Technical Information
TI061D/06/en
50102807

Coriolis Mass Flow Measuring System
PROline promass 80/83 E

Mass flow measuring system offering "Low Cost of Ownership" as an alternative to conventional volumetric flowmeters

Features and benefits

- Multifunctional: Simultaneous measurement of flow (mass flow, volume flow), density and temperature.
- Balanced dual-tube system
- Nominal diameters DN 8...50
- Measurement is independent of fluid properties
- Compact design
- "Fit and forget" installation
- Low cost of ownership
- Robust field housing (aluminium), IP 67 protection
- Additional software packs:
  - for batching applications
  - for concentration measurement
  - for advanced diagnostics
- Quick Setup menus for straightforward commissioning in the field
- Programming via HART protocol or local operation
- Guaranteed product quality, suitable for CIP/SIP cleaning
- Hygienic design in accordance with the latest requirements: 3A authorization
- Interfaces for integration into all major process control systems: HART, PROFIBUS-PA/-DP, FOUNDATION Fieldbus
- Suitable for the use in a safety instrumented system up to SIL2.
- Ex approvals: ATEX, FM, CSA
- Performance characteristics:
  - Mass flow (liquids):
    Promass 80: ±0.35% o.r.
    Promass 83: ±0.30% o.r.
  - Mass flow (gases):
    ±0.75% o.r.

Application

For mass or volume flow measurement.

Application examples:
- Deionized water
- Fuel oils
- Edible oils
- Solvents
- Gases

Endress + Hauser
The Power of Know How

Function and system design

Measuring principle

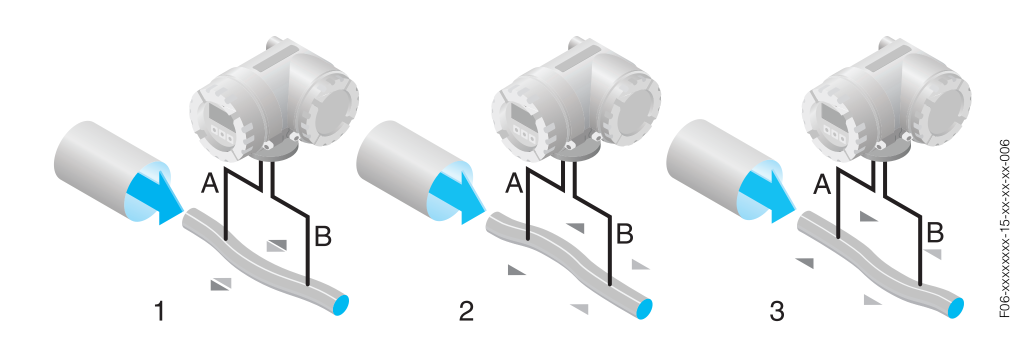
The measuring principle is based on the controlled generation of Coriolis forces. These forces are always present when both translational and rotational movements are superimposed.

$\vec{F}_C = 2 \cdot \Delta m \, (\vec{v} \cdot \vec{\omega})$

$\vec{F}_C$ = Coriolis force
Δm = moved mass
$\vec{\omega}$ = angular velocity
$\vec{v}$ = radial velocity in the rotating or oscillating system

The amplitude of the Coriolis force depends on the moving mass Δm, its velocity $\vec{v}$ in the system and thus on the mass flow. Instead of a constant angular velocity $\vec{\omega}$ the Promass 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, in other words 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).



The phase difference (A-B) increases with increasing mass flow. Electrodynamic sensors register the tube oscillations at the inlet and outlet.

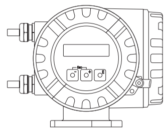
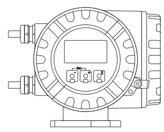
System balance is ensured by the antiphase oscillation of the two measuring tubes.
The measuring principle operates independently of temperature, pressure, viscosity, conductivity and flow profile.

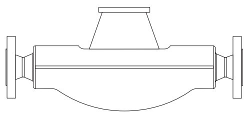
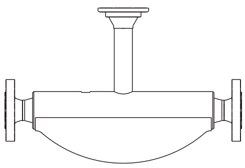
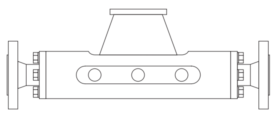
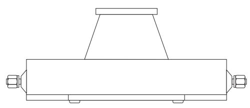
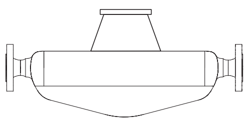
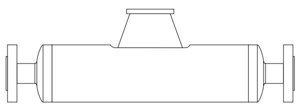
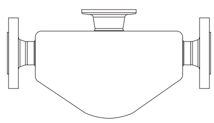
Volume measurement
The measuring tubes are continuously excited at their resonance frequency. A change in the mass and thus the density of the oscillating system (comprising measuring tubes and fluid) results in a corresponding, automatic adjustment in the oscillation frequency. Resonance frequency is thus a function of fluid density. The density value obtained in this way can be used in conjunction with the measured mass flow to calculate the volume flow.
The temperature of the measuring tubes is also determined in order to calculate the compensation factor due to temperature effects.

Measuring system

The measuring system consists of a transmitter and a sensor.
Two versions are available:
- Compact version: transmitter and sensor form a single mechanical unit.
- Remote version: transmitter and sensor are installed separately.

- Transmitter Promass 80/83
- Sensor Promass E
- Sensor Promass F/M/A/H/I (see separate documentation)

Transmitter	
Promass 80 	• Two-line liquid-crystal display • Operation with push buttons • Quick Setup • Mass flow, volume flow, density and temperature measurement
Promass 83 	• Four-line liquid-crystal display • Operation with "Touch control" • Application-specific Quick Setup • Mass flow, volume flow, density and temperature measurement as well as calculated variables (e.g. fluid concentrations)

Sensor		
F 	• Universal sensor for fluid temperatures up to 200 °C. • Nominal diameters DN 8...150 • Tube material: stainless steel or Alloy C-22	Documentation No. TI 053D/06/en
F (High-temperature) 	• Universal high-temperature sensor for fluid temperatures up to 350 °C. • Nominal diameters DN 25, 50, 80 • Tube material: Alloy C-22	Documentation No. TI 053D/06/en
M 	• Robust sensor for extreme process pressures, high requirements for the secondary containment and fluid temperatures up to 150 °C • Nominal diameters DN 8...80 • Tube material: titanium	Documentation No. TI 053D/06/en
A 	• Single-tube system for highly accurate measurement of very small flows • Nominal diameters DN 1...4 • Tube material: stainless steel or Alloy C-22	Documentation No. TI 054D/06/en
H 	• Single bent tube. Low pressure loss and chemically resistant material • "Fit-and-forget" • Nominal diameters DN 8...50 • Tube material: zirconium	Documentation No. TI 052D/06/en
I 	• Straight single-tube instrument. Minimal shear stress on fluid, hygienic design, low pressure loss. • "Fit-and-forget": No special supports required for installation. • Nominal diameters DN 8...50 • Tube material: titanium	Documentation No. TI 052D/06/en
E 	• General purpose sensor, ideal replacement for volumetric flowmeters. • Nominal diameters DN 8...50 • Tube material: stainless steel	Documentation No. TI 061D/06/en

Input

Measured variable

- Mass flow (proportional to the phase difference between two sensors mounted on the measuring tubes to register a phase shift in the oscillation)
- Fluid density (proportional to resonance frequency of the measuring tubes)
- Fluid temperature (measured with temperature sensors)

Measuring range

Measuring ranges for liquids:

DN	Range of full scale values (liquids) $\dot{m}_{min(F)} ... \dot{m}_{max(F)}$
8	0...2000 kg/h
15	0...6500 kg/h
25	0...18000 kg/h
40	0...45000 kg/h
50	0...70000 kg/h

Measuring ranges for gases:
The full scale values depend on the density of the gas. Use the formula below to calculate the full scale values:

$$\dot{m}_{max(G)} = \dot{m}_{max(F)} \cdot \frac{\rho_{(G)}}{225\ kg/m^3}$$

$\dot{m}_{max(G)}$ = Max. full scale value for gas [kg/h]
$\dot{m}_{max(F)}$ = Max. full scale value for liquid [kg/h]
$\rho_{(G)}$ = Gas density in [kg/m^3] under process conditions

Worked example for gas:
- Sensor type: Promass E, DN 50
- Gas: air with a density of 60.3 kg/m^3 (at 20 °C and 50 bar)
- Max. full scale value (liquid): 70000 kg/h

Max. possible full scale value:

$$\dot{m}_{max(G)} = \frac{\dot{m}_{max(F)} \cdot \rho_{(G)}}{225\ kg/m^3} = \frac{70000\ kg/h \cdot 60.3\ kg/m^3}{225\ kg/m^3} = 18760\ kg/h$$

Recommended measuring ranges:
See Page 16 (“Limiting flow”)

Operable flow range

Greater than 1000 :1. Flow rates above the preset full scale value do not overload the amplifier, i.e. the totalizer values are registered correctly.

Input signal

Status input (auxiliary input):
U = 3...30 V DC, R_i = 5 kΩ, galvanically isolated.
Configurable for: totalizer(s) reset, positive zero return, error-message reset, zero point adjustment.

Current input (for Promass 83 only):
Active/passive selectable, galvanically isolated, resolution: 2 µA
active: 4...20 mA, $R_i \leq$ 150 Ω, U_{out} = 24 V DC, short-circuit-proof
passive: 0/4...20 mA, $R_i \leq$ 150 Ω, U_{max} = 30 V DC

Output

Output signal

Promass 80

Current output:
Active/passive selectable, galvanically isolated, time constant selectable (0.05...100 s), full scale value selectable, temperature coefficient: typically 0.005% o.r./°C; resolution: 0.5 µA
- Active: 0/4...20 mA, R_L < 700 Ω (for HART: R_L ≥ 250 Ω)
- Passive: 4...20 mA; Operating voltage V_S 18...30 V DC, R_L ≤ 700 Ω

Pulse/frequency output:
Passive, open collector, 30 V DC, 250 mA, galvanically isolated.
- Frequency output: full scale frequency 2...1000 Hz (f_{max} = 1250 Hz), on/off ratio 1:1, pulse width max. 2 s
  Pulse output: pulse value and pulse polarity selectable, pulse width adjustable (0.5... 2000 ms)

PROFIBUS-PA interface:
- PROFIBUS-PA in accordance with EN 50170 Volume 2, IEC 61158-2 (MBP), galvanically isolated
- Current consumption: 11 mA
- Permissible supply voltage: 9...32 V
- FDE (Fault Disconnection Electronic): 0 mA
- Data transmission rate, supported baudrate: 31.25 kBit/s
- Signal encoding: Manchester II
- Function blocks: 4 x Analog Input, 1 x Totalizer
- Output data: Mass flow, Volume flow, Density, Temperature, Totalizer
- Input data: Empty pipe detection (ON/OFF), Zero point adjustment, Measuring mode, Control totalizer
- Bus address adjustable via DIP-switches at the measuring device

Promass 83

Current output:
Active/passive selectable, galvanically isolated, time constant selectable (0.05...100 s), full scale value selectable, temperature coefficient: typically 0.005% o.r./°C; resolution: 0.5 µA
- Active: 0/4...20 mA, R_L < 700 Ω (for HART: R_L ≥ 250 Ω)
- Passive: 4...20 mA; Operating voltage V_S 18...30 V DC, R_L ≤ 700 Ω

Pulse/frequency output:
active/passive selectable, galvanically isolated
- Active: 24 V DC, 25 mA (max. 250 mA during 20 ms), R_L > 100 Ω
- Passive: open collector, 30 V DC, 250 mA

- Frequency output: full scale frequency 2...10000 Hz (f_{max} = 12500 Hz), on/off ratio 1:1, pulse width max. 2 s
  Pulse output: pulse value and pulse polarity selectable, pulse width adjustable (0.05 ... 2000 ms)

PROFIBUS-DP interface:
- PROFIBUS-DP/-PA in accordance with EN 50170 Volume 2, IEC 61158-2, galvanically isolated
- Data transmission rate, supported baudrat: 9.6 kBaud...12 MBaud
- Current consumption: 11 mA
- Permissible supply voltage: 9...32 V
- Signal encoding: NRZ-Code
- Function blocks: 6 x Analog Input, 3 x Totalizer
- Output data: Mass flow, Volume flow, Corrected volumen flow, Density, Reference density, Temperature, Totalizer 1...3
- Input data: Positive zero return (ON/OFF), Zero point adjustment, Measuring mode, Control totalizer
- Bus address adjustable via DIP-switches at the measuring device
- Automatic data transmission rate recognition

PROFIBUS-PA interface:
- PROFIBUS-PA in accordance with EN 50170 Volume 2, IEC 61158-2 (MBP), galvanically isolated
- Data transmission rate, supported baudrate: 31.25 kBit/s
- Current consumption: 11 mA
- Permissible supply voltage: 9...32 V
- FDE (Fault Disconnection Electronic): 0 mA
- Signal encoding: Manchester II
- Function blocks: 6 x Analog Input, 3 x Totalizer
- Output data: Mass flow, Volume flow, Corrected volume flow, Density, Standard Density, Temperature, Totalizer 1...3
- Input data: Empty pipe detection (ON/OFF), Zero point adjustment, Measuring mode, Control totalizer
- Bus address adjustable via DIP-switches at the measuring device

FOUNDATION Fieldbus interface:
- FOUNDATION Fieldbus H1, IEC 61158-2, galvanically isolated
- Data transmission rate, supported baudrate: 31.25 kBit/s
- Current consumption: 12 mA
- Permissible supply voltage: 9...32 V
- FDE (Fault Disconnection Electronic): 0 mA
- Signal encoding: Manchester II
- Function blocks: 7 x Analog Input, 1 x Digital Output, 1 x PID
- Output data: Mass flow, Volume flow, Corrected volume flow, Density, Standard Density, Temperature, Totalizer 1...3
- Input data: Empty pipe detection (ON/OFF), Zero point adjustment, Measuring mode, Reset totalizer
- Link Master function (LAS) is supported

Signal on alarm

- Current output → failsafe mode selectable (e.g. in accordance with NAMUR Recommendation NE 43)
- Pulse/frequency output → failsafe mode selectable
- Status output → “non-conductive” by fault or power supply failure

Load

see “Output signal”

Switching output

Open collector, max. 30 V DC / 250 mA, galvanically isolated.
Configurable for: error messages, Empty Pipe Detection (EPD), flow direction, limit values.

Low flow cut off

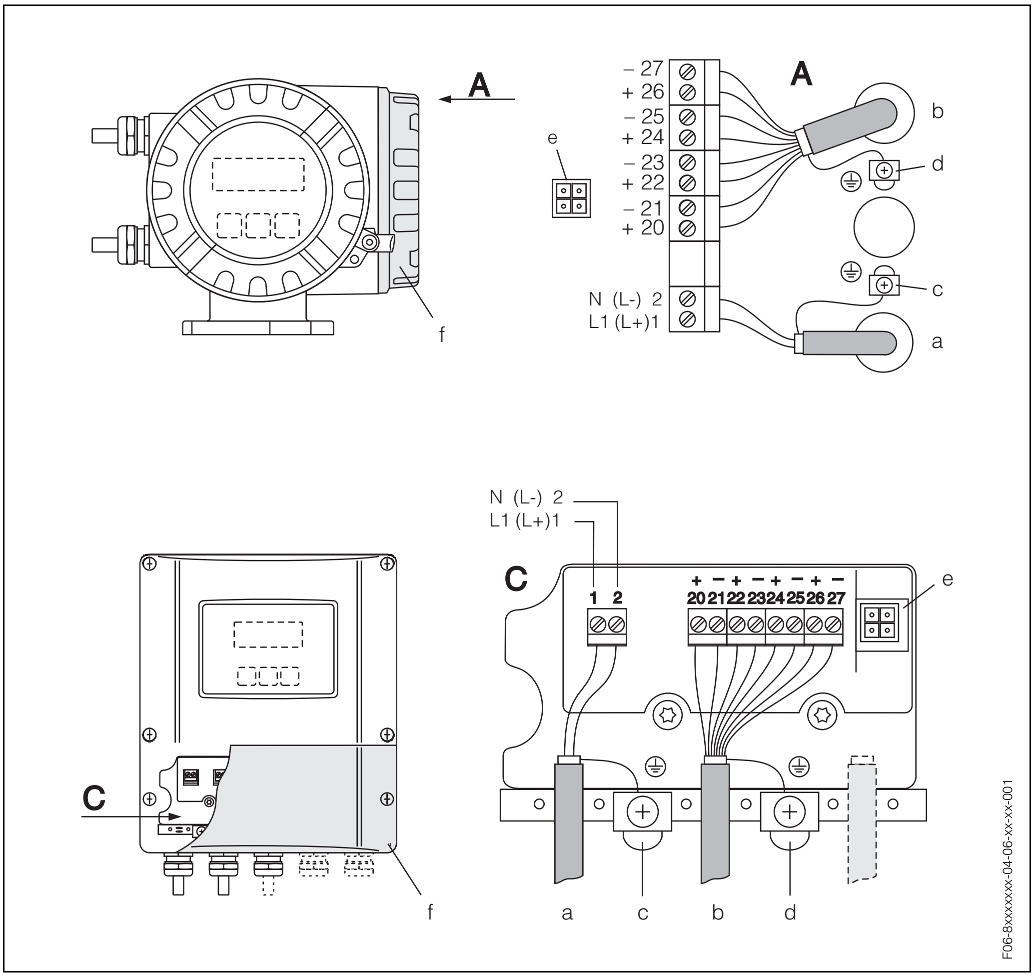
Switch points for low flow cut off are selectable.

Galvanic isolation

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

Power supply

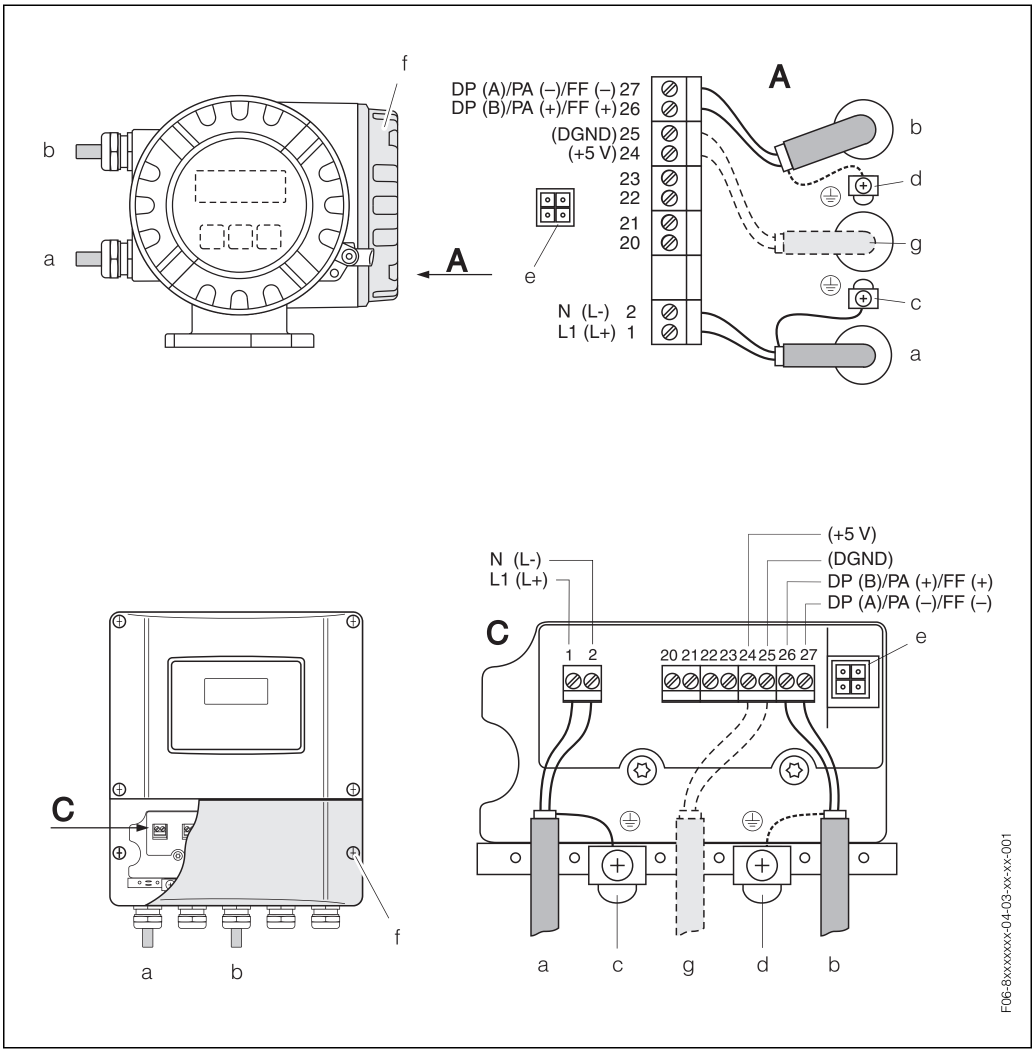
Electrical connection Measuring unit



A = View A (field housing)
B = View B (wall-mount housing)

a Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC
Terminal No. 1: L1 for AC, L+ for DC
Terminal No. 2: N for AC, L– for DC
b Signal cable: Terminals Nos. 20–27 → see table below
c Ground terminal for protective conductor
d Ground terminal for signal-cable shield
e Service connector for connecting service interface FXA 193 (FieldCheck, FieldTool)
f Cover of the connection compartment

Electrical connection Measuring unit (bus communication)



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

A = View A (field housing)
C = View C (wall-mount housing)

- a *Cable for power supply: 85...260 V AC, 20...55 V AC, 16...62 V DC*
  Terminal No. 1: L1 for AC, L+ for DC
  Terminal No. 2: N for AC, L- for DC
- b *Fieldbus cable:*
  Terminal No. 26: DP (B) / PA (+) / FF (+) (with reverse polarity protection)
  Terminal No. 27: DP (A) / PA (–) / FF (–) (with reverse polarity protection)
  DP (A) = RxD/TxD-N; DP (B) = RxD/TxD-P
- c *Ground terminal for protective conductor*
- d *Ground terminal for Fieldbus cable*
- e *Service connector for connecting service interface FXA 193 (FieldCheck, FieldTool)*
- f *Cover of the connection compartment*
- g *Cabel for external termination (only PROFIBUS):*
  Terminal No. 24: +5 V
  Terminal No. 25: DGND

Terminal assignment Promass 80

Order variant	Terminal Nos. (inputs/outputs)			
	20 – 21	22 – 23	24 – 25	26 – 27
80***-***********A	–	–	Frequency output	Current output HART
80***-***********D	Status input	Status output	Frequency output	Current output HART
80***-***********H	–	–	–	PROFIBUS-PA
80***-***********S	–	–	Frequency output Ex i, passive	Current output Ex i active, HART
80***-***********T	–	–	Frequency output Ex i, passive	Current output Ex i passive, HART
80***-***********8	Status input	Frequency output	Current output 2	Current output 1 HART

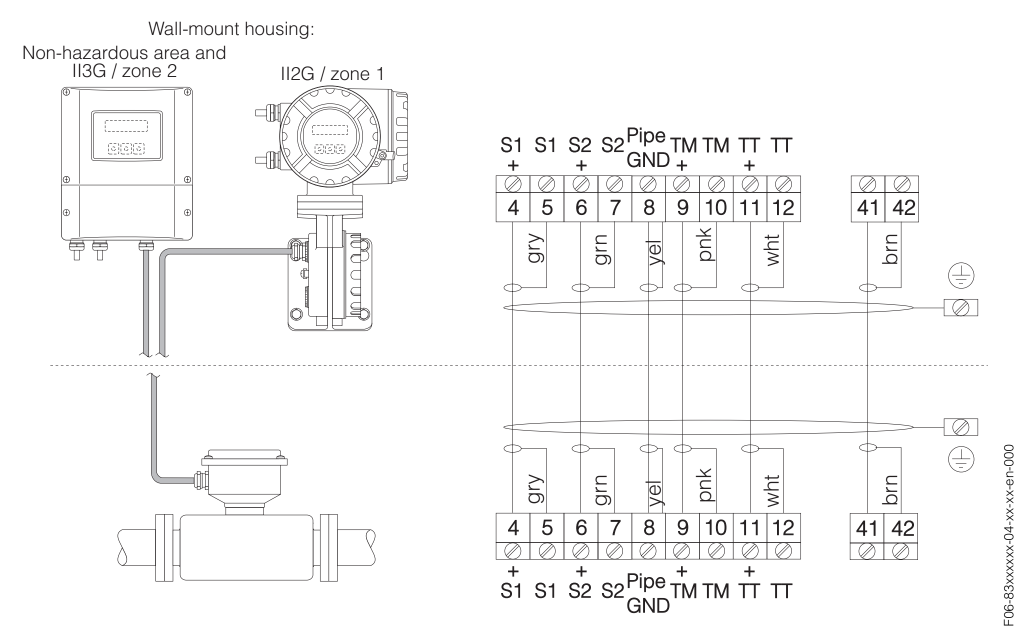
Terminal assignment, Promass 83

The inputs and outputs on the communication board can be either permanently assigned (fixed) or variable (flexible), depending on the version ordered (see table). Replacements for modules which are defective or which have to be replaced can be ordered as accessories.

Order variant	Terminal Nos. (inputs/outputs)			
	20 – 21	22 – 23	24 – 25	26 – 27
Fixed communication boards (permanent assignment)				
83***-***********A	–	–	Frequency output	Current output HART
83***-***********B	Relay output	Relay output	Frequency output	Current output HART
83***-***********F	–	–	–	PROFIBUS-PA Ex i
83***-***********G	–	–	–	FOUNDATION Fieldbus, Ex i
83***-***********H	–	–	–	PROFIBUS-PA
83***-***********J	–	–	–	PROFIBUS-DP
83***-***********K	–	–	–	FOUNDATION Fieldbus
83***-***********R	–	–	Current output 2 Ex i, active	Current output 1 Ex i active, HART
83***-***********S	–	–	Frequency output Ex i, passive	Current output Ex i, active, HART
83***-***********T	–	–	Frequency output Ex i, passive	Current output Ex i passive, HART
83***-***********U	–	–	Current output 2 Ex i, passive	Current output 1 Ex i passive, HART
Flexible communication boards				
83***-***********C	Relay output 2	Relay output 1	Frequency output	Current output HART
83***-***********D	Status input	Relay output	Frequency output	Current output HART
83***-***********E	Status input	Relay output	Current output 2	Current output 1 HART
83***-***********L	Status input	Relay output 2	Relay output 1	Current output HART
83***-***********M	Status input	Frequency output 2	Frequency output 1	Current output HART
83***-***********W	Relay output	Current output 3	Current output 2	Current output 1 HART

Order variant	Terminal Nos. (inputs/outputs)			
	20 – 21	22 – 23	24 – 25	26 – 27
83***-***********0	Status input	Current output 3	Current output 2	Current output 1 HART
83***-***********2	Relay output	Current output 2	Frequency output	Current output 1 HART
83***-***********3	Current input	Relay output	Current output 2	Current output 1 HART
83***-***********4	Current input	Relay output	Frequency output	Current output HART
83***-***********5	Status input	Current input	Frequency output	Current output HART
83***-***********6	Status input	Current input	Current output 2	Current output HART

Electrical connection Remote version



Supply voltage

85...260 V AC, 45...65 Hz
20...55 V AC, 45...65 Hz
16...62 V DC

Potential equalisation

No measures necessary.

Cable entries

Power-supply and signal cables (inputs/outputs):
- Cable entry M20 x 1.5 (8...12 mm)
- Threads for cable entries, PG 13.5 (5...15 mm), 1/2" NPT, G 1/2"

Connecting cable for remote version:
- Cable entry M20 x 1.5 (8...12 mm)
- Threads for cable entries, PG 13.5 (5...15 mm), 1/2" NPT, G 1/2"

Cable specifications Remote version

- 6 x 0.38 mm^2 PVC cable with common shield and individually shielded cores.
- Conductor resistance: ≤ 50 Ω/km
- Capacitance: core/shield: ≤ 420 pF/m
- Cable length: max. 20 m
- Permanent operating temperature: +105 °C

Operation in zones of severe electrical interference:
The measuring device complies with the general safety requirements in accordance with EN 61010, the EMC requirements of EN 61326/A1, and NAMUR recommendation NE 21/43.

Power consumption

AC: <15 VA (including sensor)
DC: <15 W (including sensor)

Switch-on current:
- Max. 13.5 A (< 50 ms) at 24 V DC
- Max. 3 A (< 5 ms) at 260 V AC

Power supply failure

Lasting min. 1 power cycle
- EEPROM retains the measuring-system data in the event of a power supply failure
- S-DAT = exchangeable data storage chip with sensor specific data: nominal diameter, serial number, calibration factor, zero point, etc.

Performance characteristics

Reference operating conditions

Error limits following ISO/DIS 11631:
- 20...30 °C; 2...4 bar
- Calibration systems as per national norms
- Zero point calibrated under operating conditions
- Field density calibrated

Maximum measured error

The following values refer to the pulse/frequency output.
The additional measured error at the current output is typically ±5 µA.

Mass flow (liquid)
Promass 80: ±0.35% ± [(zero point stability / measured value) x 100]% o.r.
Promass 83: ±0.30% ± [(zero point stability / measured value) x 100]% o.r.

Mass flow (gas)
Promass 80/83: ±0.75% ± [(zero point stability / measured value) x 100]% o.r.

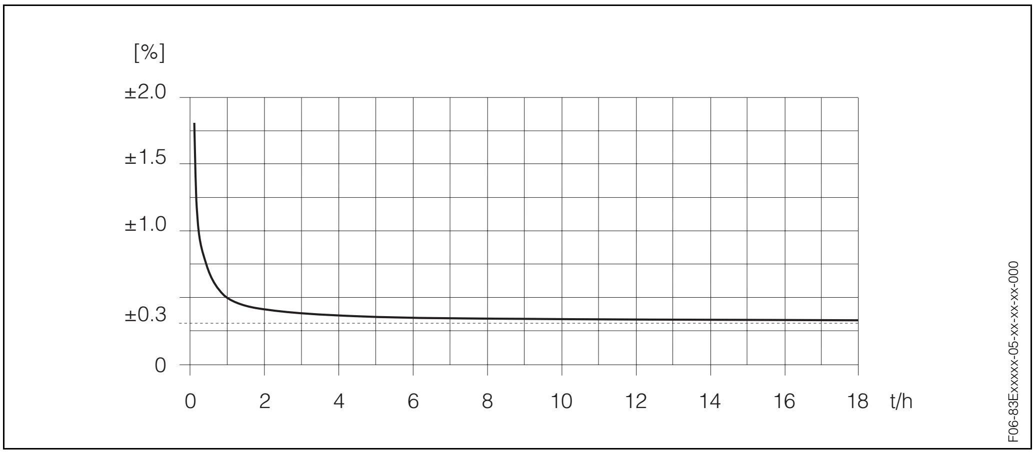
Volume flow (liquid)
Promass 80/83: ±0.45% ± [(zero point stability / measured value) x 100]% o.r.

o.r. = of reading

DN	**Maximum full scale value** [kg/h] or [l/h]	**Zero point stability** [kg/h] or [l/h]
8	2000	0.20
15	6500	0.65
25	18000	1.8
40	45000	4.5
50	70000	7.0

Calculation example (mass flow, liquid):
Given: Promass 83 E / DN 25, measured flow = 8000 kg/h
Max. measured error: ±0.30% ± [(zero point stability / measured value) x 100]% o.r.

Max. measured error → $\pm 0.30\% \pm \frac{1.8\ \text{kg/h}}{8000\ \text{kg/h}} \cdot 100\% = \pm 0.323\%$



Maximum measured error in % of reading (example: Promass 83 E / DN 25)

Density (liquid)
Standard calibration: ±0.02 g/cc (1 g/cc = 1 kg/l)

After field density calibration or under reference conditions: ±0.001 g/cc

Temperature
±0.5 °C ±0.005 x T (T = fluid temperature in °C)

Repeatability

Flow measurement
Promass 80/83 E:
- Mass flow (liquid): ±0.15% ± [1/2 x (zero point stability / measured value) x 100]% o.r.
- Mass flow (gas): ±0.35% ± [1/2 x (zero point stability / measured value) x 100]% o.r.
- Volume flow (liquid): ±0.20% ± [1/2 x (zero point stability / measured value) x 100]% o.r.

o.r. = of reading
Zero point stability: see “Max. measured error”

Calculation example (mass flow, liquid):
Given: Promass 80 E / DN 25, measured flow = 8000 kg/h
Repeatability: ±0.15% ± [1/2 x (zero point stability / measured value) x 100]% o.r.

Repeatability → $\pm 0.15\% \pm 1/2 \cdot \frac{1.8\ \text{kg/h}}{8000\ \text{kg/h}} \cdot 100\% = \pm 0.161\%$

Density measurement (liquid)
±0.0005 g/cc (1 g/cc = 1 kg/l)

Temperature measurement
±0.25 °C ±0.0025 x T (T = fluid temperature in °C)

Influence of medium temperature

When there is a difference between the temperature for zero point adjustment and the process temperature, the typical measured error of Promass E is ±0.0002% of the full scale value / °C.

Influence of medium pressure

With nominal diameters DN 8...40, the effect on accuracy of mass flow due to a difference between calibration pressure and process pressure can be neglected.

With DN 50 the influence is –0.009% o.r. / bar (o.r. = of reading)

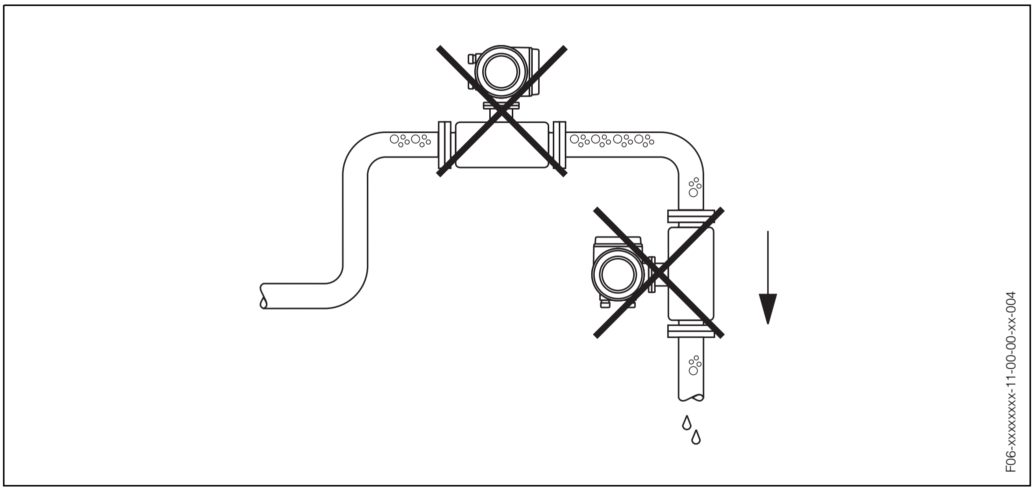
Operating conditions (installation)

Installation instructions

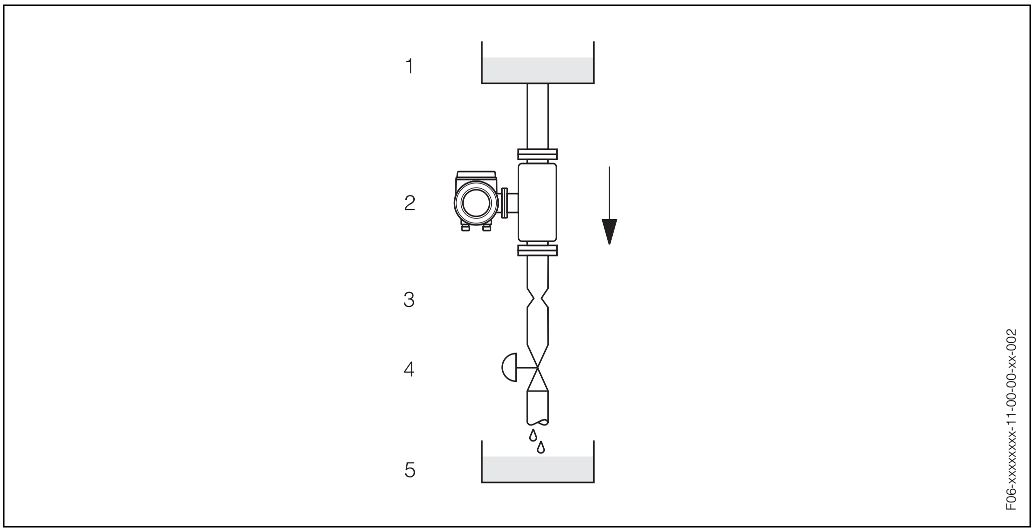
Note the following points:
- No special measures such as supports are necessary. External forces are absorbed by the construction of the instrument, for example the secondary containment.
- The high oscillation frequency of the measuring tubes ensures that the correct operation of the measuring system is not influenced by pipe vibrations.
- No special precautions need to be taken for fittings which create turbulence (valves, elbows, T-pieces, etc.), as long as no cavitation occurs.

Mounting location

Entrained air or gas bubbles in the measuring tube can result in an increase in measuring errors. Avoid the following locations:
- Highest point in a run.
- Directly upstream from a free pipe outlet in a vertical pipeline.



Notwithstanding the above, the installation proposal below permits installation in an open vertical pipeline. Pipe restrictions or the use of an orifice with a smaller cross-section than the nominal diameter prevent the sensor running empty while measurement is in progress.



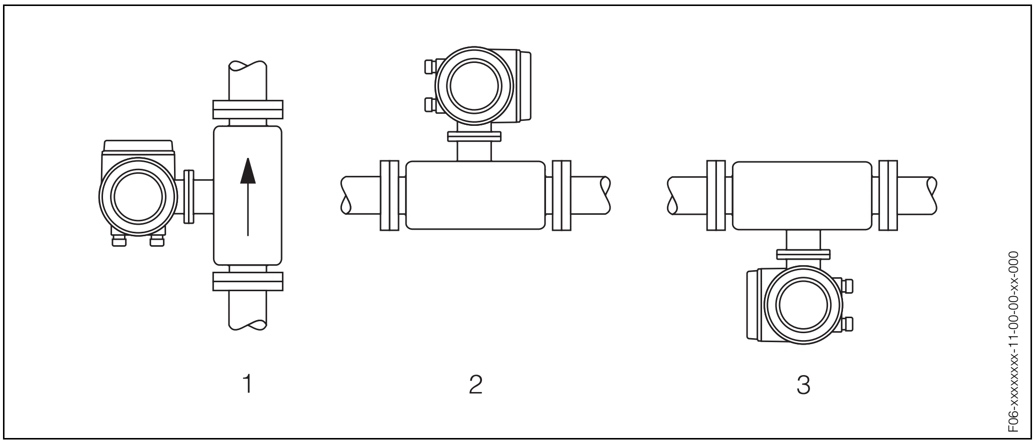
Installation in a vertical pipeline (e.g. for batching applications)
1 = Supply tank, 2 = Sensor, 3 = Orifice, pipe restrictions (see Table), 4 = Valve, 5 = Batching tank

Promass E / DN	8	15	25	40	50
Ø orifice / pipe restriction	6 mm	10 mm	14 mm	22 mm	28 mm

Orientation

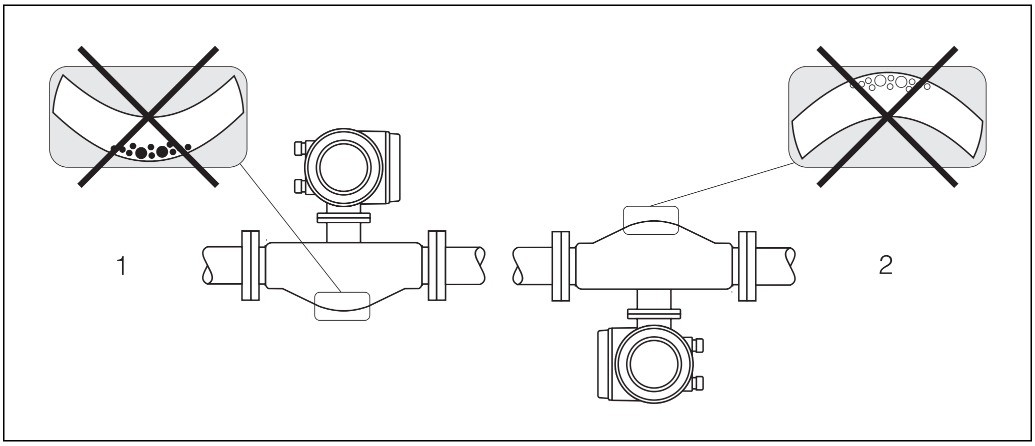
Vertical
Recommended orientation with upward direction of flow (View 1). Entrained solids sink down. Gases rise away from the measuring tube when fluid is not flowing. The measuring tubes can be completely drained and protected against solids build-up.

Horizontal
The measuring tubes of Promass E must be in the same horizontal plane. When installation is correct the transmitter housing is above or below the pipe (Views 2, 3). Always avoid having the transmitter housing in the same horizontal plane as the pipe.



Orientation

Caution:
The measuring tubes of Promass E are slightly curved. The position of the sensor, therefore, has to be matched to the fluid properties when the sensor is installed horizontally (see illustration below).



1 *Not suitable for fluids with entrained solids. Risk of solids accumulating!*
2 *Not suitable for outgassing fluids. Risk of air accumulating!*

Fluid temperature / orientation

In order to ensure that the permissible ambient temperature for the transmitter (–20...+60 °C, optional –40...+60 °C) is not exceeded, we recommend the following orientations:

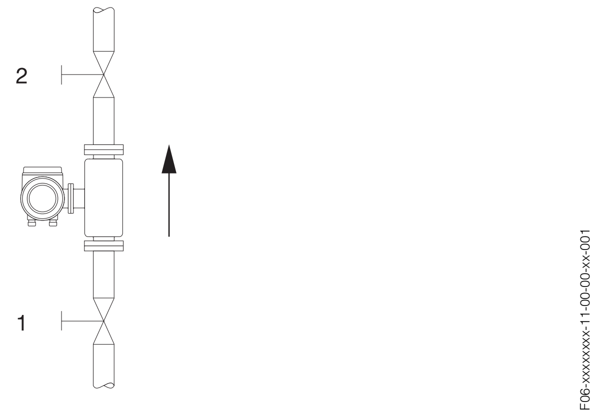
High fluid temperature
Vertical piping: installation in accordance with Fig. "Orientation" / View 1
Horizontal piping: installation in accordance with Fig. "Orientation" / View 3

Low fluid temperature
Vertical piping: installation in accordance with Fig. "Orientation" / View 1
Horizontal piping: installation in accordance with Fig. "Orientation" / View 2

Zero point adjustment
Promass generally does not require zero point adjustment!

Zero point adjustment is only required in special cases:
- To achieve highest measuring accuracy also with very small flow rates
- Under extreme process or operating conditions (e.g. very high process pressure or very high viscosity of the fluid).

Zero point adjustment is performed with the measuring tubes completely filled and "zero flow". This can be achieved, for example, with shut-off valves upstream and/or downstream of the sensor or by using existing valves and gates:
- Normal operation → valves 1 and 2 open
- Zero point adjustment *with* pump pressure → valve 1 open / valve 2 closed
- Zero point adjustment *without* pump pressure → valve 1 closed / valve 2 open



Tracing, thermal insulation
Some fluids require suitable measures to avoid heat transfer at the sensor. A wide range of materials can be used to provide the required thermal insulation. Heating can be electric, e.g. with heating elements, or by means of hot-water or steam pipes made of copper.

Caution:
Risk of electronics overheating!
Make sure that the connector between sensor and transmitter as well as the connection housing of the remote version always remain free of insulating material.
Note that a certain orientation might be required, depending on the fluid temperature (see Page 14).

Inlet and outlet runs
There are no installation requirements regarding inlet and outlet runs.

Length of connecting cable
Max. 20 meters (remote version)

System pressure
It is important to ensure that cavitation does not occur, because it would influence the oscillation of the measuring tubes. No special measures need to be taken for fluids which have properties similar to water under normal conditions.
In the case of liquids with a low boiling point (hydrocarbons, solvents, liquefied gases) or in suction lines, it is important to ensure that pressure does not drop below the vapour pressure and that the liquid does not start to boil. It is also important to ensure that the gases that occur naturally in many liquids do not outgas. Such effects can be prevented when system pressure is sufficiently high.

Consequently, it is generally best to install the sensor:
- Downstream from pumps (no risk of partial vacuum)
- At the lowest point in a vertical pipe

Operating conditions (environment)

Ambient temperature range	Standard: –20...+60 °C (sensor, transmitter) Optional: –40...+60 °C (sensor, transmitter) Note! • Install the device at a shady location. Avoid direct sunlight, particularly in warm climatic regions. • At ambient temperatures below –20 °C the readability of the display may be impaired.
Storage temperature	–40...+80 °C (preferably +20 °C)
Degree of protection	Standard: IP 67 (NEMA 4X) for transmitter and sensor
Shock resistance	According to IEC 68-2-31
Vibration resistance	Acceleration up to 1 g, 10...150 Hz, following IEC 68-2-6
Electromagnetic compatibility (EMC)	To EN 61326/A1 and NAMUR recommendation NE 21

Operating conditions (process)

Medium temperature range	Sensor: –40...+125 °C Seals: no internal seals
Limiting medium pressure range (nominal pressure)	Flanges: DIN PN 40...100 / ANSI Cl 150, Cl 300, Cl 600 / JIS 10K, 20K, 40K, 63K The sensor Promass E has no secondary containment.
Limiting flow	See Page 4 (“Measuring range”). Select nominal diameter by optimising between required flow range and permissible pressure loss. See Page 4 for a list of max. possible full scale values. • The minimum recommended full scale value is approx. $^{1}/_{20}$ of the max. full scale value. • In most applications, 20...50% of the maximum full scale value can be considered ideal. • Select a lower full scale value for abrasive substances such as fluids with entrained solids (flow velocity <1 m/s). • For gas measurement the following rules apply: – Flow velocity in the measuring tubes should not be more than half the sonic velocity (0.5 Mach). – The maximum mass flow depends on the density of the gas (see formula on Page 4)

Pressure loss

Pressure loss depends on the fluid properties and on the flow rate.
The following formula can be used to approximately calculate the pressure loss.

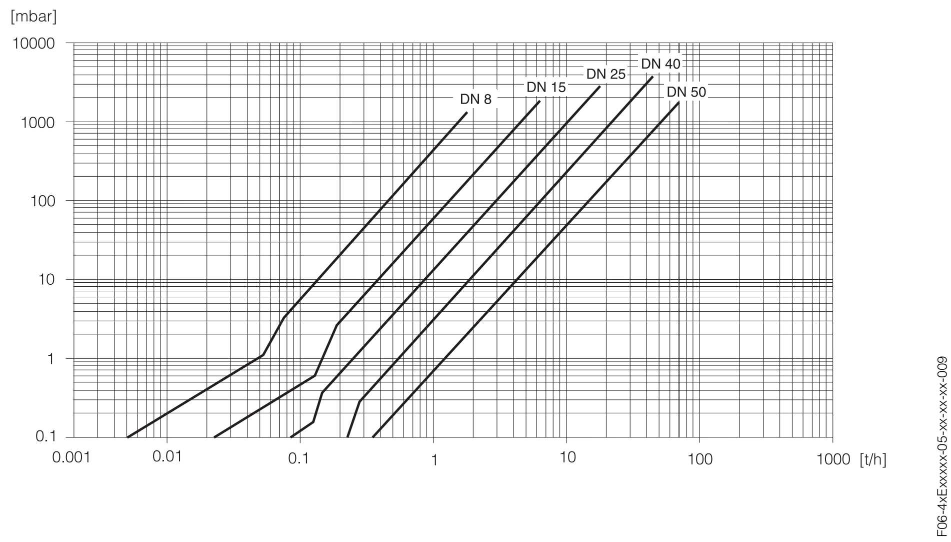
Reynolds number	$Re = \frac{2 \cdot \dot{m}}{\pi \cdot d \cdot \upsilon \cdot \rho}$
Re ≥ 2300 [1]	$\Delta p = K \cdot \upsilon^{0.25} \cdot \dot{m}^{1.85} \cdot \rho^{-0.86}$
Re < 2300	$\Delta p = K1 \cdot \upsilon \cdot \dot{m} + \frac{K2 \cdot \upsilon^{0.25} \cdot \dot{m}^2}{\rho}$

Δp = pressure loss [mbar]
υ = kinematic viscosity [m^2/s]
$\dot{m}$ = mass flow [kg/s]
ρ = fluid density [kg/m^3]
d = inside diameter of measuring tubes [m]
K...K2 = constants (depending on nominal diameter)

1) To compute the pressure loss for gases, always use the formula for Re ≥ 2300.

Pressure loss coefficient for Promass E

DN	d [m]	K	K1	K2
8	$5.35 \cdot 10^{-3}$	$5.70 \cdot 10^{7}$	$7.91 \cdot 10^{7}$	$2.10 \cdot 10^{7}$
15	$8.30 \cdot 10^{-3}$	$7.62 \cdot 10^{6}$	$1.73 \cdot 10^{7}$	$2.13 \cdot 10^{6}$
25	$12.00 \cdot 10^{-3}$	$1.89 \cdot 10^{6}$	$4.66 \cdot 10^{6}$	$6.11 \cdot 10^{5}$
40	$17.60 \cdot 10^{-3}$	$4.42 \cdot 10^{5}$	$1.35 \cdot 10^{6}$	$1.38 \cdot 10^{5}$
50	$26.00 \cdot 10^{-3}$	$8.54 \cdot 10^{4}$	$4.02 \cdot 10^{5}$	$2.31 \cdot 10^{4}$

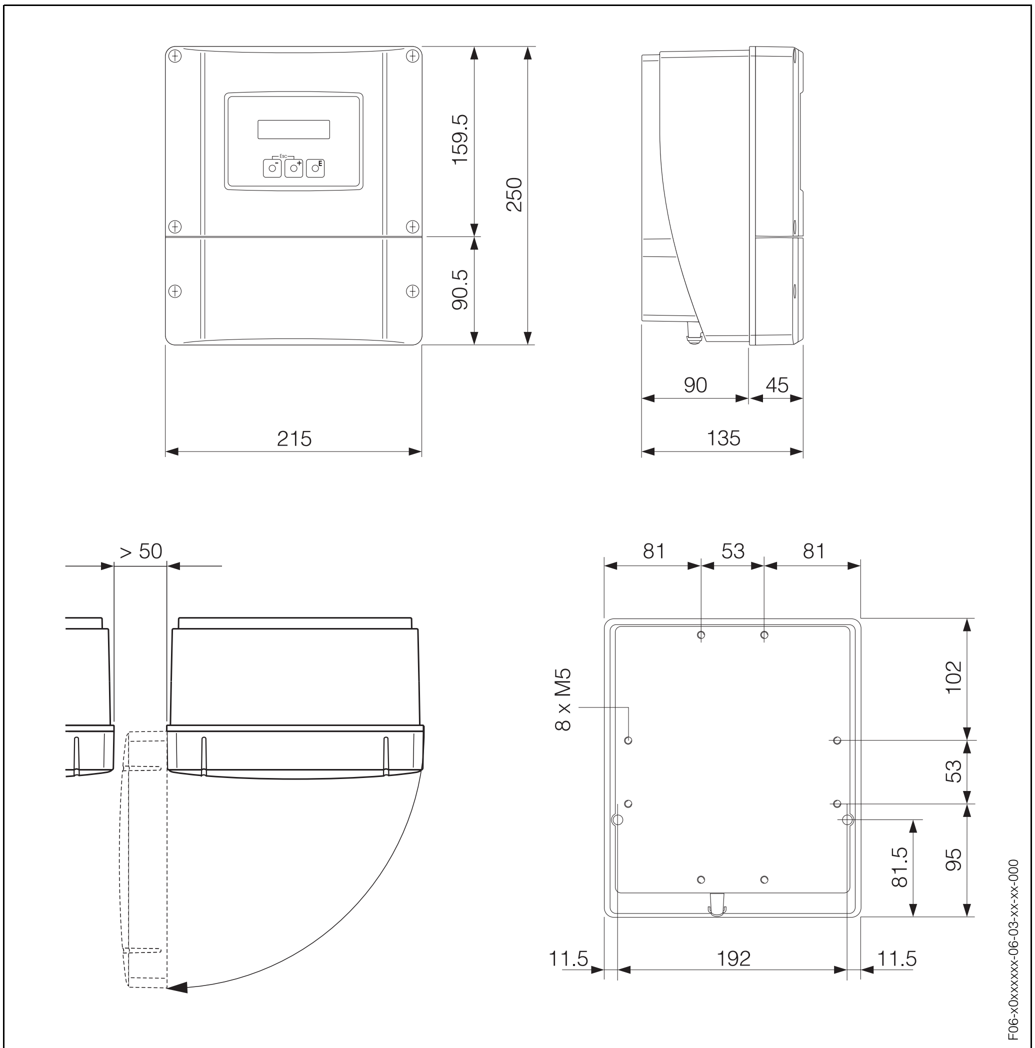


Pressure loss diagram for water

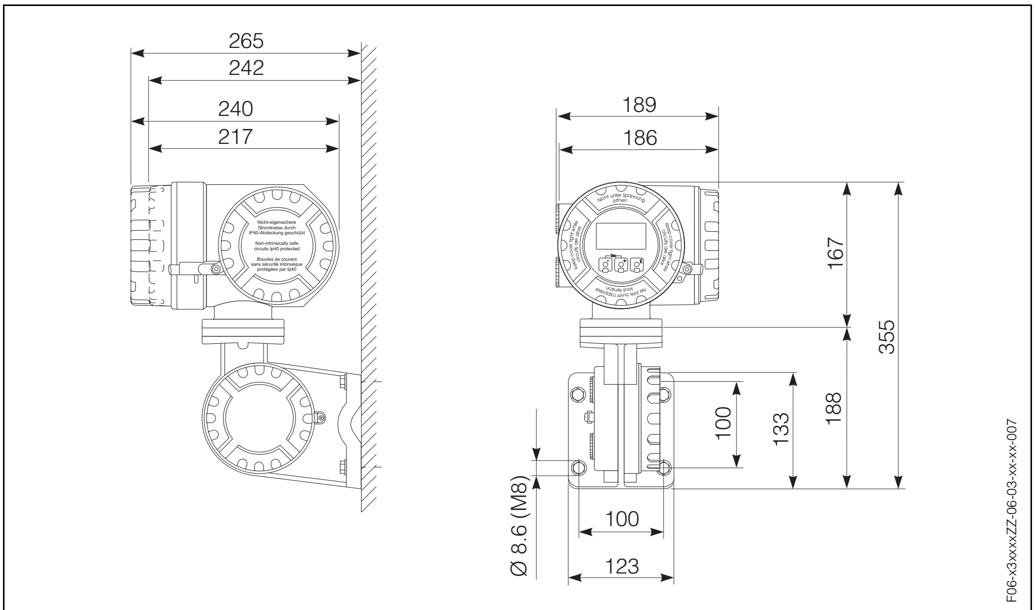
Mechanical construction

Design / dimensions

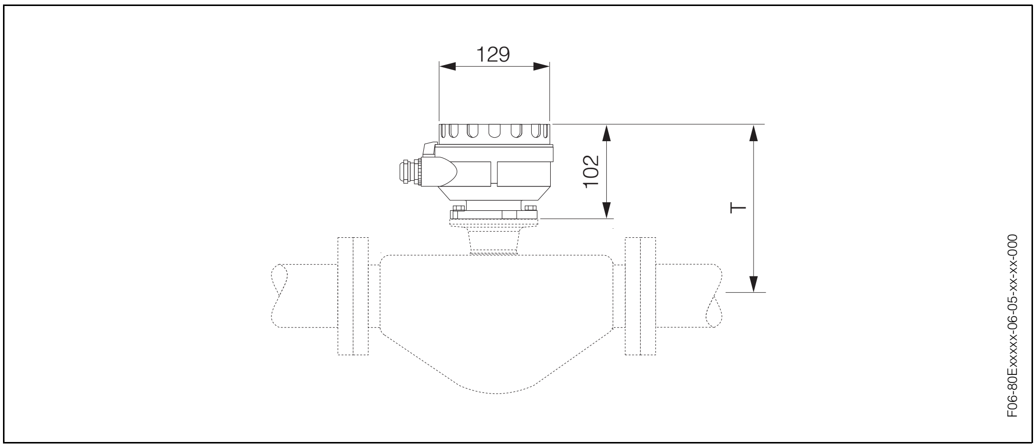
Dimensions: Wall-mount housing (non hazardous area and II3G / zone 2)



Dimensions: Remote field housing (II2G / zone 1)

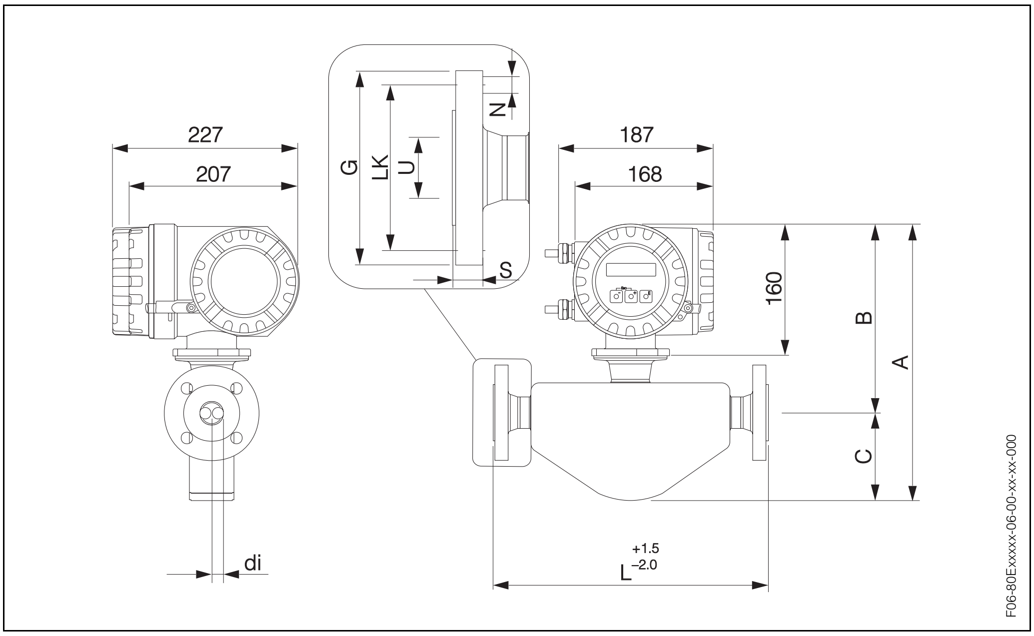


Dimensions: Remote version



T = dimension B in the compact version (with corresponding nominal diameter) minus 58 mm

Dimensions: Flange connections EN (DIN), ANSI, JIS



Flange EN 1092-1 (DIN 2501 / DIN 2512N [1]) / PN 40: 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
8	317	224	93	95	232	4 x Ø14	16	65	17.3	5.35
15	331	226	105	95	279	4 x Ø14	16	65	17.3	8.30
25	337	231	106	115	329	4 x Ø14	18	85	28.5	12.00
40	358	237	121	150	445	4 x Ø18	18	110	43.1	17.60
50	423	253	170	165	556	4 x Ø18	20	125	54.5	26.00
[1] Flange with groove to EN 1092-1 Form D (DIN 2512N) available										

Flange EN 1092-1 (DIN 2501) / PN 40 (with DN 25-flanges): 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
8	341	266	75	115	440	4 x Ø14	18	85	28.5	5.35
15	341	266	75	115	440	4 x Ø14	18	85	28.5	8.30

Flange EN 1092-1 (DIN 2501 / DIN 2512N [1]) / PN 63: 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
50	423	253	170	180	565	4 x Ø22	26	135	54.5	26.00
[1] Flange with groove to EN 1092-1 Form D (DIN 2512N) available										

Flange EN 1092-1 (DIN 2501 / DIN 2512N [1]) / PN 100: 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
8	317	224	93	105	261	4 x Ø14	20	75	17.3	5.35
15	331	226	105	105	295	4 x Ø14	20	75	17.3	8.30
25	337	231	106	140	360	4 x Ø18	24	100	28.5	12.00
40	358	237	121	170	486	4 x Ø22	26	125	42.5	17.60
50	423	253	170	195	581	4 x Ø26	28	145	53.9	26.00
[1] Flange with groove to EN 1092-1 Form D (DIN 2512N) available										

Flange ANSI B16.5 / Cl 150: 1.4404/316L											
DN		A	B	C	G	L	N	S	LK	U	di
8	3/8"	317	224	93	88.9	232	4 x Ø15.7	11.2	60.5	15.7	5.35
15	1/2"	331	226	105	88.9	279	4 x Ø15.7	11.2	60.5	15.7	8.30
25	1"	337	231	106	108.0	329	4 x Ø15.7	14.2	79.2	26.7	12.00
40	1 1/2"	358	237	121	127.0	445	4 x Ø15.7	17.5	98.6	40.9	17.60
50	2"	423	253	170	152.4	556	4 x Ø19.1	19.1	120.7	52.6	26.00

Flange ANSI B16.5 / Cl 300: 1.4404/316L											
DN		A	B	C	G	L	N	S	LK	U	di
8	3/8"	317	224	93	95.2	232	4 x Ø15.7	14.2	66.5	15.7	5.35
15	1/2"	331	226	105	95.2	279	4 x Ø15.7	14.2	66.5	15.7	8.30
25	1"	337	231	106	123.9	329	4 x Ø19.0	17.5	88.9	26.7	12.00
40	1 1/2"	358	237	121	155.4	445	4 x Ø22.3	20.6	114.3	40.9	17.60
50	2"	423	253	170	165.1	556	8 x Ø19.0	22.3	127.0	52.6	26.00

Flange ANSI B16.5 / Cl 600: 1.4404/316L											
DN		A	B	C	G	L	N	S	LK	U	di
8	3/8"	317	224	93	95.3	261	4 x Ø15.7	20.6	66.5	13.9	5.35
15	1/2"	331	226	105	95.3	295	4 x Ø15.7	20.6	66.5	13.9	8.30
25	1"	337	231	106	124.0	380	4 x Ø19.1	23.9	88.9	24.3	12.00
40	1 1/2"	358	237	121	155.4	496	4 x Ø22.4	28.7	114.3	38.1	17.60
50	2"	423	253	170	165.1	583	8 x Ø19.1	31.8	127.0	49.2	26.00

Flange JIS B2238 / 10K: 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
50	423	253	170	155	556	4 x Ø19	16	120	50	26.00

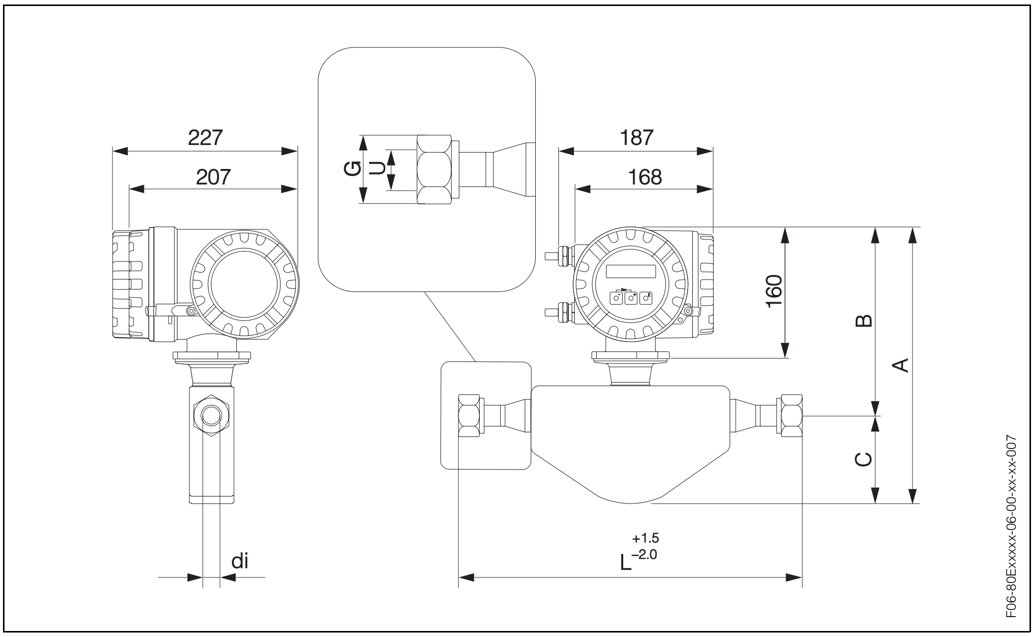
Flange JIS B2238 / 20K: 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
8	317	224	93	95	232	4 x Ø15	14	70	15	5.35
15	331	226	105	95	279	4 x Ø15	14	70	15	8.30
25	337	231	106	125	329	4 x Ø19	16	90	25	12.00

Flange JIS B2238 / 20K: 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
40	358	237	121	140	445	4 x Ø19	18	105	40	17.60
50	423	253	170	155	556	8 x Ø19	18	120	50	26.00

Flange JIS B2238 / 40K: 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
8	317	224	93	115	261	4 x Ø19	20	80	15	5.35
15	331	226	105	115	300	4 x Ø19	20	80	15	8.30
25	337	231	106	130	375	4 x Ø19	22	95	25	12.00
40	358	237	121	160	496	4 x Ø23	24	120	38	17.60
50	423	253	170	165	601	8 x Ø19	26	130	50	26.00

Flange JIS B2238 / 63K: 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
8	317	224	93	120	282	4 x Ø19	23	85	12	5.35
15	331	226	105	120	315	4 x Ø19	23	85	12	8.30
25	337	231	106	140	383	4 x Ø23	27	100	22	12.00
40	358	237	121	175	515	4 x Ø25	32	130	35	17.60
50	423	253	170	185	616	8 x Ø23	34	145	48	26.00

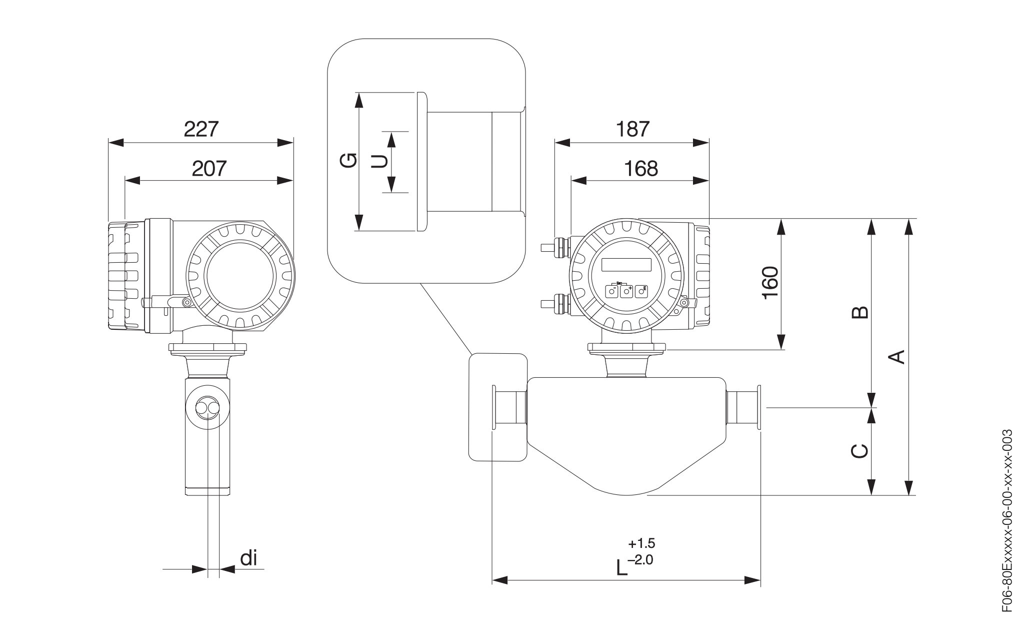
Dimensions: VCO connections



8-VCO-4 (1/2"): 1.4404/316L							
DN	A	B	C	G	L	U	di
8	317	224	93	a/f 1"	252	10.2	5.35

12-VCO-4 (3/4"): 1.4404/316L							
DN	A	B	C	G	L	U	di
15	331	226	105	a/f 1 1/2"	305	15.7	8.30

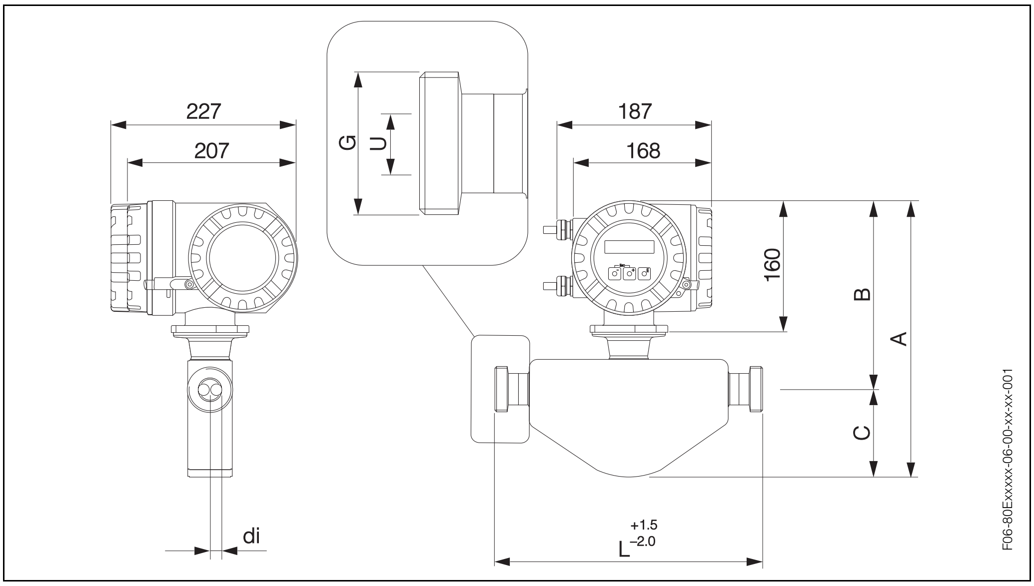
Dimensions: Tri-Clamp connections



Tri-Clamp: 1.4404/316L								
DN	Clamp	A	B	C	G	L	U	di
8	1"	317	224	93	50.4	229	22.1	5.35
15	1"	331	226	105	50.4	273	22.1	8.30
25	1"	337	231	106	50.4	324	22.1	12.00
40	1 1/2"	358	237	121	50.4	456	34.8	17.60
50	2"	423	253	170	63.9	562	47.5	26.00
3A version also available (Ra ≤ 0.8 µm/150 grit)								

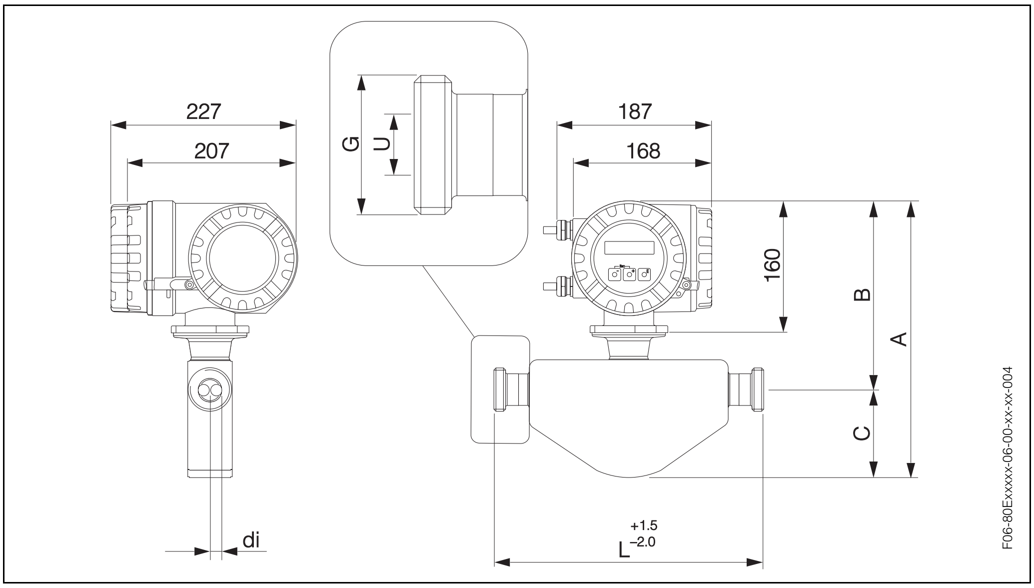
1/2" Tri-Clamp: 1.4404/316L								
DN	Clamp	A	B	C	G	L	U	di
8	1/2"	317	224	93	25.0	229	9.5	5.35
15	1/2"	331	226	105	25.0	273	9.5	8.30
3A version also available (Ra ≤ 0.8 µm/150 grit)								

Dimensions: DIN 11851 connections (hygienic coupling)



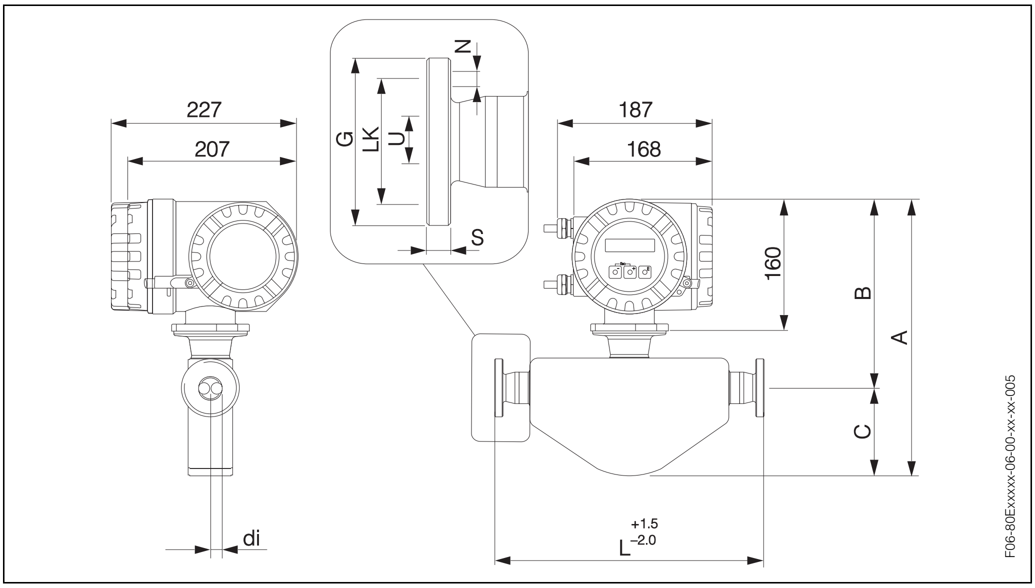
Hygienic coupling DIN 11851: 1.4404/316L							
DN	A	B	C	G	L	U	di
8	317	224	93	Rd 34 x 1/8"	229	16	5.35
15	331	226	105	Rd 34 x 1/8"	273	16	8.30
25	337	231	106	Rd 52 x 1/6"	324	26	12.00
40	358	237	121	Rd 65 x 1/6"	456	38	17.60
50	423	253	170	Rd 78 x 1/6"	562	50	26.00
3A version also available (Ra ≤ 0.8 µm/150 grit)							

Dimensions: DIN 11864-1 Form A connections (couplings)



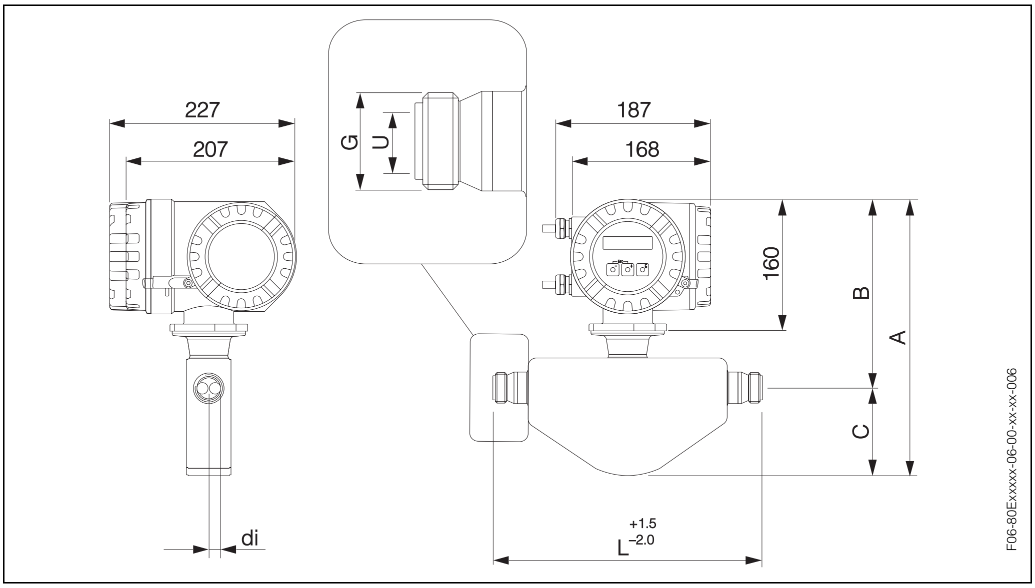
Coupling DIN 11864-1 Form A: 1.4404/316L							
DN	A	B	C	G	L	U	di
8	317	224	93	Rd 28 x 1/8"	229	10	5.35
15	331	226	105	Rd 34 x 1/8"	273	16	8.30
25	337	231	106	Rd 52 x 1/6"	324	26	12.00
40	358	237	121	Rd 65 x 1/6"	456	38	17.60
50	423	253	170	Rd 78 x 1/6"	562	50	26.00
3A version also available (Ra ≤ 0.8 µm/150 grit)							

Dimensions: flange connections DIN 11864-2 Form A (flat flange)



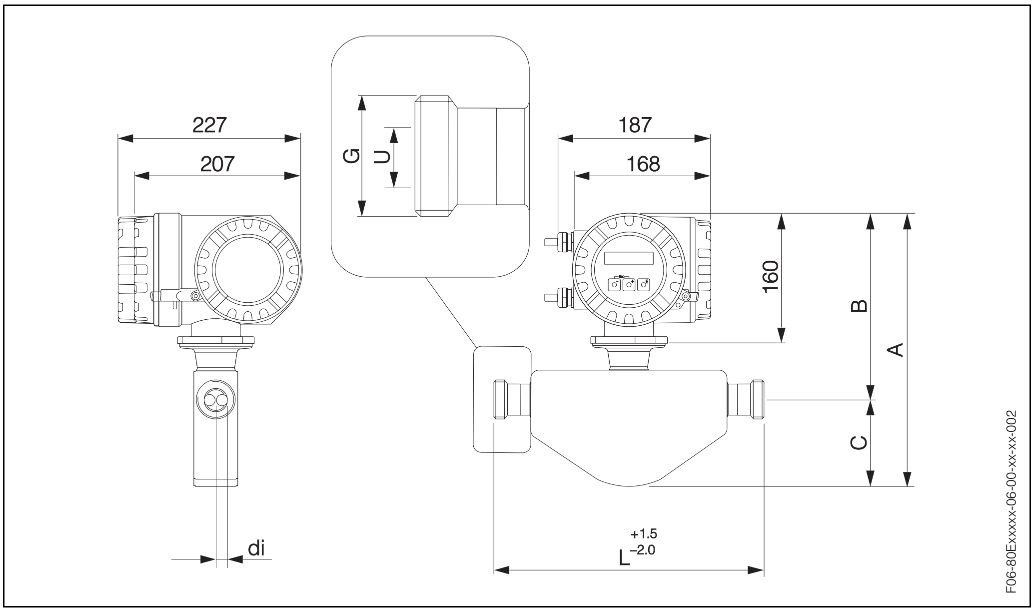
Flange DIN 11864-2 Form A (flat flange): 1.4404/316L										
DN	A	B	C	G	L	N	S	LK	U	di
8	317	224	93	54	249	4 x Ø9	10	37	10	5.35
15	331	226	105	59	293	4 x Ø9	10	42	16	8.30
25	337	231	106	70	344	4 x Ø9	10	53	26	12.00
40	358	237	121	82	456	4 x Ø9	10	65	38	17.60
50	423	253	170	94	562	4 x Ø9	10	77	50	26.00
3A version also available (Ra ≤ 0.8 µm/150 grit)										

Dimensions: ISO 2853 connections (couplings)



Coupling ISO 2853: 1.4404/316L							
DN	A	B	C	G [1)]	L	U	di
8	317	224	93	37.13	229	22.6	5.35
15	331	226	105	37.13	273	22.6	8.30
25	337	231	106	37.13	324	22.6	12.00
40	358	237	121	52.68	456	35.6	17.60
50	423	253	170	64.16	562	48.6	26.00
[1)] Max. thread diameter to ISO 2853 Annex A, 3A version also available (Ra ≤ 0.8 µm/150 grit)							

Dimensions: SMS 1145 connections (hygienic coupling)



Hygienic coupling SMS 1145: 1.4404/316L							
DN	A	B	C	G	L	U	di
8	317	224	93	Rd 40 x 1/6"	229	22.5	5.35
15	331	226	105	Rd 40 x 1/6"	273	22.5	8.30
25	337	231	106	Rd 40 x 1/6"	324	22.5	12.00
40	358	237	121	Rd 60 x 1/6"	456	35.5	17.60
50	423	253	170	Rd 70 x 1/6"	562	48.5	26.00
3A version also available (Ra ≤ 0.8 µm/150 grit)							

Weight

- Compact version: see table below
- Remote version
  - Sensor: weight of compact version minus 2 kg

Promass E / DN	**8**	**15**	**25**	**40**	**50**
Weight in [kg]	8	8	10	15	22

Materials

Transmitter housing:
- Powder coated die-cast aluminium

Sensor housing:
- Acid and alkali resistant outer surface; stainless steel 1.4301/304

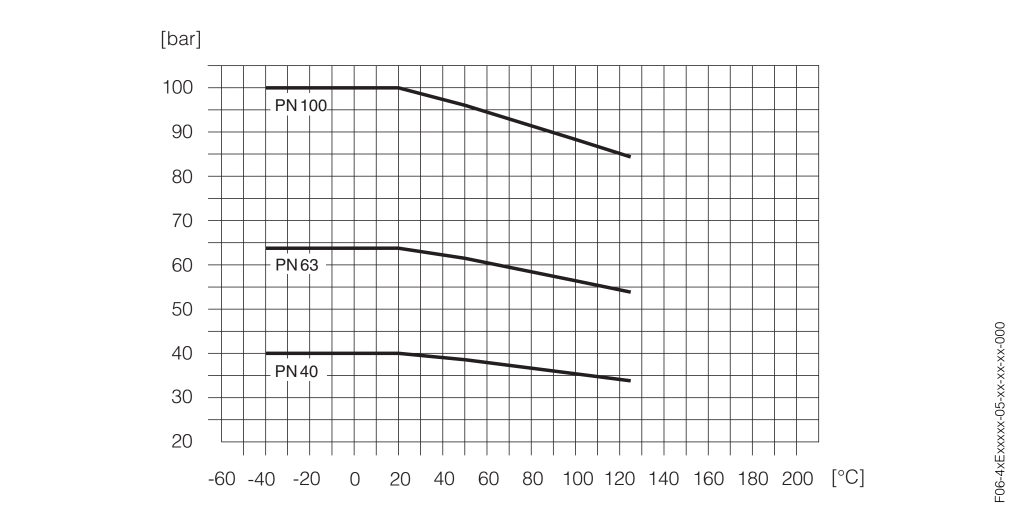
Process connections and manifolds:
- Flanges EN (DIN) / ANSI / JIS → Stainless steel 1.4404/316L
- Flange DIN 11864-2 Form A (flat flange) → Stainless steel 1.4404/316L
- VCO connection → Stainless steel 1.4404/316L
- Hygienic coupling DIN 11851 / SMS 1145 → Stainless steel 1.4404/316L
- Couplings ISO 2853 / DIN 11864-1 → Stainless steel 1.4404/316L
- Tri-Clamp → Stainless steel 1.4404/316L

Measuring tubes
- DN 8...50: Stainless steel 1.4539/904L

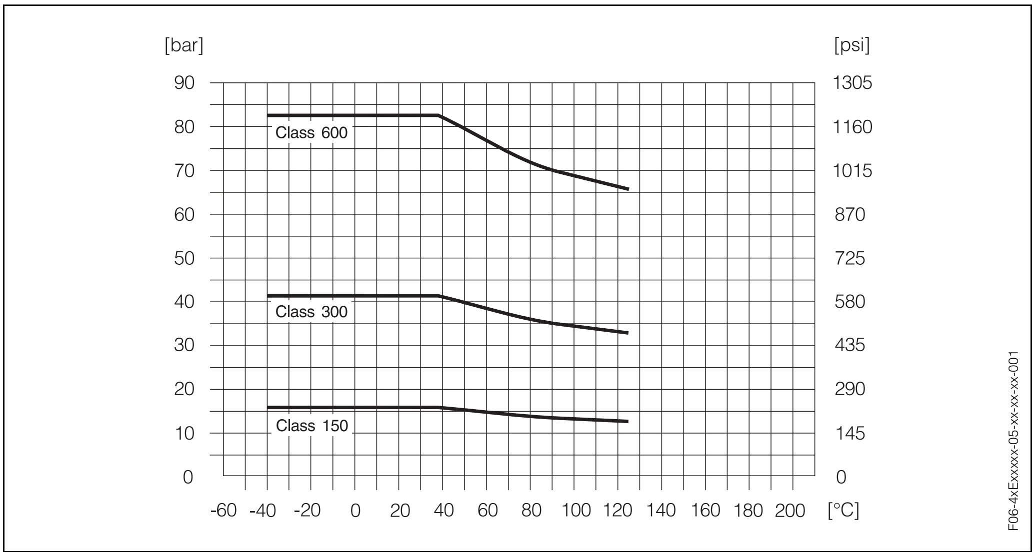
Seals:
- Welded process connections without internal seals

Material load diagram

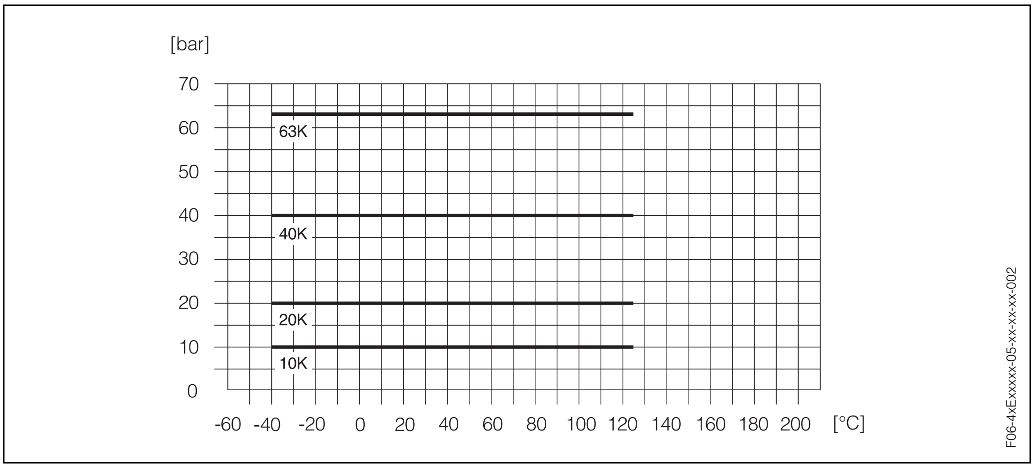
Flange connection to EN 1092-1 (DIN 2501)
Flange material: 1.4404/316L



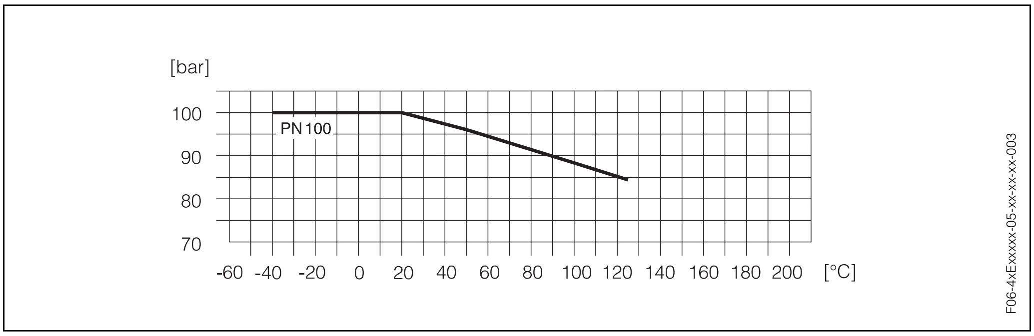
Flange connection to ANSI B16.5
Flange material: 1.4404/316L



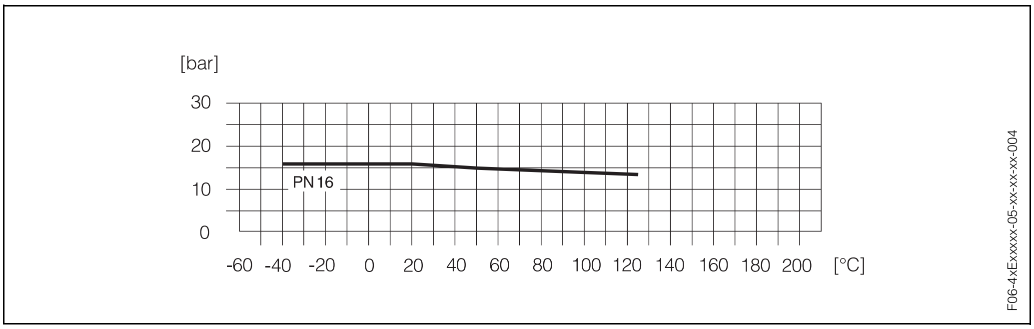
Flange connection to JIS B2238
Flange material: 1.4404/316L



VCO process connection
Coupling material: 1.4404/316L

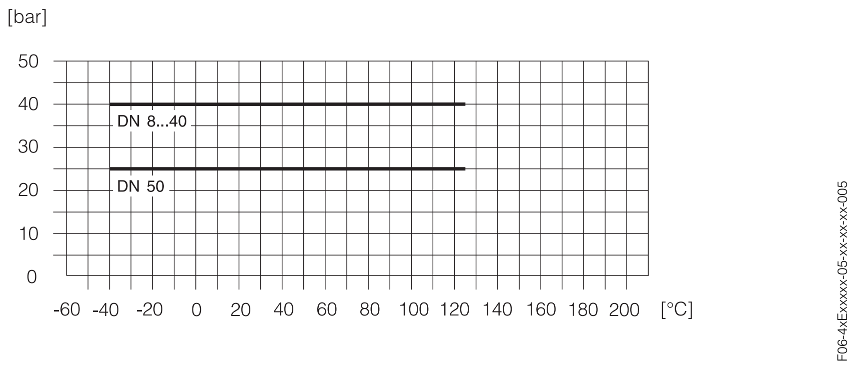


Hygienic coupling to DIN 11851 / SMS 1145
Coupling material: 1.4404/316L

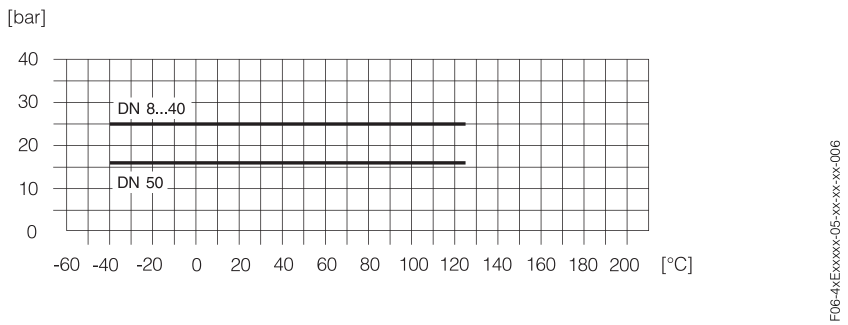


Tri-Clamp process connection
The load limit is defined exclusively by the material properties of the outer clamp used. This clamp is not included in the scope of delivery.

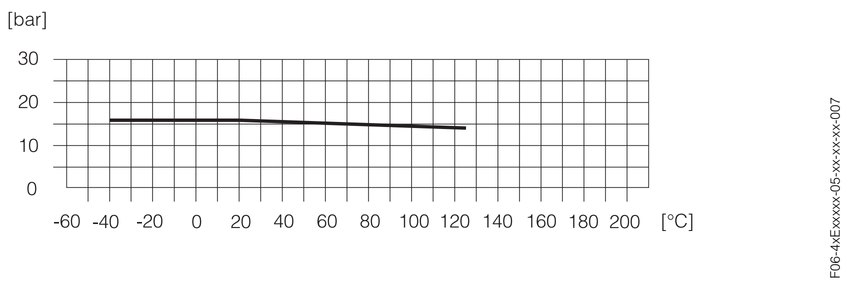
Coupling to DIN 11864-1
Coupling material: 1.4404/316L



Flange connection to DIN 11864-2 Form A (flat flange)
Flange material: 1.4404/316L



Coupling to ISO 2853
Coupling material: 1.4404/316L



Process connection

Welded process connections:
- VCO coupling, flanges EN 1092-1 (DIN 2501), ANSI B16.5, JIS B2238
- Sanitary connections: Tri-Clamp, couplings (DIN 11851, SMS 1145, ISO 2853, DIN 11864-1), flange to DIN 11864-2 Form A (flat flange)

Human interface

Display elements

- Liquid-crystal display: backlit, two lines (Promass 80) or four lines (Promass 83) with 16 characters per line
- Selectable display of different measured values and status variables
- At ambient temperatures below –20 °C the readability of the display may be impaired.

Operating elements

Unified control concept for both types of transmitter:

Promass 80 E:
- Local operation with three keys (–, +, E)
- Quick Setup menus for straightforward commissioning

Promass 83 E:
- Local operation with three optical sensors (–, +, E)
- Application specific Quick Setup menus for straightforward commissioning

Language group

Language groups for operation in different countries:
- Western Europe and America:
  English, German, Spanish, Italian, French, Dutch and Portuguese
- Northern/eastern Europe:
  English, Russian, Polish, Norwegian, Finnish, Swedish and Czech
- Southern/eastern Asia:
  English, Japanese and Indonesian

Remote operation

Promass 80 E:
Remote operation via HART, PROFIBUS-PA

Promass 83 E:
Remote operation via HART, PROFIBUS-PA/-DP, FOUNDATION Fieldbus

Certificates and approvals

Ex approval

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

Sanitary compatibility

3A authorization

Pressure Equipment Directive

Flow meters with a nominal diameter smaller or equal DN 25 are covered by Art. 3(3) of the European directive 97/23/EG (Pressure Equipment Directive) and are designed according to sound engineer practice. For larger nominal diameter, optional approvals according to Cat. III are available when required (depends on fluid and process pressure).

Functional safety

SIL 2:
accordance IEC 61508/IEC 61511-1 (FDIS)
4...20 mA output according to the following order code:

Promass 80***–***********A
Promass 80***–***********D
Promass 83***–***********A
Promass 83***–***********B

PROFIBUS-PA certification

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

- Certified to PROFIBUS-PA, profile version 3.0 (device certification number: on request)
- The device can also be operated with certified devices of other manufacturers (interoperability)

FOUNDATION Fieldbus certification

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

- Certified to FOUNDATION Fieldbus Specification
- The device meets all the specifications of the FOUNDATION Fieldbus H1.
- Interoperability Test Kit (ITK), revision status 4.0 (device certification number: on request)
- The device can also be operated with certified devices of other manufacturers
- Physical Layer Conformance Test of the Fieldbus FOUNDATION

CE mark

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

Other standards, guidelines

EN 60529:
Degrees of protection by housing (IP code)

EN 61326/A1 (IEC 1326):
Electromagnetic compatibility (EMC requirements)

NAMUR NE 21:
Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.

NAMUR NE 43:
Standardisation of the signal level for the breakdown information of digital transmitters with analogue output signal.

Ordering information

The E+H service organisation can provide detailed ordering information and information on the order codes on request.

Accessories

Various accessories, which can be ordered separately from Endress+Hauser, are available for the transmitter. The E+H service organisation can provide detailed information on request.

Supplementary documentation

- ❑ System Information Promass (SI 032D/06/en)
- ❑ Technical Information Promass 80/83 A (TI 054D/06/en)
- ❑ Technical Information Promass 80/83 I, H (TI 052D/06/en)
- ❑ Technical Information Promass 80/83 F, M (TI053D/06/en)
- ❑ Operating Instructions Promass 80 (BA 057D/06/en)
- ❑ Description of Device Functions Promass 80 (BA 058D/06/en)
- ❑ Operating Instructions Promass 80 PROFIBUS-PA (BA 072D/06/en)
- ❑ Description of Device Functions Promass 80 PROFIBUS-PA (BA 073D/06/en)
- ❑ Operating Instructions Promass 83 (BA 059D/06/en)
- ❑ Description of Device Functions Promass 83 (BA 060D/06/en)
- ❑ Operating Instructions Promass 83 PROFIBUS-DP/-PA (BA 063D/06/en)
- ❑ Description of Device Functions Promass 83 PROFIBUSDP/-PA (BA 064D/06/en)
- ❑ Operating Instructions Promass 83 FOUNDATION Fieldbus (BA 065D/06/en)
- ❑ Description of Device Functions Promass 83 FOUNDATION Fieldbus (BA 066D/06/en)
- ❑ Supplementary documentation on Ex-ratings: ATEX, FM, CSA
- ❑ Functional safety manual Promass 80/83 (SD077D/06/en)

TRI-CLAMP®
Registered trademark of Ladish & Co., Inc., Kenosha, USA

HART®
Registered trademark of HART Communication Foundation, Austin, USA

S-DAT™, T-DAT™, F-CHIP™
Registered or registration-pending trademark of Endress+Hauser Flowtec AG, Reinach, CH

Subject to modification

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