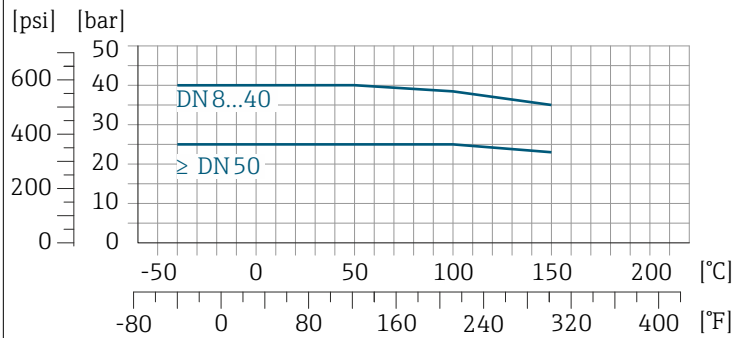
Connection material 1.4404 (F316/F316L)



A0029848-EN

**Thread DIN 11851**

Connection material 1.4404 (F316/F316L)

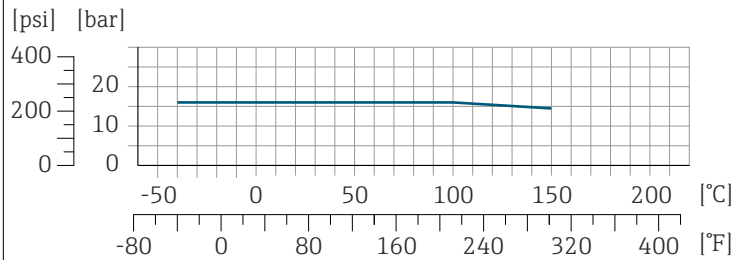


A0029848-EN

DIN 11851 allows for applications up to +140 °C (+284 °F) if suitable sealing materials are used. Please take this into account when selecting seals and counterparts, as these components can limit the pressure and temperature range.

**Thread ISO 2853**

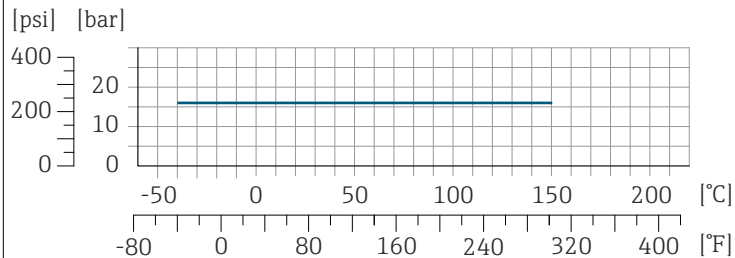
Connection material 1.4404 (F316/F316L)



A0029853-EN

**Thread SMS 1145**

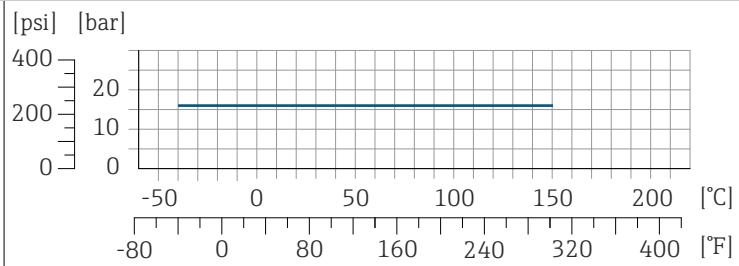
Connection material 1.4404 (F316/F316L)



A0032218-EN



**Tri-Clamp**



A0032218-EN

The clamp connections are suitable up to a maximum pressure of 16 bar (232 psi). Please observe the operating limits of the clamp and seal used as they can be over 16 bar (232 psi). The clamp and seal are not included in the scope of supply.

**Sensor housing**

The sensor housing is filled with dry nitrogen gas and protects the electronics and mechanics inside.

**i** If a measuring pipe fails, e.g. due to process characteristics like corrosive or abrasive media, the medium will be contained by the sensor housing.

If a measuring pipe fails, the pressure level inside the sensor housing will rise according to the operating pressure. If the user judges that the sensor housing burst pressure does not provide an adequate safety margin, the device can be fitted with a rupture disk. The rupture disk prevents excessively high pressure from forming inside the sensor housing. The rupture disk is urgently recommended in the following applications:

- For high gas pressures
- Process pressure is higher than 2/3 of the burst pressure of the sensor housing.

**Sensor housing burst pressure**

If the device is fitted with a rupture disk (order code for "Sensor option", option CA "Rupture disk"), the rupture disk trigger pressure is decisive.

The sensor housing burst pressure refers to a typical internal pressure which is reached prior to mechanical failure of the sensor housing and which was determined during type testing. The corresponding type test declaration can be ordered with the device (order code for "Additional approval", option LN "Sensor housing burst pressure, type test").

DN		Sensor housing burst pressure	
[mm]	[in]	[bar]	[psi]
8	3/8	250	3 620
15	1/2	250	3 620
25	1	250	3 620
40	1 1/2	200	2 900
50	2	180	2 610
80	3	120	1 740

For information on the dimensions: see the "Mechanical construction" section → *Mechanical construction*, 52.


**Rupture disk**

- Order code for "Sensor option", option CA
- Trigger pressure: 10 to 15 bar (145 to 217.5 psi)

The use of a rupture disk cannot be combined with a heating jacket.

### Pressure loss



To calculate the pressure loss, use the *Applicator* sizing tool → *Service-specific accessory* ,  85

## Mechanical construction

---

Weight	52
Materials	53
Process connections	53
Surface roughness	53

## Weight

All values refer to devices with EN/DIN PN 40 flanges

Weight information including transmitter as per order code for "Housing", option A "Aluminum, coated".

Different values due to different transmitter versions:

Transmitter version for the hazardous area: +1 kg (+2.2 lbs)

### Weight in SI units

DN [mm]	Weight [kg]
8	6
15	6.5
25	8
40	12
50	17
80	33

### Weight in US units

DN [in]	Weight [lbs]
3/8	13
1/2	14
1	18
1 1/2	26
2	37
3	73

## Materials

Transmitter housing	
Order code for "Housing"	Option A: aluminum, AlSi10Mg, coated
Window material	Glass
Cable glands and entries	
Cable gland M20×1.5	<ul style="list-style-type: none"> <li>▪ Non-hazardous area: plastic</li> <li>▪ Hazardous area: brass</li> </ul>
Adapter for cable entry with female thread G ½" or NPT ½"	Nickel-plated brass
Sensor housing	
	<ul style="list-style-type: none"> <li>▪ Acid and alkali-resistant outer surface</li> <li>▪ Stainless steel 1.4301 (304)</li> </ul>
Measuring pipes	
	Stainless steel: 1.4539 (904L) Manifold: stainless steel, 1.4404 (316L)
Seals	
	Welded process connections without internal seals
Process connections	
<ul style="list-style-type: none"> <li>▪ EN 1092-1 (DIN 2501)</li> <li>▪ ASME B16.5</li> <li>▪ JIS B2220</li> </ul>	Stainless steel, 1.4404 (F316/F316L)
Other process connections	Stainless steel, 1.4404 (316/316L)
Accessories	
Protective cover	Stainless steel, 1.4404 (316L)

## Process connections

- Fixed flange connections:
  - EN 1092-1 (DIN 2501) flange
  - ASME B16.5 flange
  - JIS B2220 flange
  - DIN 11864-2 Form A flange, DIN 11866 series A, flange with notch
- Clamp connections:
  - Tri-Clamp (OD tubes), DIN 11866 series C
- Thread:
  - DIN 11851 thread, DIN 11866 series A
  - SMS 1145 thread
  - ISO 2853 thread, ISO 2037
  - DIN 11864-1 Form A thread, DIN 11866 series A

## Surface roughness

All data relate to parts in contact with medium. The following surface roughnesses can be ordered:

- Not polished
- $Ra_{max} = 0.76 \mu\text{m}$  (30  $\mu\text{in}$ )

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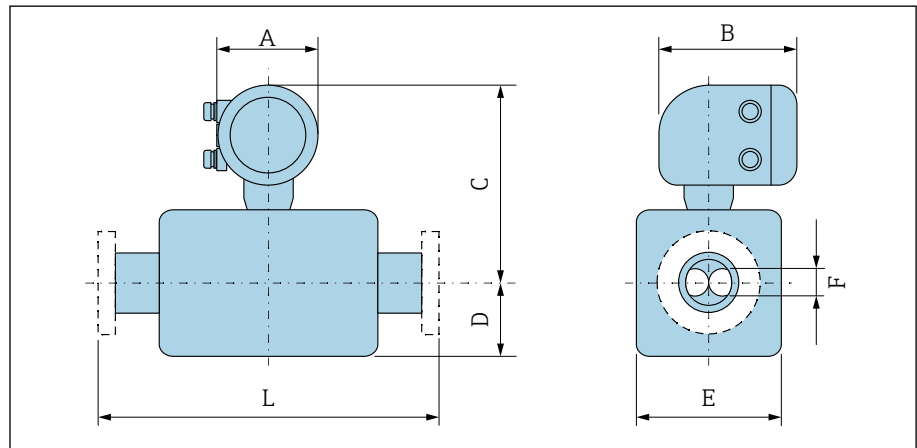
## Dimensions in SI units

---

<b>Compact version</b>	<b>56</b>
Order code for "Housing", option A "Aluminum, coated"	56
Order code for "Housing", option A "Aluminum, coated"; Zone 1	57
<b>Fixed flange</b>	<b>58</b>
Flange according to EN 1092-1 (DIN 2501): PN 40	58
Flange according to ASME B16.5: Class 150	59
Flange according to ASME B16.5: Class 300	59
Flange JIS B2220: 20K	60
Flange JIS B2220: 40K	60
Flange DIN 11864-2 Form A, flange with notch	61
<b>Clamp connections</b>	<b>62</b>
Tri-Clamp	62
<b>Couplings</b>	<b>63</b>
Thread as per DIN 11851	63
Thread as per DIN 11864-1 Form A	63
Thread as per SMS 1145	64
Thread as per ISO 2853	64
<b>Accessories</b>	<b>65</b>
Protective cover	65

## Compact version

Order code for "Housing", option A "Aluminum, coated"



A0043228

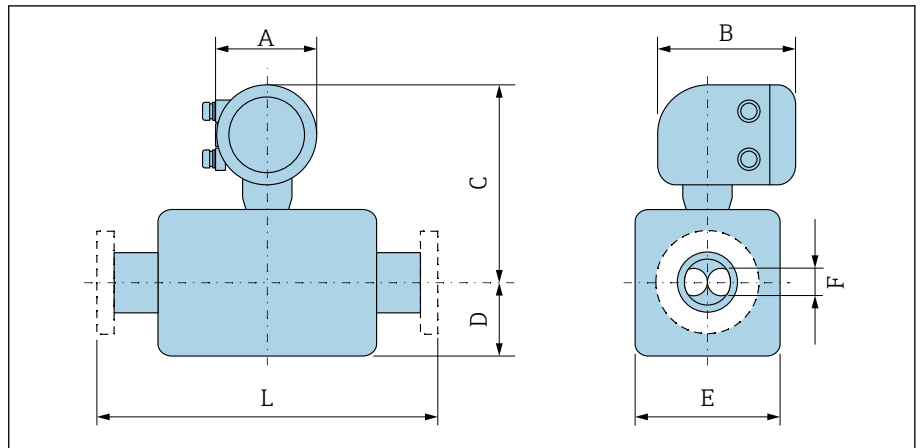
The dimension L depends on the specific process connection:

DN [mm]	A <sup>1)</sup> [mm]	B [mm]	C [mm]	D [mm]	E [mm]	F [mm]
8	139	178	254	89	45	5.35
15	139	178	254	100	45	8.30
25	139	178	251	102	51	12.0
40	139	178	257	121	65	17.6
50	139	178	271	175.5	95	26.0
80	139	178	291	205	127	40.5

1) Depending on the cable gland used: values up to +30 mm



Order code for "Housing", option A "Aluminum, coated"; Zone 1



The dimension L depends on the specific process connection:

DN [mm]	A <sup>1)</sup> [mm]	B <sup>2)</sup> [mm]	C [mm]	D [mm]	E [mm]	F [mm]
8	139	206	246	89	45	5.35
15	139	206	246	100	45	8.30
25	139	206	243	102	51	12.0
40	139	206	249	121	65	17.6
50	139	206	263	175.5	95	26.0
80	139	206	282	205	127	40.5

- 1) Depending on the cable gland used: values up to +30 mm
- 2) For Ex de: values +10 mm

## Fixed flange

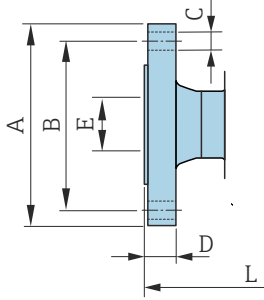
### Flange according to EN 1092-1 (DIN 2501): PN 40

Order code for "Process connection", option D2S

1.4404 (F316/F316L)

DN 8 with DN 15 flanges as standard

Surface roughness (flange): EN 1092-1 Form B1 (DIN 2526 Form C), Ra 3.2 to 12.5  $\mu\text{m}$



A0042813

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
8	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
40	150	110	4 × Ø18	18	43.1	445
50	165	125	4 × Ø18	20	54.5	556
80	200	160	8 × Ø18	24	82.5	611

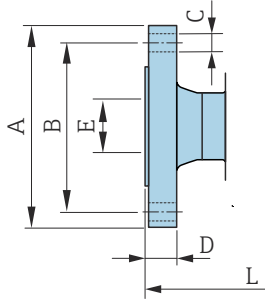
**Flange according to ASME B16.5: Class 150**

Order code for "Process connection", option AAS

1.4404 (F316/F316L)

DN 8 with DN 15 flanges as standard

Surface roughness (flange): Ra 3.2 to 12.5 µm



A0042813

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
8	90	60.3	4 × Ø15.7	11.2	15.7	232
15	90	60.3	4 × Ø15.7	11.2	15.7	279
25	110	79.4	4 × Ø15.7	14.2	26.7	329
40	125	98.4	4 × Ø15.7	17.5	40.9	445
50	150	120.7	4 × Ø19.1	19.1	52.6	556
80	190	152.4	4 × Ø19.1	23.9	78.0	611

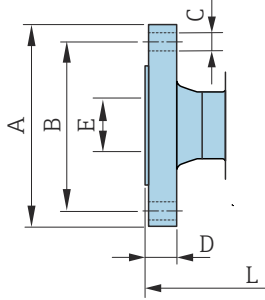
**Flange according to ASME B16.5: Class 300**

Order code for "Process connection", option ABS

1.4404 (F316/F316L)

DN 8 with DN 15 flanges as standard

Surface roughness (flange): Ra 3.2 to 12.5 µm



A0042813

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
8	95	66.7	4 × Ø15.7	14.2	15.7	232
15	95	66.7	4 × Ø15.7	14.2	15.7	279
25	125	88.9	4 × Ø19.0	17.5	26.7	329
40	155	114.3	4 × Ø22.3	20.6	40.9	445
50	165	127	8 × Ø19.0	22.3	52.6	556
80	210	168.3	8 × Ø22.3	28.4	78.0	611

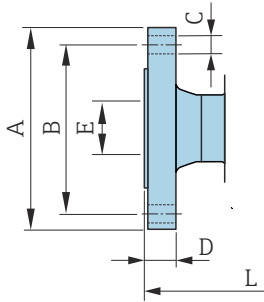
**Flange JIS B2220: 20K**

Order code for "Process connection", option NES

1.4404 (F316/F316L)

DN 8 with DN 15 flanges as standard

Surface roughness (flange): Ra 3.2 to 12.5 µm



A0042813

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
8	95	70	4 × Ø15	14	15	232
15	95	70	4 × Ø15	14	15	279
25	125	90	4 × Ø19	16	25	329
40	140	105	4 × Ø19	18	40	445
50	155	120	8 × Ø19	18	50	556
80	200	160	8 × Ø23	22	80	603

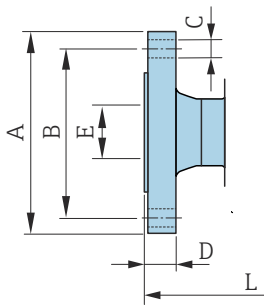
**Flange JIS B2220: 40K**

Order code for "Process connection", option NGS

1.4404 (F316/F316L)

DN 8 with DN 15 flanges as standard

Surface roughness (flange): Ra 3.2 to 12.5 µm



A0042813

DN [mm]	A [mm]	B [mm]	C [mm]	D [mm]	E [mm]	L [mm]
8	115	80	4 × Ø19	20	15	261
15	115	80	4 × Ø19	20	15	300
25	130	95	4 × Ø19	22	25	375
40	160	120	4 × Ø23	24	38	496
50	165	130	8 × Ø19	26	50	601
80	210	170	8 × Ø23	32	75	661

**Flange DIN 11864-2 Form A, flange with notch**

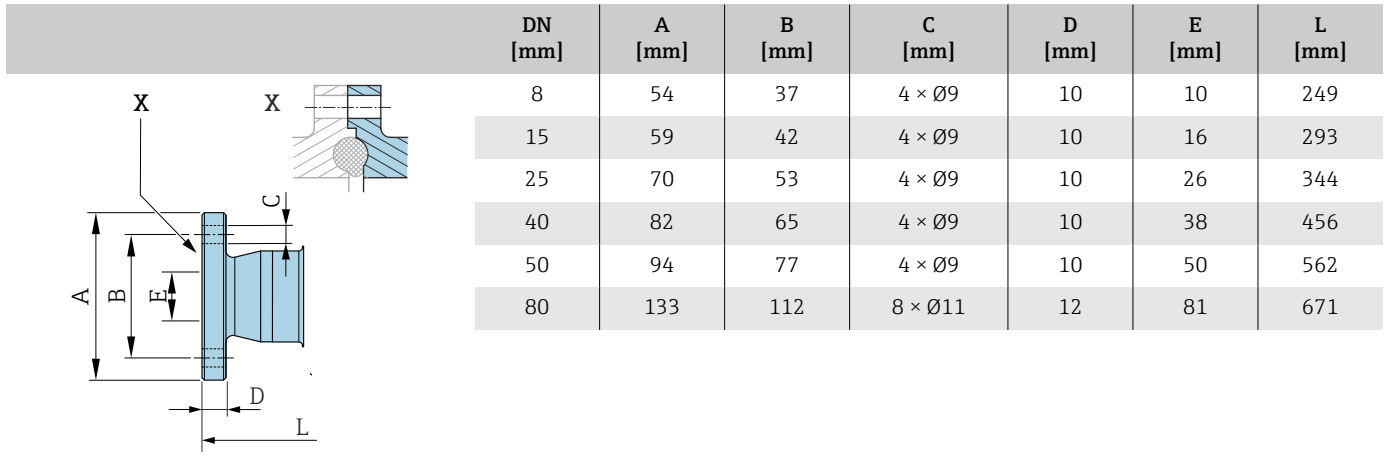
Order code for "Process connection", option KCS

1.4404 (316/316L)

Suitable for pipe as per DIN11866 series A, flange with notch

Surface roughness:  $Ra_{max} = 0.76 \mu m$

 Length tolerance for dimension L in mm:  
+1.5 / -2.0



A0042819

## Clamp connections

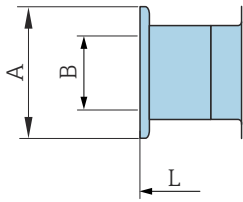
### Tri-Clamp

Order code for "Process connection", option FTS

1.4404 (316/316L)

Suitable for pipe according to DIN 11866 series C

Surface roughness:  $Ra_{max} = 0.76 \mu m$



A0043179

DN [mm]	Clamp [mm]	A [mm]	B [mm]	L [mm]
8	1	50.4	22.1	229
15	1	50.4	22.1	273
25	1	50.4	22.1	324
40	1½	50.4	34.8	456
50	2	63.9	47.5	562
80	3	90.9	72.9	671

## Couplings

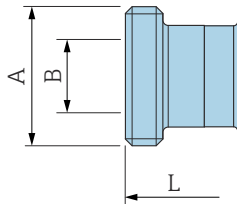
### Thread as per DIN 11851

Order code for "Process connection", option FMW

1.4404/316L

Suitable for pipe as per DIN11866 series A

Surface roughness:  $Ra_{max} = 0.76 \mu m$



A0043257

DN [mm]	A [mm]	B [mm]	L [mm]
8	Rd $34 \times \frac{1}{8}$	16	229
15	Rd $34 \times \frac{1}{8}$	16	273
25	Rd $52 \times \frac{1}{6}$	26	324
40	Rd $65 \times \frac{1}{6}$	38	456
50	Rd $78 \times \frac{1}{6}$	50	562
80	Rd $110 \times \frac{1}{4}$	81	671

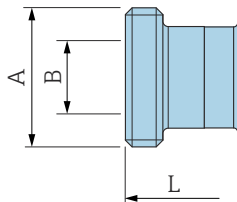
### Thread as per DIN 11864-1 Form A

Order code for "Process connection", option FLW

1.4404/316L

Suitable for pipe as per DIN11866 series A

Surface roughness:  $Ra_{max} = 0.76 \mu m$



A0043257

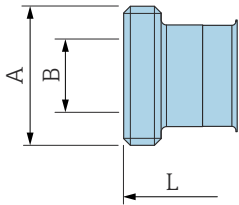
DN [mm]	A [mm]	B [mm]	L [mm]
8	Rd $28 \times \frac{1}{8}$	10	229
15	Rd $34 \times \frac{1}{8}$	16	273
25	Rd $52 \times \frac{1}{6}$	26	324
40	Rd $65 \times \frac{1}{6}$	38	456
50	Rd $78 \times \frac{1}{6}$	50	562
80	Rd $110 \times \frac{1}{4}$	81	671

**Thread as per SMS 1145**

Order code for "Process connection", option SCS

1.4404 (316/316L)

Surface roughness:  $Ra_{max} = 0.76 \mu m$



A0043257

DN [mm]	A [mm]	B [mm]	L [mm]
8	Rd $40 \times \frac{1}{6}$	22.5	229
15	Rd $40 \times \frac{1}{6}$	22.5	273
25	Rd $40 \times \frac{1}{6}$	22.5	324
40	Rd $60 \times \frac{1}{6}$	35.5	456
50	Rd $70 \times \frac{1}{6}$	48.5	562
80	Rd $98 \times \frac{1}{6}$	72.9	671

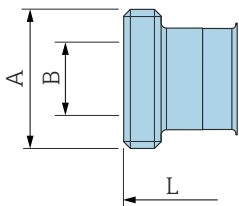
**Thread as per ISO 2853**

Order code for "Process connection", option JSF

1.4404 (316/316L)

Max. thread diameter A as per ISO 2853 Annex A

Surface roughness:  $Ra_{max} = 0.76 \mu m$



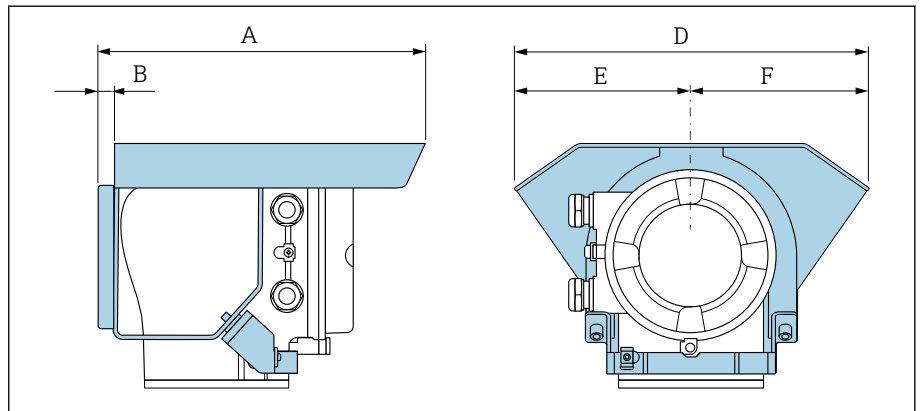
A0043257

DN [mm]	A [mm]	B [mm]	L [mm]
8	37.13	22.6	229
15	37.13	22.6	273
25	37.13	22.6	324
40	50.68	35.6	456
50	64.16	48.6	562
80	91.19	72.9	671



## Accessories

### Protective cover



A0042332

A [mm]	B [mm]	D [mm]	E [mm]	F [mm]
257	12	280	140	140

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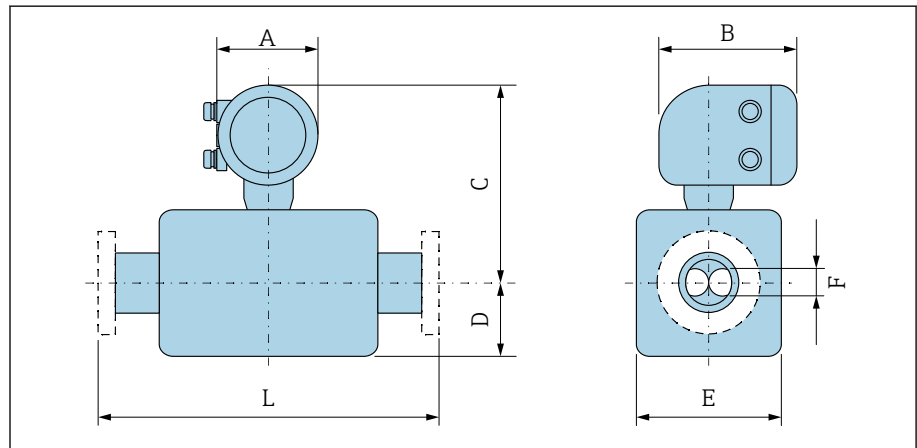
## Dimensions in US units

---

<b>Compact version</b>	<b>68</b>
Order code for "Housing", option A "Aluminum, coated"	68
Order code for "Housing", option A "Aluminum, coated"; Zone 1	69
<b>Fixed flange</b>	<b>70</b>
Flange according to ASME B16.5: Class 150	70
Flange according to ASME B16.5: Class 300	70
<b>Clamp connections</b>	<b>71</b>
Tri-Clamp	71
<b>Couplings</b>	<b>71</b>
Thread as per SMS 1145	71
<b>Accessories</b>	<b>72</b>
Protective cover	72

### Compact version

Order code for "Housing", option A "Aluminum, coated"



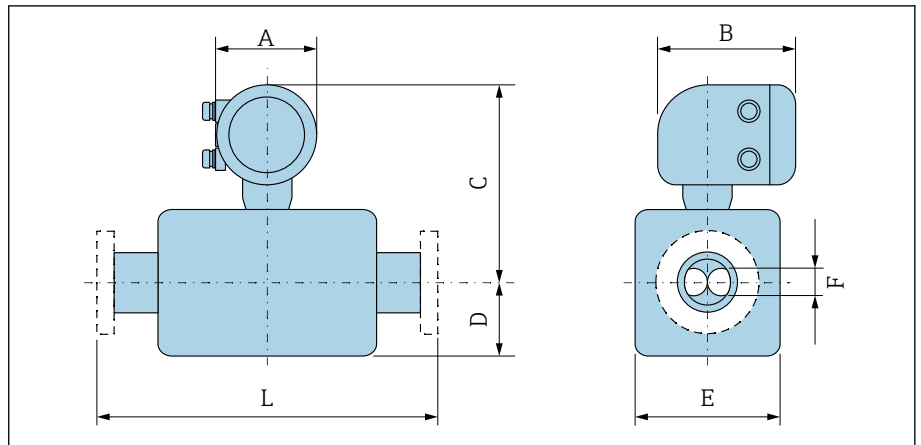
A0043228

The dimension L depends on the specific process connection:

DN [in]	A <sup>1)</sup> [in]	B [in]	C [in]	D [in]	E [in]	F [in]
$\frac{3}{8}$	5.47	7.01	10	3.5	1.77	0.211
$\frac{1}{2}$	5.47	7.01	10	3.94	1.77	0.33
1	5.47	7.01	9.88	4.02	2.01	0.47
1½	5.47	7.01	10.12	4.76	2.56	0.69
2	5.47	7.01	10.67	6.91	3.74	1.02
3	5.47	7.01	11.46	8.07	5	1.59

1) Depending on the cable gland used: values up to 1.18 in

Order code for "Housing", option A "Aluminum, coated"; Zone 1



The dimension L depends on the specific process connection:

DN [in]	A <sup>1)</sup> [in]	B <sup>2)</sup> [in]	C [in]	D [in]	E [in]	F [in]
3/8	5.47	8.11	9.69	3.5	1.77	0.211
1/2	5.47	8.11	9.69	3.94	1.77	0.33
1	5.47	8.11	9.57	4.02	2.01	0.47
1 1/2	5.47	8.11	9.8	4.76	2.56	0.69
2	5.47	8.11	10.35	6.91	3.74	1.02
3	5.47	8.11	11.1	8.07	5	1.59

- 1) Depending on the cable gland used: values up to 1.18 in
- 2) For Ex de: values 0.39 in

### Fixed flange

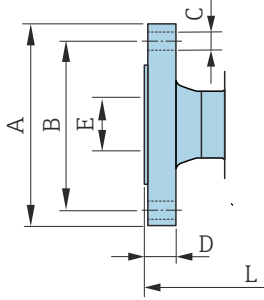
#### Flange according to ASME B16.5: Class 150

Order code for "Process connection", option AAS

1.4404 (F316/F316L)

DN 3/8" with DN 1/2" flanges as standard

Surface roughness (flange): Ra 12.5 to 492 µin



A0042813

DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	L [in]
3/8	3.54	2.37	4 × Ø0.62	0.44	0.62	9.13
1/2	3.54	2.37	4 × Ø0.62	0.44	0.62	10.98
1	4.33	3.13	4 × Ø0.62	0.56	1.05	12.95
1 1/2	4.92	3.87	4 × Ø0.62	0.69	1.61	17.52
2	5.91	4.75	4 × Ø0.75	0.75	2.07	21.89
3	7.48	6	4 × Ø0.75	0.94	3.07	24.06

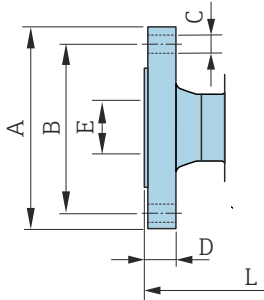
#### Flange according to ASME B16.5: Class 300

Order code for "Process connection", option ABS

1.4404 (F316/F316L)

DN 3/8" with DN 1/2" flanges as standard

Surface roughness (flange): Ra 12.5 to 492 µin



A0042813

DN [in]	A [in]	B [in]	C [in]	D [in]	E [in]	L [in]
3/8	3.74	2.63	4 × Ø0.62	0.56	0.62	9.13
1/2	3.74	2.63	4 × Ø0.62	0.56	0.62	10.98
1	4.92	3.5	4 × Ø0.75	0.69	1.05	12.95
1 1/2	6.1	4.5	4 × Ø0.88	0.81	1.61	17.52
2	6.5	5	8 × Ø0.75	0.88	2.07	21.89
3	8.27	6.63	8 × Ø0.88	1.12	3.07	24.06

### Clamp connections

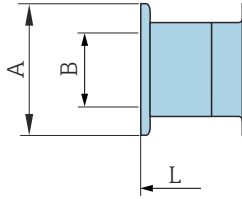
#### Tri-Clamp

Order code for "Process connection", option FTS

1.4404 (316/316L)

Suitable for pipe according to DIN 11866 series C

Surface roughness:  $Ra_{max} = 30 \mu\text{in}$



A0043179

DN [in]	Clamp [in]	A [in]	B [in]	L [in]
3/8	1	1.98	0.87	9.02
1/2	1	1.98	0.87	10.75
1	1	1.98	0.87	12.76
1 1/2	1 1/2	1.98	1.37	17.95
2	2	2.52	1.87	22.13
3	3	3.58	2.87	26.42

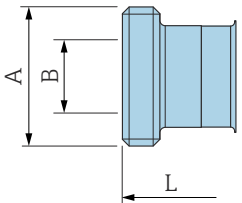
### Couplings

#### Thread as per SMS 1145

Order code for "Process connection", option SCS

1.4404 (316/316L)

Surface roughness:  $Ra_{max} = 30 \mu\text{in}$

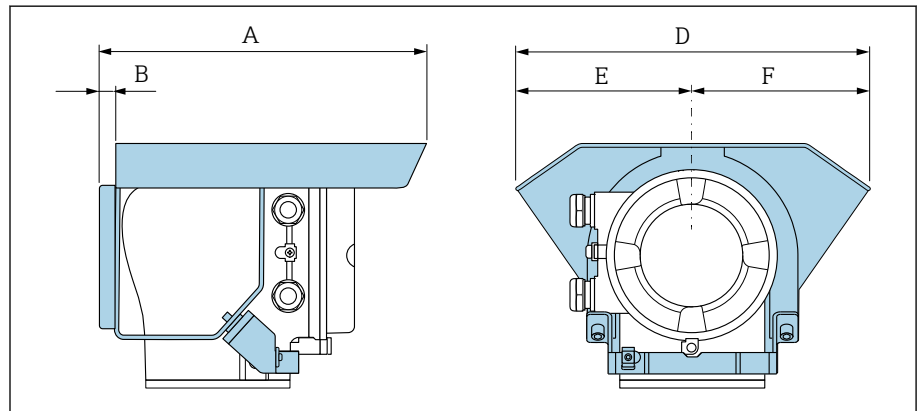


A0043257

DN [in]	A [in]	B [in]	L [in]
3/8	Rd 40 × 1/6	0.89	9.02
1/2	Rd 40 × 1/6	0.89	10.75
1	Rd 40 × 1/6	0.89	12.76
1 1/2	Rd 60 × 1/6	1.4	17.95
2	Rd 70 × 1/6	1.91	22.13
3	Rd 98 × 1/6	2.87	26.42

Accessories

Protective cover



A [in]	B [in]	D [in]	E [in]	F [in]
10.12	0.47	11.02	5.51	5.51



## Local display

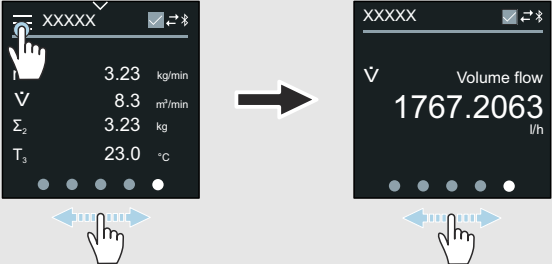
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## Operating concept

Operation method	<ul style="list-style-type: none"> <li>Operation via local display with touch screen.</li> <li>Operation via SmartBlue App.</li> </ul>
Menu structure	<p>Operator-oriented menu structure for user-specific tasks:</p> <ul style="list-style-type: none"> <li>Diagnostics</li> <li>Application</li> <li>System</li> <li>Guidance</li> <li>Language</li> </ul>
Commissioning	<ul style="list-style-type: none"> <li>Commissioning via a guided menu (<b>Commissioning</b> wizard).</li> <li>Menu guidance with interactive help function for individual parameters.</li> </ul>
Reliable operation	<ul style="list-style-type: none"> <li>Operation in local language.</li> <li>Uniform operating philosophy in device and in the SmartBlue App.</li> <li>Write protection</li> <li>When electronics modules are replaced: configurations are transferred using the T-DAT Backup device memory. The device memory contains process data, device data and the event logbook. No reconfiguration is necessary.</li> </ul>
Diagnostic behavior	<p>Efficient diagnostic behavior increases measurement availability:</p> <ul style="list-style-type: none"> <li>Open troubleshooting measures via local display and SmartBlue App.</li> <li>Diverse simulation options.</li> <li>Logbook of events that have occurred.</li> </ul>

## Operating options

Local display	 <p>Display elements:</p> <ul style="list-style-type: none"> <li>LCD touch screen</li> <li>Depends on the orientation, automatic alignment of local display.</li> <li>Configuration of display format for measured variables and status variables.</li> </ul> <p>Operating elements:</p> <ul style="list-style-type: none"> <li>Touch screen</li> <li>Local display can also be accessed in the hazardous area.</li> </ul>
SmartBlue App	<ul style="list-style-type: none"> <li>The SmartBlue App allows the user to put devices into operation and operate them.</li> <li>Based on Bluetooth.</li> <li>No separate driver required.</li> <li>Available for mobile handheld terminals, tablets and smartphones.</li> <li>Suitable for convenient and secure access to devices in hard-to-reach locations or in hazardous areas.</li> <li>Can be used within a 20 m (65.6 ft) radius of the device.</li> <li>Encrypted and secure data transmission.</li> <li>No data loss during commissioning and maintenance.</li> <li>Diagnostic information and process information in real time.</li> </ul>

## Operating tools

Operating tools	Operating unit	Interface	Additional information
DeviceCare SFE100	<ul style="list-style-type: none"> <li>▪ Notebook</li> <li>▪ PC</li> <li>▪ Tablet with Microsoft Windows system</li> </ul>	<ul style="list-style-type: none"> <li>▪ CDI service interface</li> <li>▪ Fieldbus protocol</li> </ul>	Innovation brochure IN01047S
FieldCare SFE500	<ul style="list-style-type: none"> <li>▪ Notebook</li> <li>▪ PC</li> <li>▪ Tablet with Microsoft Windows system</li> </ul>	<ul style="list-style-type: none"> <li>▪ CDI service interface</li> <li>▪ Fieldbus protocol</li> </ul>	Operating Instructions BA00027S and BA00059S
SmartBlue App	<ul style="list-style-type: none"> <li>▪ Devices with iOS: iOS9.0 or higher</li> <li>▪ Devices with Android: Android 4.4 KitKat or higher</li> </ul>	Bluetooth	Endress+HauserSmartBlue App: <ul style="list-style-type: none"> <li>▪ Google Playstore (Android)</li> <li>▪ iTunes Apple Shop (iOS devices)</li> </ul>
Device Xpert	Field Xpert SFX 100/350/370	HART fieldbus protocol	Operating Instructions BA01202S

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## Certificates and approvals

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### Ex approval

- ATEX
- IECEX
- cCSAus
- EAC
- NEPSI
- INMETRO
- JPN

### Non-Ex approval

- cCSAus
- EAC

### Pressure Equipment Directive

- CRN
- PED Cat. II/III

### HART certification

The device is certified and registered by the FieldComm Group. The measuring system meets all the requirements of the following specifications:

- Certified according to HART 7
- The device can also be operated with certified devices of other manufacturers (interoperability).

### Radio approval

The device has radio approvals.

### Other standards and guidelines

- IEC/EN 60529  
Degrees of protection provided by enclosures (IP code)
- IEC/EN 60068-2-6  
Environmental influences: Test procedure - Test Fc: vibrate (sinusoidal)
- IEC/EN 60068-2-31  
Environmental influences: Test procedure - Test Ec: shocks due to rough handling, primarily for devices.
- IEC/EN 61010-1  
Safety requirements for electrical equipment for measurement, control and laboratory use - general requirements.
- IEC/EN 61326  
Emission in accordance with Class A requirements. Electromagnetic compatibility (EMC requirements)
- NAMUR NE 21  
Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.
- NAMUR NE 32  
Data retention in the event of a power failure in field and control instruments with microprocessors.
- NAMUR NE 43  
Standardization of the signal level for the breakdown information of digital transmitters with analog output signal.
- NAMUR NE 53  
Software of field devices and signal-processing devices with digital electronics.
- NAMUR NE 80  
The application of the pressure equipment directive to process control devices.
- NAMUR NE 105  
Specifications for integrating fieldbus devices in engineering tools for field devices.
- NAMUR NE 107  
Self-monitoring and diagnosis of field devices.

- NAMUR NE 131  
Requirements for field devices for standard applications.
- NAMUR NE 132  
Coriolis mass meter
- ETSI EN 300 328  
Guidelines for 2.4 GHz radio components
- EN 301489  
Electromagnetic compatibility and radio spectrum matters (ERM).





## Application packages

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## Use

Many different application packages are available to enhance the functionality of the device. Such packages might be needed to address safety aspects or specific application requirements.

The application packages can be ordered with the device or subsequently from Endress+Hauser. Detailed information on the relevant order code is available from your local Endress+Hauser sales organization or on the product page of the Endress+Hauser website: [www.endress.com](http://www.endress.com).

## Heartbeat Verification + Monitoring

### Heartbeat Verification

Availability depends on the product structure.

Meets the requirement for traceable verification to DIN ISO 9001:2008 Chapter 7.6 a) "Control of monitoring and measuring equipment":

- Functional testing in the installed state without interrupting the process.
- Traceable verification results on request, including a report.
- Simple testing process with local operation or other operating interfaces.
- Clear measuring point assessment (pass/fail) with high test coverage within the framework of manufacturer specifications.
- Extension of calibration intervals according to operator's risk assessment.

### Heartbeat Monitoring

Availability depends on the product structure.

Heartbeat Monitoring continuously supplies data, which are characteristic of the measuring principle, to an external condition monitoring system for the purpose of preventive maintenance or process analysis. These data enable the operator to:

- Draw conclusions - using these data and other information - about the impact the process influences, e.g. corrosion, abrasion, formation of buildup, have on the measuring performance over time.
- Schedule servicing in time.
- Monitor the process quality or product quality, e.g. gas pockets.

## Density output

Many applications use density as a key measured value for monitoring quality or controlling processes. The device measures the density of the medium and makes this value available to the control system.

With this application package, the density can be assigned as a process variable and displayed.



## Accessories

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## Device-specific accessories







### Transmitter

Accessories	Description	Order number
Proline 10 transmitter	 Installation Instructions EA01350D	8XBBXX-*...*
Protective cover	Protects the device from weather exposure:  Installation Instructions EA01351D	71502730



### Sensor

Accessories	Description
Heating jacket	<p>The heating jacket is used to stabilize the temperature of the media in the sensor. Water, water vapor and other non-corrosive liquids are permitted for use as media.</p> <p> If using oil as a heating medium, please consult with an Endress+Hauser service organization.</p> <p>Heating jackets cannot be used with sensors fitted with a rupture disk.</p> <ul style="list-style-type: none"> <li>▪ If ordering with the device: order code for "Accessory enclosed" <ul style="list-style-type: none"> <li>▪ Option RB "Heating jacket, G 1/2" female thread"</li> <li>▪ Option RC "Heating jacket, G 3/4" female thread"</li> <li>▪ Option RD "Heating jacket, NPT 1/2" female thread"</li> <li>▪ Option RE "Heating jacket, NPT 3/4" female thread"</li> </ul> </li> <li>▪ If ordering subsequently: use the order code with the product root DK8003.</li> </ul> <p>Special Documentation SD02695D</p>





### Communication-specific accessories

Accessories	Description
Commubox FXA195 USB/HART modem	Intrinsically safe HART communication with FieldCare and FieldXpert  Technical Information TI00404F
Commubox FXA291	Connects the Endress+Hauser devices with the CDI interface (= Endress+Hauser Common Data Interface) to the USB interface of a personal computer or laptop.  Technical Information TI405C/07
HART Loop Converter HMX50	Is used to evaluate and convert dynamic HART process variables to analog current signals or limit values.  <ul style="list-style-type: none"> <li>▪ Technical Information TI00429F</li> <li>▪ Operating Instructions BA00371F</li> </ul>
Fieldgate FXA42	Transmission of measured values from connected 4 to 20 mA analog and digital devices.  <ul style="list-style-type: none"> <li>▪ Technical Information TI01297S</li> <li>▪ Operating Instructions BA01778S</li> <li>▪ Product page: <a href="http://www.endress.com/fxa42">www.endress.com/fxa42</a></li> </ul>
Field Xpert SMT70	Tablet PC for the configuration of the device. Enables mobile Plant Asset Management to manage the devices with a digital communication interface. Suitable for Zone 2.  <ul style="list-style-type: none"> <li>▪ Technical Information TI01342S</li> <li>▪ Operating Instructions BA01709S</li> <li>▪ Product page: <a href="http://www.endress.com/smt70">www.endress.com/smt70</a></li> </ul>
Field Xpert SMT77	Tablet PC for the configuration of the device. Enables mobile Plant Asset Management to manage the devices with a digital communication interface. Suitable for Zone 1.  <ul style="list-style-type: none"> <li>▪ Technical Information TI01418S</li> <li>▪ Operating Instructions BA01923S</li> <li>▪ Product page: <a href="http://www.endress.com/smt77">www.endress.com/smt77</a></li> </ul>

### Service-specific accessory

Accessories	Description	Order number
Applicator	Software for selecting and sizing Endress+Hauser devices.	<a href="https://portal.endress.com/webapp/applicator">https://portal.endress.com/webapp/applicator</a>
W@M Life Cycle Management	<ul style="list-style-type: none"> <li>▪ Information platform with software applications and services</li> <li>▪ Supports the entire life cycle of the facility.</li> </ul>	<a href="http://www.endress.com/lifecyclemanagement">www.endress.com/lifecyclemanagement</a>
FieldCare	FDT-based plant asset management software from Endress+Hauser. Management and configuration of Endress+Hauser devices.  Operating Instructions BA00027S and BA00059S	<ul style="list-style-type: none"> <li>▪ Device driver: <a href="http://www.endress.com">www.endress.com</a> → Download Area</li> <li>▪ CD-ROM (contact Endress+Hauser)</li> <li>▪ DVD (contact Endress+Hauser)</li> </ul>
DeviceCare	Software for connecting and configuring Endress+Hauser devices.  Innovation brochure IN01047S	<ul style="list-style-type: none"> <li>▪ Device driver: <a href="http://www.endress.com">www.endress.com</a> → Download Area</li> <li>▪ CD-ROM (contact Endress+Hauser)</li> <li>▪ DVD (contact Endress+Hauser)</li> </ul>

## System components

Accessories	Description
Memograph M	Graphic data manager: <ul style="list-style-type: none"> <li>▪ Record measured values</li> <li>▪ Monitor limit values</li> <li>▪ Analyze measuring points</li> </ul>  <ul style="list-style-type: none"> <li>▪ Technical Information TI00133R</li> <li>▪ Operating Instructions BA00247R</li> </ul>
iTEMP	Temperature transmitter: <ul style="list-style-type: none"> <li>▪ Measure the absolute pressure and gauge pressure of gases, vapors and liquids</li> <li>▪ Read the medium temperature</li> </ul>  "Fields of Activity" document FA00006T
Cerabar M	Pressure device: <ul style="list-style-type: none"> <li>▪ Measure the absolute pressure and gauge pressure of gases, vapors and liquids</li> <li>▪ Read the operating pressure value</li> </ul>  <ul style="list-style-type: none"> <li>▪ Technical Information TI00426P and TI00436P</li> <li>▪ Operating Instructions BA00200P and BA00382P</li> </ul>
Cerabar S	Pressure device: <ul style="list-style-type: none"> <li>▪ Measure the absolute pressure and gauge pressure of gases, vapors and liquids</li> <li>▪ Read the operating pressure value</li> </ul>  <ul style="list-style-type: none"> <li>▪ Technical Information TI00383P</li> <li>▪ Operating Instructions BA00271P</li> </ul>

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

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