Level | Pressure | Flow | Temperature | Liquid Analysis | Registration | Systems Components | Services | Solutions

Technical Information

Proline Promass 84A

Coriolis Mass Flow Measuring System
The single-tube system for highly accurate measurement of very small flows for custody transfer

Application
The Coriolis measuring principle operates independently of the physical fluid properties, such as viscosity and density.

- Suitable for continuous measurement, filling and dosing of very small flows.
- Extremely accurate, verified measurement of liquids and gases such as emulsions, additives, flavouring, insulin, gases for high pressure and low pressure
- Fluid temperatures up to +200 °C
- Process pressures up to 400 bar

Approvals for custody transfer:
- PTB, NMi

Approvals for hazardous area:
- ATEX, FM, CSA, TIIS

Approvals in the food industry/hygiene sector:
- 3A, FDA, EHEDG

Connection to process control system:
- HART

Relevant safety aspects:
- Pressure Equipment Directive

Features and benefits
The Promass measuring devices make it possible to simultaneously record several process variables (mass/density/temperature) for various process conditions during measuring operation.

The **Proline transmitter concept** comprises:
- Modular device and operating concept resulting in a higher degree of efficiency
- Diagnostic ability and data back-up for increased process quality

The **Promass sensors**, tried and tested in over 100000 applications, offer:
- Multivariable flow measurement in compact design
- Insensitivity to vibrations thanks to balanced single-tube measuring system
- Efficient protection against forces from piping thanks to robust construction
- Easy installation without taking inlet and outlet runs into account

TI068D/06/en/03.05
50109206

Endress+Hauser
People for Process Automation

Table of contents

Function and system design

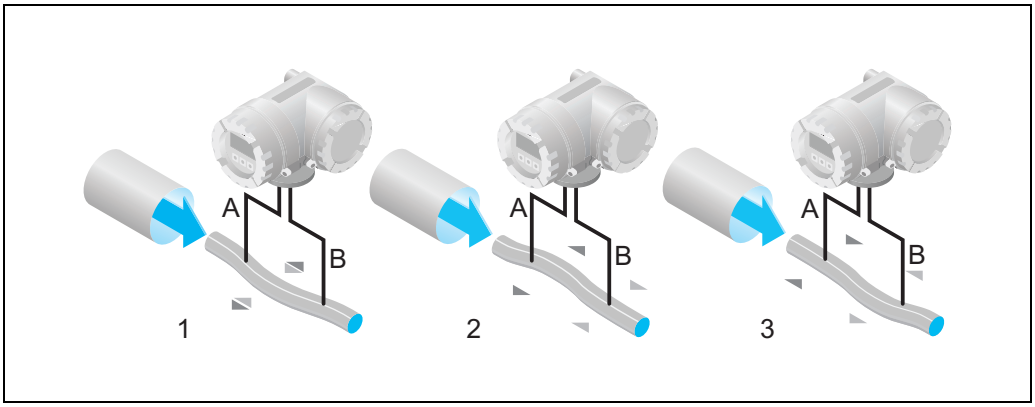
Measuring principle

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.

$F_C = 2 \cdot \Delta m\ (v \cdot \omega)$
F_C = Coriolis force
Δm = moving mass
ω = rotational velocity
v = radial velocity in rotating or oscillating system

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

The measuring tube, through which the medium flows, oscillates. The Coriolis forces produced at the measuring tube cause a phase shift in the tube oscillations (see illustration):
- At zero flow, i.e. when the fluid is at a standstill, the oscillation registered at points A and B is in phase, i.e. there is no phase difference (1).
- Mass flow causes deceleration of the oscillation at the inlet of the tubes (2) and acceleration at the outlet (3).



a0003383

The phase difference (A-B) increases with increasing mass flow. Electrodynamic sensors register the tube oscillations at the inlet and outlet.
Compared to two-tube systems, other constructive solutions are required for the system balance for single-tube systems. For this purpose, Promass A has an internal reference mass.
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 fluid density. The microprocessor utilises this relationship to obtain a density signal.

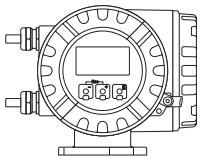
Temperature measurement

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.
The temperature measurement cannot be used to generate data for invoicing in applications subject to legal metrology controls.

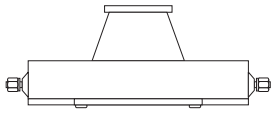
Measuring system

The measuring system consists of a transmitter and a sensor. Two versions are available:
- Compact version: transmitter and sensor form a mechanical unit.
- Remote version: transmitter and sensor are mounted physically separate from one another.

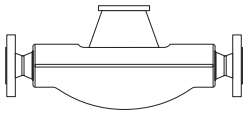
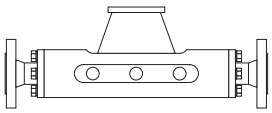
Transmitter

Promass 84  a0003672	■ 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

A  a0003679	■ Single-tube system for highly accurate measurement of very small flows ■ Nominal diameters DN 2..4 ■ Measuring tube made of stainless steel or Alloy C-22	Documentation No. TI 054D/06/en

Further sensors in separate documentations

F  a0003673	■ Universal sensor for fluid temperatures up to 200 C ■ Nominal diameters DN 8...250 ■ Measuring tubes made of stainless steel or Alloy C-22	Documentation No. TI 053D/06/en
M  a0003676	■ Robust sensor for extreme process pressures, high secondary containment requirements and fluid temperatures up to 150 C ■ Nominal diameters DN 8...80 ■ Tube material: titanium	Documentation No. TI 053D/06/en

Input

Measured variable

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

Measuring range in non-custody transfer mode

Measuring ranges for liquids

DN	Range for full scale values (liquids) $\dot{m}_{min(F)}...\dot{m}_{max(F)}$
2	0...100 kg/h
4	0...450 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:

$\dot{m}_{max(G)} = \dot{m}_{max(F)} \cdot \rho_{(G)} / 32$ [kg/m³]

$\dot{m}_{max(G)}$ = 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/m³] at process conditions

Here, $\dot{m}_{max(G)}$ can never be greater than $\dot{m}_{max(F)}$

Calculation example for gas:

- Measuring device: Promass A, DN 2
- Gas: air with a density of 11.9 kg/m³ (at 20 °C and 10 bar)
- Measuring range: 100 kg/h

Max. possible full scale value:
$\dot{m}_{max(G)} = \dot{m}_{max(F)} \cdot \rho_{(G)} / 32$ [kg/m³] = 100 kg/h ·11.9 kg/h / 32 kg/m³ = 37.2 kg/h

Recommended full scale values:

See information in the “Limiting flow” Section → Page 17 ff.

Measuring range in custody transfer mode

Measuring ranges for liquids in mass flow:

DN	Range for mass flow (liquids) $Q_{min\ [kg/min]}...Q_{max\ [kg/min]}$	Smallest measured quantity [kg]
2	0.1...2	0.05
4	0.4...8	0.20

Measuring ranges for liquids in volume flow (also LPG):

DN	Range for volume flow (liquids) (with P = 1 kg/dm³) $Q_{min\ [l/min]}...Q_{max\ [l/min]}$	Smallest measured quantity [l]
2	0.1...2	0.05
4	0.4...8	0.20

Operable flow range

Over 20 : 1 for verified device

Input signal

Status input (auxiliary input):

U = 3...30 V DC, R_i = 5 kΩ, galvanically isolated.
Configurable for: totalizer reset, positive zero return, error message reset, zero point adjustment start

Output

Output signal

Current output:

Active/passive selectable, galvanically isolated, time constant selectable (0.05...100 s), full scale value adjustable, Temperature coefficient: typ. 0.005% o.r./°C, resolution: 0.5 µA
- Active: 0/4...20 mA, $R_L < 700\ \Omega$ (at HART: $R_L \geq 250\ \Omega$)
- Passive: 4...20 mA; supply voltage V_S 18...30 V DC; $R_i \geq 150\ \Omega$

Pulse/frequency output:

For custody transfer measurement, two pulse outputs can be operated, phase-shifted 90.

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

- Frequency output: full scale frequency 2...10000 Hz (f_{max} = 12500 Hz), on/off ration 1:1, pulse width max. 2 s. For phase-shifted double pulse max. 5000 Hz.
- Pulse output: pulse value and pulse polarity selectable, pulse width adjustable (0.05...2000 ms); the on/off ratio is 1:1 as of a frequency of 1 / (2 x pulse width)

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:

De-energised by fault or power supply failure

Load

see "Output signal"

Low flow cut off

Switch points for low flow cut off are selectable.

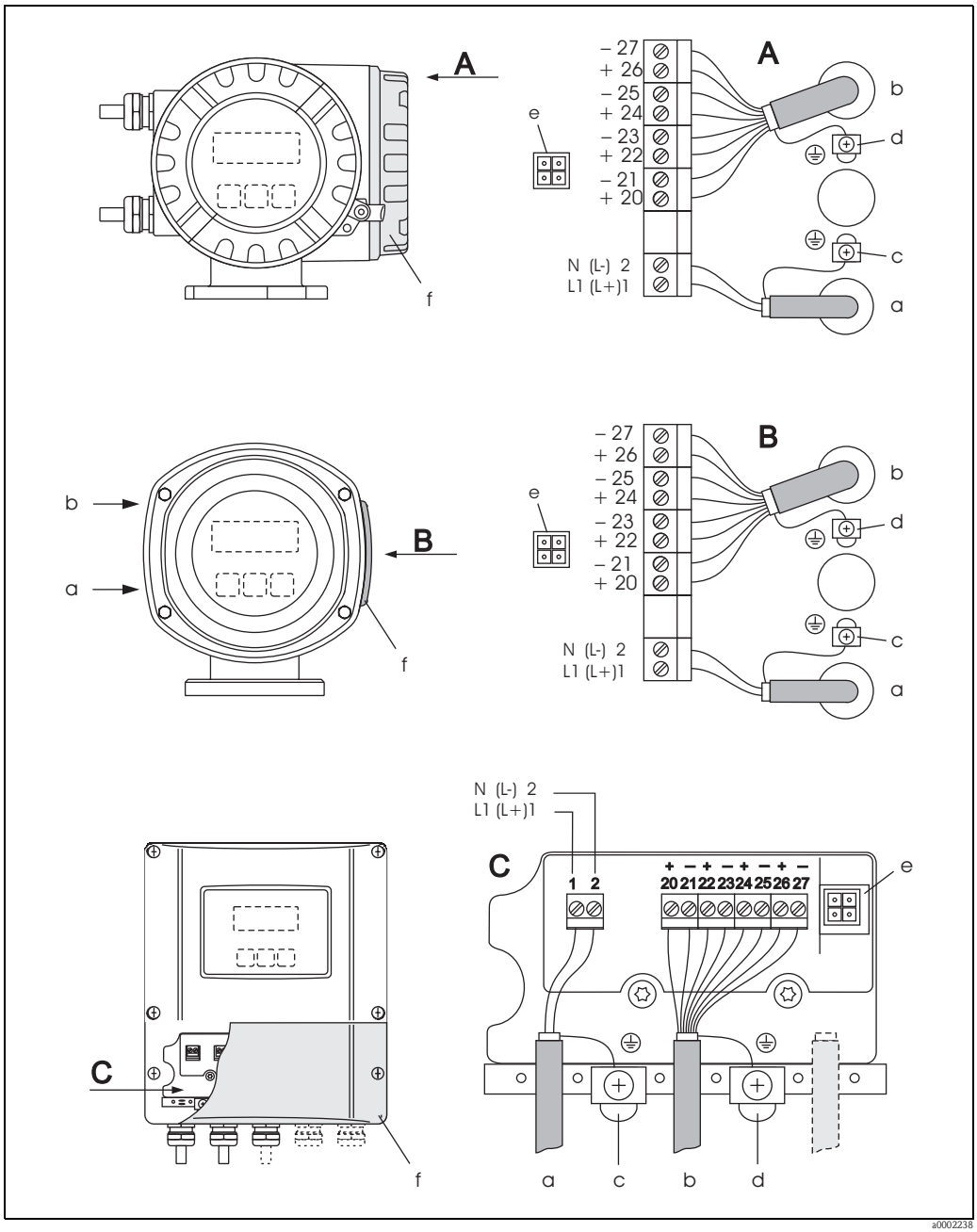
Nominal diameter	Low flow cutoff / factory settings (v ~ 0.04 m/s)	
[mm]	SI units [kg/h]	US units [lb/min]
2	0,40	0,015
4	1,80	0,066

Galvanic isolation

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

Power supply

Electrical connection
Measuring unit



a0002238

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

A View A (field housing)
B View B (stainless steel 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 Signal cable: Terminals No. 20–27 → Page 9
c Ground terminal for protective earth
d Ground terminal for signal cable shield
e Service connector for connecting service interface FXA 193 (Fieldcheck, ToF Tool - Fieldtool Package)
f Cover of the connection compartment

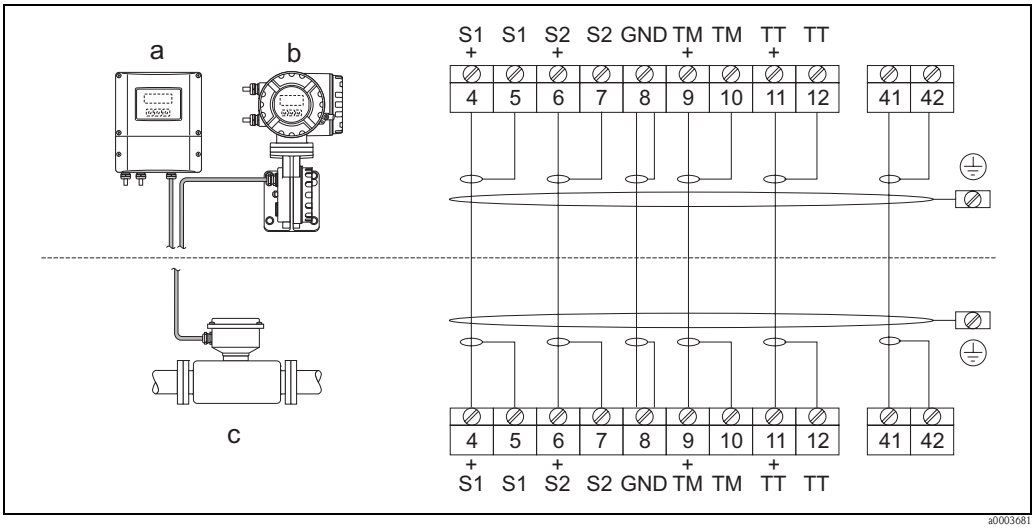
Electrical connection, terminal assignment

Promass 84

Replacements for modules which are defective or which have to be replaced can be ordered as accessories.

	Terminal No. (inputs/outputs)			
Order variant	**20 (+) / 21 (-)**	**22 (+) / 23 (-)**	**24 (+) / 25 (-)**	**26 (+) / 27 (-)**
84***-**********M	Status input	Frequency output 2	Frequency output 1	Current output HART

Electrical connection Remote version



a Wall-mount housing: Non-hazardous area and ATEX II3G (zone 2)

b Wall-mount housing: ATEX II2G (zone 1)

c Remote sensor flanged version

Wire color:
Terminal no.: 4/5 = grey; 6/7 = green; 8 = yellow; 9/10 = pink; 11/12 = white; 41/42 = brown

Supply voltage

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

Switching on the power supply in custody transfer mode

If the device is started in custody transfer mode, for example also after a power outage, system error No. 271 “POWER BRK. DOWN” flashes on the local display. The fault message can be acknowledged or reset using the “Enter” key or by means of the status input configured accordingly.

Cable entries

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

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

Remote version cable specifications

- 6 x 0.38 mm² 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
- Operating temperature: max. +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 or T-DAT save measuring system data if the power supply fails.
- S-DAT: exchangeable data storage chip with sensor specific data (nominal diameter, serial number, calibration factor, zero point, etc.)
- See Note on Page 9 (switching on the power supply in custody transfer mode)

Potential equalisation

No measures necessary.
Exception: explosion protected equipment must be included in the potential equalization.

Performance characteristics

Note!
The accuracy solely refers to the measuring device suitable for custody transfer measurement and not to the measuring system.

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 (or special density calibration)

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):

±0.10% ± [(zero point stability / measured value) x 100]% o.r.

Mass flow (gas):

±0.50% ± [(zero point stability / measured value) x 100]% o.r.

Volume flow (liquid)

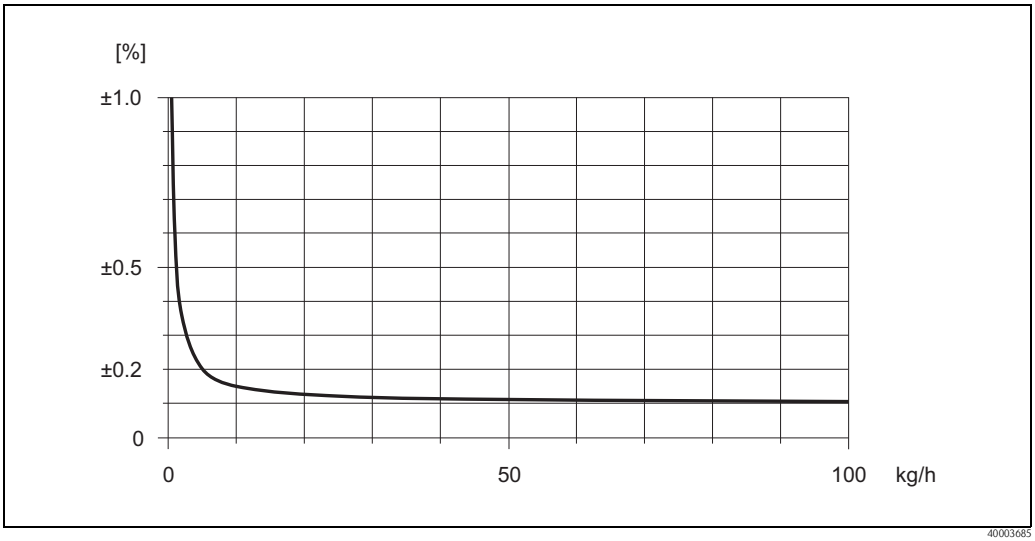
±0.25% ± [(zero point stability / measured value) x 100]% o.r.

o.r. = of reading

Zero point stability (Promass A):

DN	Max. full scale value [kg/h] or [l/h]	Zero point stability [kg/h] or [l/h]
2	100	0.0050
4	450	0.0225

Sample calculation



Max. measured error in % of measured value (example: Promass 84A / DN 2)

Calculation example (mass flow, liquid):
Given: Promass 84A / DN 2, measured value flow = 40 kg/h
Max. measured error: ±0.10% ± [(zero point stability / measured value) x 100]% o.r.
Max. measured error → ±0.10% ±0.005 kg/h ÷ 40 kg/h · 100% = ±0.11%

Density (liquid)

Standard calibration (1g/cc = 1 kg/l):

±0.02 g/cc

Special density calibration (optional)

±0.002 g/cc

After field density calibration or under reference conditions:

±0.0010 g/cc

Temperature

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

Repeatability

Mass flow (liquid):

±0.05% ± [1/2 x (zero point stability / measured value) x 100]% o.r.

Mass flow (gas):

±0.25% ± [1/2 x (zero point stability / measured value) x 100]% o.r.

Volume flow (liquid):

±0.10% ± [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 84A / DN 2, measured value flow = 40 kg/h
Repeatability: ±0.05% ± [1/2 x (zero point stability / measured value) x 100]% o.r.
Repeatability → ±0.05% ±1/2 · 0.005 kg/h ÷ 40 kg/h · 100% = ±0.056%

Density measurement (liquid)

±0.0005 g/cc

Temperature measurement

±0.25 °C ±0.0025 x T (T = medium 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 the Promass sensor is ±0.0002% of the full scale value / °C.

Influence of medium pressure

A difference in pressure between the calibration pressure and the process pressure does not have any effect on the accuracy.

Operating conditions: Installation

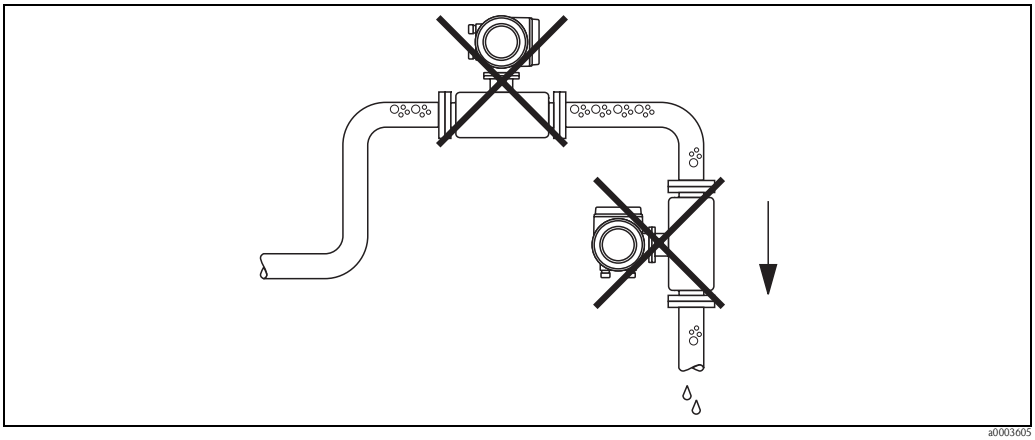
Installation instructions

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, Tpieces, etc.), as long as no cavitation occurs.
- For mechanical reasons and to protect the pipe, support is recommended for heavy sensors.
- Please refer to the verification ordinances for the installation conditions of the approval for custody transfer in question.

Note!
The necessary steps for creating a measuring system and obtaining approval from the Standards Authorities must be clarified with the authority for legal metrology controls responsible.

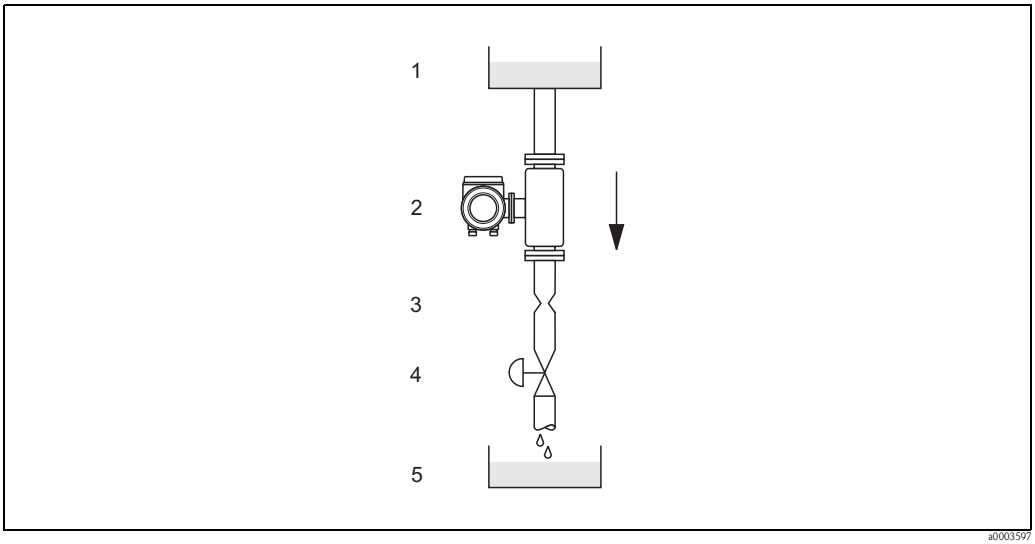
Mounting location

Entrained air or gas bubbles in the measuring tube can result in an increase in measuring errors.
For this reason, avoid the following mounting locations in the pipe:
- Highest point of a pipeline. Risk of air accumulating.
- Directly upstream from a free pipe outlet in a vertical pipeline.



Mounting location

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 down pipe (e.g. for batching applications)

1 Supply tank
2 Sensor
3 Orifice plate, pipe restriction (see Table)
4 Valve
5 Batching tank

DN	2	4
∅ **Orifice plate, pipe restriction**	1.5 mm	3.0 mm

Orientation

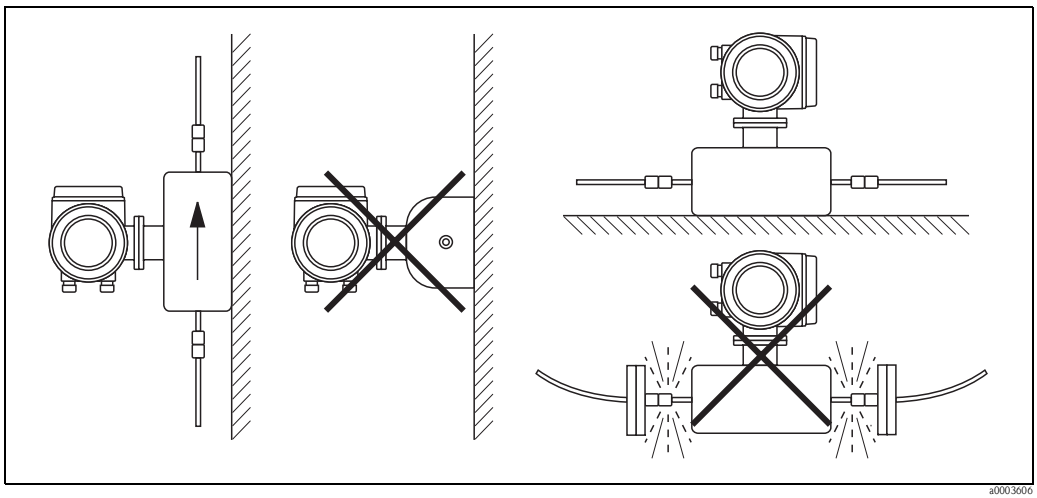
Make sure that the direction of the arrow on the nameplate of the sensor matches the direction of flow (direction of fluid flow through the pipe).

Vertical

Recommended orientation with direction of flow upwards. When fluid is not flowing, entrained solids will sink down and gases will rise away from the measuring tube. The measuring tubes can be completely drained and protected against solids build-up.

Horizontal

When installation is correct the transmitter housing is above or below the pipe. This means that no gas bubbles or solids deposits can form in the bent measuring tube (single-tube system).
The sensor cannot be installed suspended (i.e. without support or holder) in the pipe. This prevents excessive material load in the area of the process connection. The base plate of the sensor housing allows bench, wall or post mounting.



Vertical and horizontal orientation (Promass A)

Heating

Some fluids require suitable measures to avoid heat transfer at the sensor. Heating can be electric, e.g. with heated elements, or by means of hot water or steam pipes made of copper.

Caution!
- Risk of electronics overheating! Consequently, make sure that the adapter between the sensor and transmitter and 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 .
- If using an electric trace heating system whose heating is regulated via phase angle control or pulse packages, influence on the measured values cannot be ruled out due to magnetic fields (i.e. for values that are greater than the values approved by the EN standard (sine 30 A/m)). In such instances, it is necessary to magnetically screen the sensor.
  The secondary containment can be screened with tin plate or electric sheets without privileged direction (e.g. V330-35A) with the following properties:
  – Relative magnetic permeability $\mu_r \geq 300$
  – Plate thickness $d \geq 0.35$ mm
- Information on permitted temperature ranges → Page 17

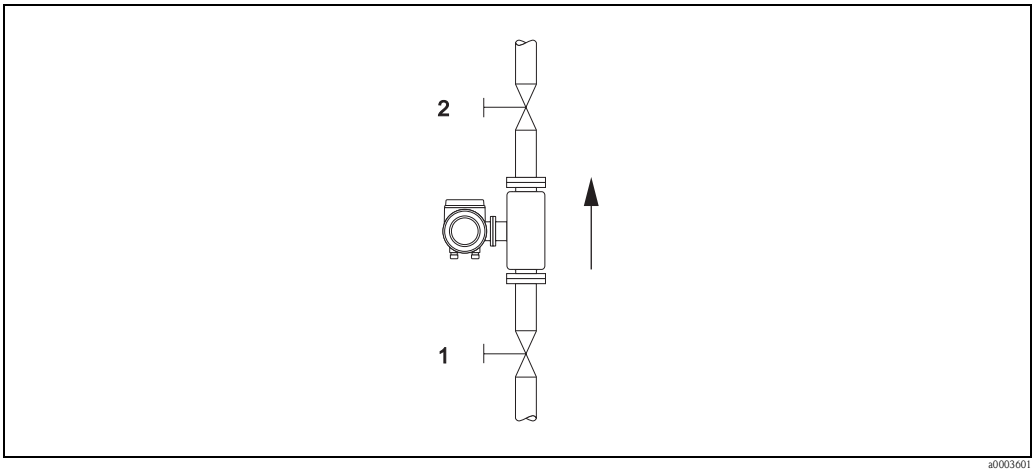
Special heating jackets, which can be ordered separately from Endress+Hauser as an accessory, are available for the sensors.

Zero point adjustment

All Promass devices are calibrated to state-of-the-art technology. The zero point determined in this way is imprinted on the nameplate. Calibration takes place under reference conditions. → Page 10 ff.
For this reason, Promass generally does **not** require zero point adjustment!

Experience shows that the zero point adjustment is advisable only 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 temperatures or very high-viscosity fluids).

Please note the following before carrying out the adjustment:
- The adjustment can only be performed with fluids that have no gas or solid contents.
- Zero point adjustment is performed with the measuring tubes completely filled and at zero flow (v = 0 m/s). 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



Zero point adjustment and shut-off valves

Inlet and outlet run

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 tube. 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

In accordance with IEC 68-2-31

Vibration resistance

Acceleration up to 1g, 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

–50...+200 °C

Seals:

(Only for mounting kits with screw-on connections)
Viton –15...200 °C; EPDM –40...+160 °C; silicone –60...+200 °C; Kalrez –20...+275 °C

Medium pressure range (nominal pressure)

Threaded joints:

Max. 160 bar (standard versions), max. 400 bar (high pressure versions)

Flanges:

DIN PN 40...100 / ANSI Cl 150, Cl 300 / JIS 10K

Note!
Material load diagrams for the process connections can be found on → Page 30 ff.

Pressure ranges of secondary containment:

25 bar or 375 psi

Warning!
In case a danger of measuring tube failure exists due to process characteristics, e.g. with corrosive process fluids, we recommend the use of sensors whose secondary containment is equipped with special pressure monitoring connections (ordering option). With the help of these connections, fluid collected in the secondary containment in the event of tube failure can be bled off. This is especially important in high pressure gas applications. These connections can also be used for gas circulation and/or detection. Dimensions

Limiting flow

See information in the “Measuring range” Section → Page 5

Select nominal diameter by optimising between required flow range and permissible pressure loss. An overview of max. possible full scale values can be found in the “Measuring range” Section.

- 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: formula → Page 5

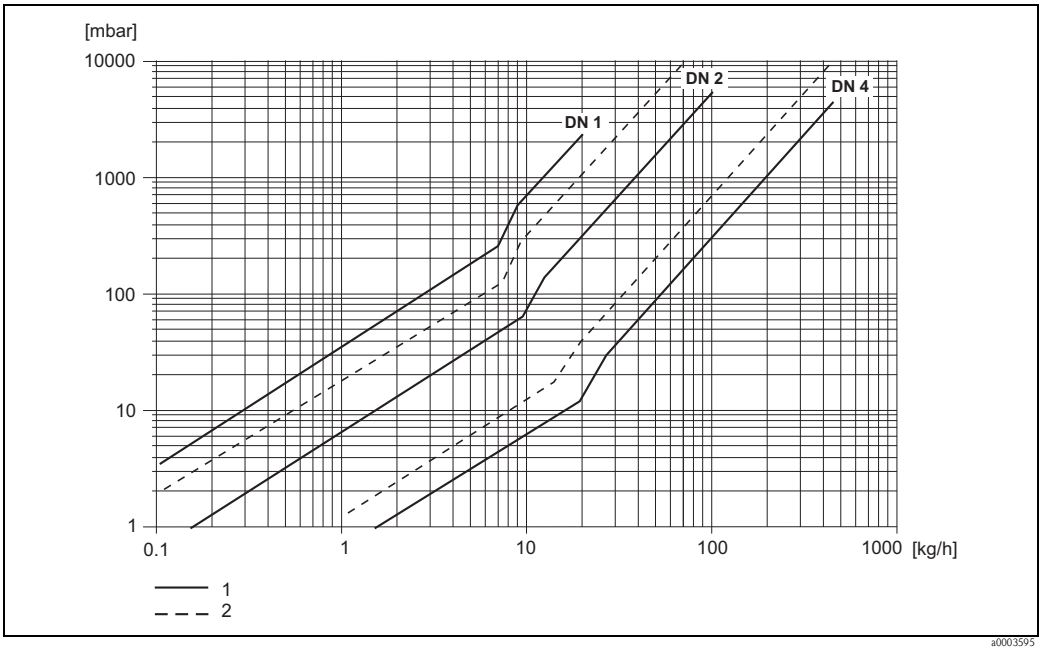
Pressure loss

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

Reynolds number	$Re = \frac{4 \cdot \dot{m}}{\pi \cdot d \cdot \nu \cdot \rho}$ a0003381
$Re \geq 2300$ [1)]	$\Delta p = K \cdot \nu^{0.25} \cdot \dot{m}^{1.75} \cdot \rho^{-0.75}$ a0003380
$Re < 2300$	$\Delta p = K1 \cdot \nu \cdot \dot{m}$ a0003379
Δp = pressure loss [mbar] ν = kinematic viscosity [m2/s] $\dot{m}$ = mass flow [kg/s]	ρ = density [kg/m^3] d = inside diameter of measuring tubes [m] K...K1 = constant (depends on nominal diameter)
1) To compute the pressure loss for gases, always use the formula for $Re \geq 2300$.	

Pressure loss coefficients for Promass A

DN	d [m]	K	K1
1	$1.1 \cdot 10^{-3}$	$1.2 \cdot 10^{11}$	$1.3 \cdot 10^{11}$
2	$1.8 \cdot 10^{-3}$	$1.6 \cdot 10^{10}$	$2.4 \cdot 10^{10}$
4	$3.5 \cdot 10^{-3}$	$9.4 \cdot 10^{8}$	$2.3 \cdot 10^{9}$
High pressure version			
2	$1.4 \cdot 10^{-3}$	$5.4 \cdot 10^{10}$	$6.6 \cdot 10^{10}$
4	$3.0 \cdot 10^{-3}$	$2.0 \cdot 10^{9}$	$4.3 \cdot 10^{9}$



Pressure loss diagram for water

1 Standard version
2 High pressure version

Custody transfer measurement

Promass 84 is a flowmeter suitable for custody transfer measurement for liquids (other than water) and for fuel gases under high pressure (> 100 bar).

Custody transfer variables

- Mass flow
- Volume flow
- Density

Suitability for custody transfer measurement, approval by the Standards Authorities, repeated calibration due to legal metrology controls

- All Promass 84 flowmeters are verified on site using reference measurements. Only once it has been approved on site by the authority for legal metrology controls may the measuring device be regarded as verified and used for applications subject to legal metrology controls. The associated seal (stamp) on the measuring device ensures this status.

Caution!
Only flowmeters verified by the Standards Authorities may be used for invoicing in applications subject to legal metrology controls.

- The owner-operator of a verified Promass 84 measuring system is obliged to carry out repeat calibration on the unit in accordance with the regulations of the authority.
- In contrast to mechanical counters, mass flowmeters which have been verified by the Standards Authorities may be operated continuously at $Q_{100\%} = Q_{max}$ in accordance with the approval certificate.
- A preliminary examination does not have to be performed as the verification certificate (approval) is available.

Approval for custody transfer

The requirements of the following test centres are taken into consideration:

- **PTB**, Germany; (www.eichamt.de)
- **NMi**, The Netherlands; (www.nmi.nl)
- **METAS**, Switzerland; (www.metas.ch)
- **BEV**, Austria; (www.eichamt.at)

Special features of working in the custody transfer mode

- In the custody transfer mode, the flow may only be measured and totalized in one direction of flow (forward).
- In the custody transfer mode, error messages that occur during operation must be confirmed and reset. The error messages can also be reset by means of the status input.

Switching on the power supply in custody transfer mode

If the device is started in custody transfer mode, for example also after a power outage, system error No. 271 “POWER BRK. DOWN” flashes on the local display. The fault message can be acknowledged or reset using the “Enter” key or by means of the status input configured accordingly.

Note!
For correct measuring operation, it is not mandatory to reset the fault message.

Definition of terms

Terms used in the subject area “Suitability for custody transfer measurement for liquids other than water”

■ Verify	Inspection of a measuring system to determine the measured error from the “true” value with subsequent system sealing. Verification can only be carried out on site by the authority for legal metrology controls responsible.
■ Suitable for custody transfer measurement	A measuring system or a part of the system, for example counters or accessory equipment, has the (type) “approval for national verification” of a (national) approval centre.
■ Verified	The measuring system has been inspected and sealed on site by a representative of the authority for legal metrology controls. This must be arranged by the facility's owner-operator.
■ Repair	Upon request, the authority responsible can give companies that repair verified measuring devices (repairers) the authority to mark repaired devices (repairer mark) if they have the equipment necessary for repair and adjustment and have properly trained specialist staff. Endress+Hauser is authorised to carry out repair work on verified measuring devices.

■ Adjust	Adjustment on site (zero point, density) under operating conditions. Is performed by the facility's owner-operator.
■ Calibrate	Determine and save correction values for the individual measuring instrument to get as close as possible to the “real” value with the measured value.
■ Smallest measured quantity	Smallest measured variable for which the measuring system/the measuring device is approved.
■ Quantity convertor	Unit for automatically converting the measured value determined to another variable (pressure, temperature, density, etc.) or non-volatile saved conversion values for the fluid.
■ Measured error	(Also known as limit of permissible error, error limit or inaccuracy). Relative measurement error, derived from the quotient (measured value – “true” measured value) / “true” measured value in per cent.
■ Measuring system	Measuring device that includes the counter and all the ancillary equipment and additional devices.
■ Reapproval	Verified measuring devices can be reapproved if they observe the applicable limits of error in legal metrology and meet any other requirements which applied when they were initially verified. The authority responsible provides you with information as to how long the verification is valid.
■ Q_{min}	Minimum flow as of which the counter must observe the error limits.
■ Q_{max}	Maximum flow of the counter while observing the error limits.
■ Stamp points	To be provided on all parts of the measuring system which cannot otherwise be protected against any alteration (=falsification) to measured value determination and processing. Lead stamping is preferably used but adhesive seals are also permitted. They may only be affixed by an authorised party, namely authority for legal metrology controls or service team with field service mark.
■ Preliminary examination, Standards Authority	Early examination on a test bench where the medium corresponds to the material to be measured later both in terms of density and viscosity.
■ Counter	Device for measuring, saving and displaying the variables subject to mandatory verification (mass, volume, density, etc.)
■ Additional devices	Equipment that does not have a direct effect on the measurement but which is needed to ensure correct measuring or make it easier (e.g. gas display units, filters, pumps, etc.)
■ Ancillary equipment	Equipment used for direct further processing of the measurement result (e.g. printers, quantity convertors, price calculators, pre-set devices, etc.)

Verification process

Type-approved measuring systems for liquids other than water are always verified at their place of deployment. For this purpose, the facility's owner-operator must make everything available when the Standards Authorities come to inspect and approve the system. This includes:

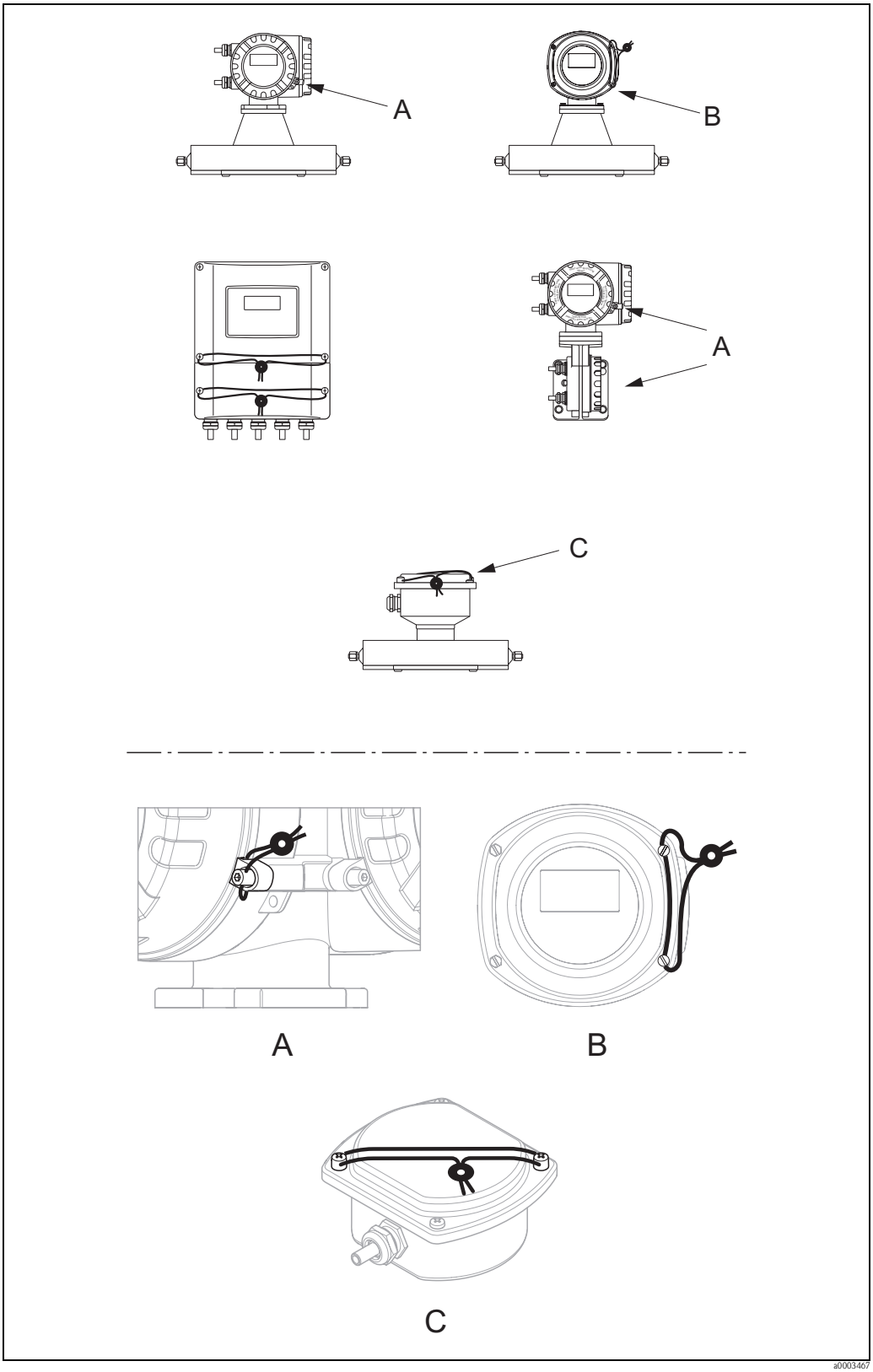
- Scales or container with a reading unit with a load or volumetric capacity that corresponds to the operation of the system at Q_{max} for one minute. The resolution of the scales display or the reading unit must be at least 0.1 % of the minimum measured quantity.
- Unit for removing the medium being measured after the totalizer to fill the scales or the container.
- Making a sufficient quantity of the medium being measured available. The quantity is derived from the operation of the system. The following rule of thumb applies – quantity at:
  3 x 1 minute at Q_{min},
  plus 3 x 1 minute at ½ Q_{max},
  plus 3 x 1 minute at Q_{max},
  plus adequate quantity in reserve.
- Approval certificates

Note!
All issues should be clarified in advance with the authority responsible to ensure the successful verification of the measuring system.

Setting up custody transfer mode

A detailed description of the “setting up custody transfer mode” process is provided in the Operating Instructions supplied with the device.

Stamp points



Examples of how to seal the various device versions.

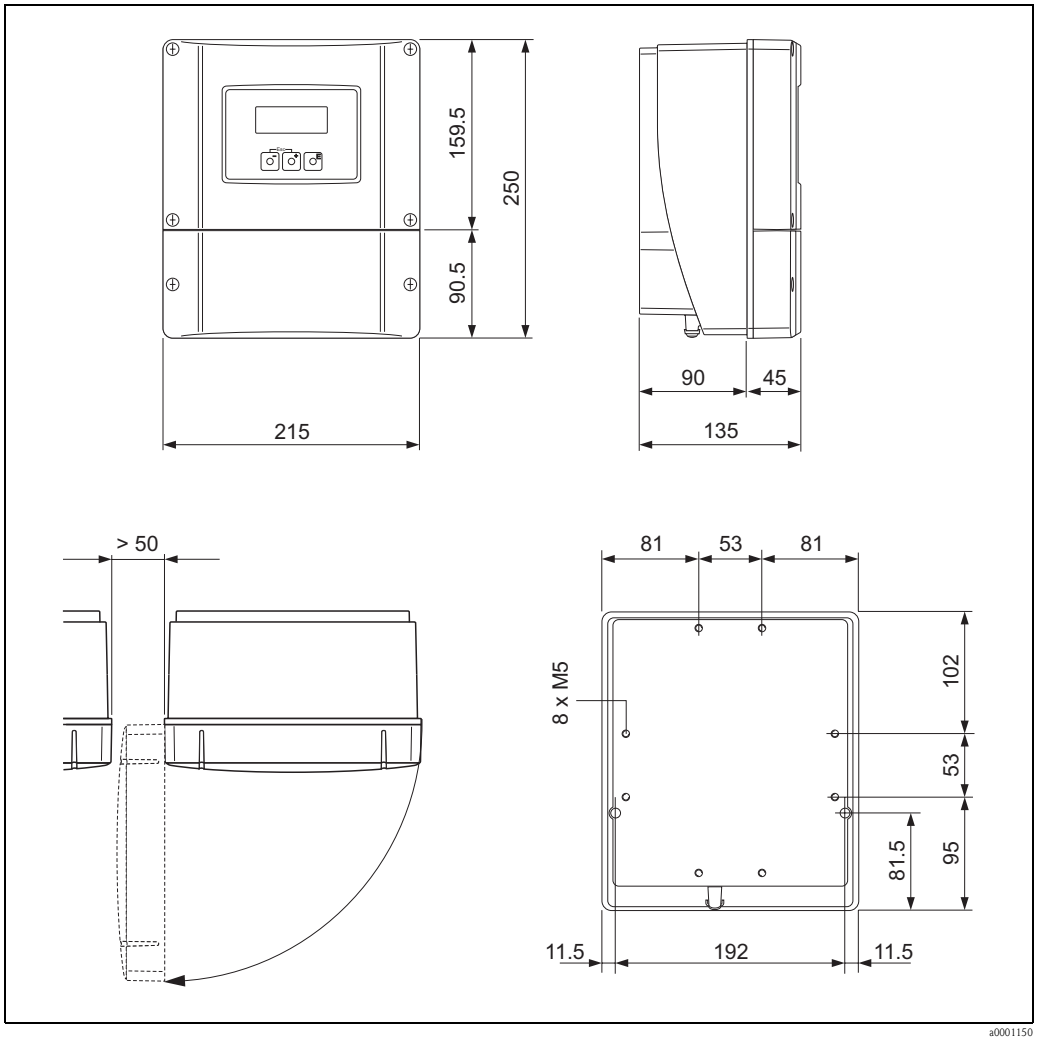
Disabling custody transfer mode

A detailed description of the "disabling custody transfer mode" process is provided in the Operating Instructions supplied with the device.

Mechanical construction

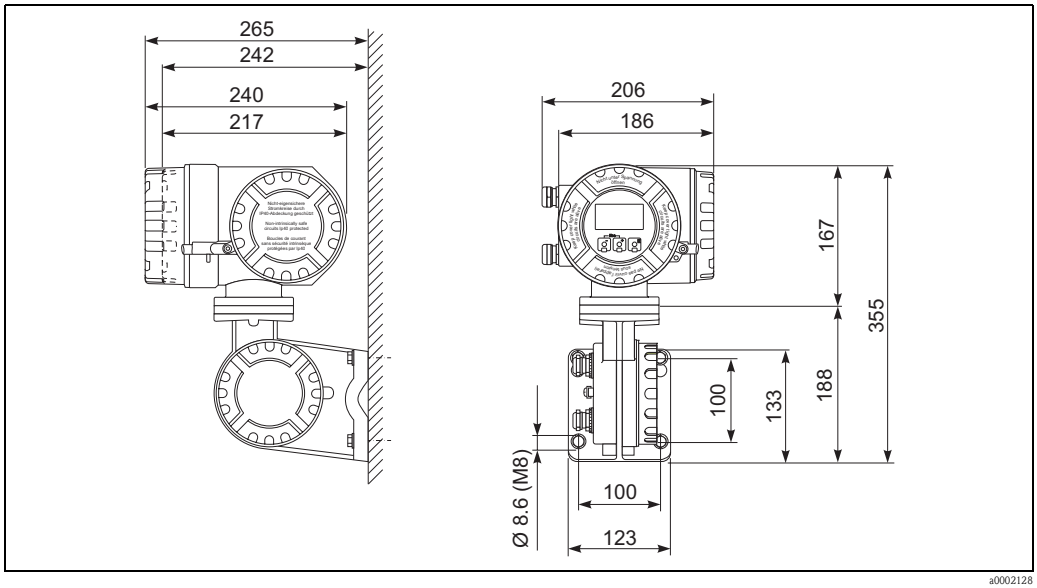
Design / dimensions

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



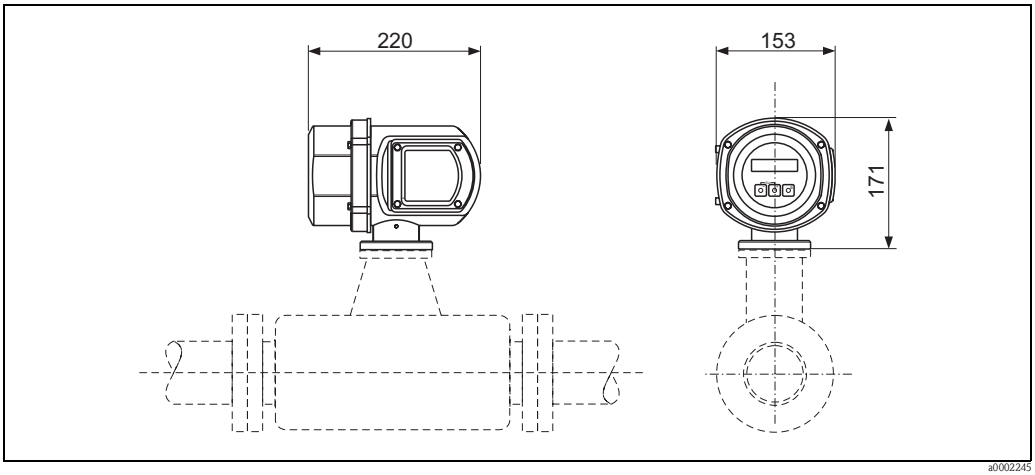
a0001150

Dimensions: Remote field housing (II2G / zone 1)



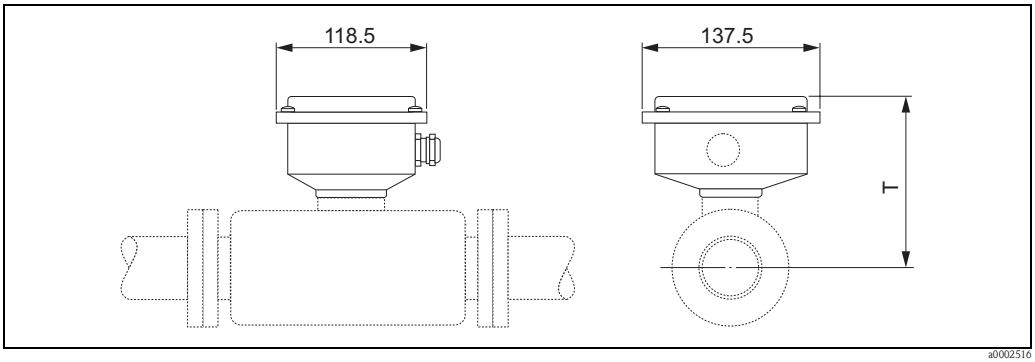
a0002128

Dimensions: stainless steel field housing



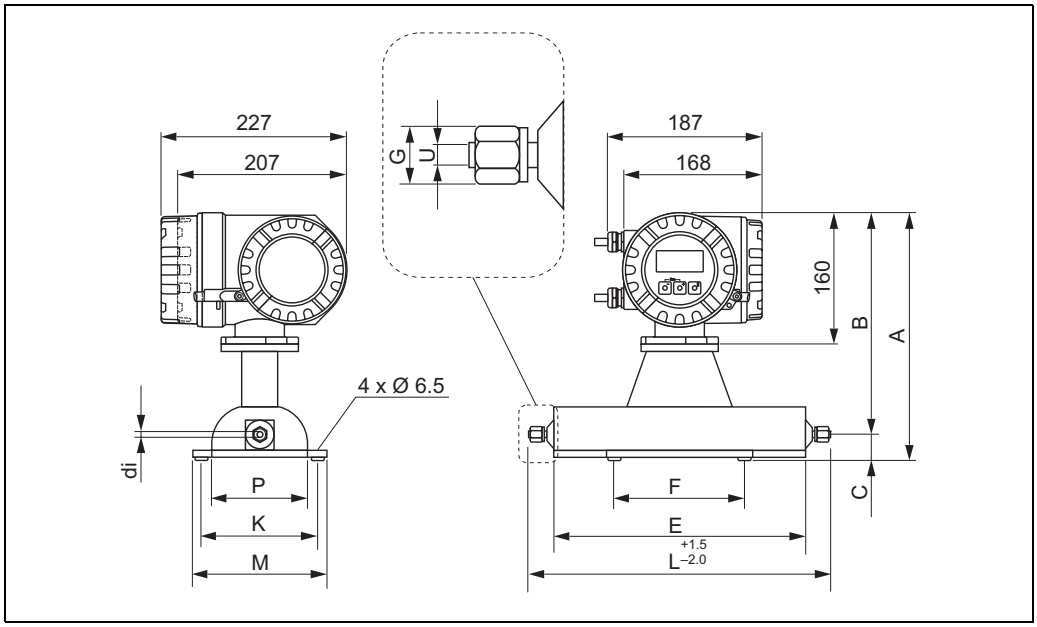
Dimensions: stainless steel field housing

Dimensions: Remote version



T = dimension B in the compact version (with corresponding nominal diameter) minus 153 mm

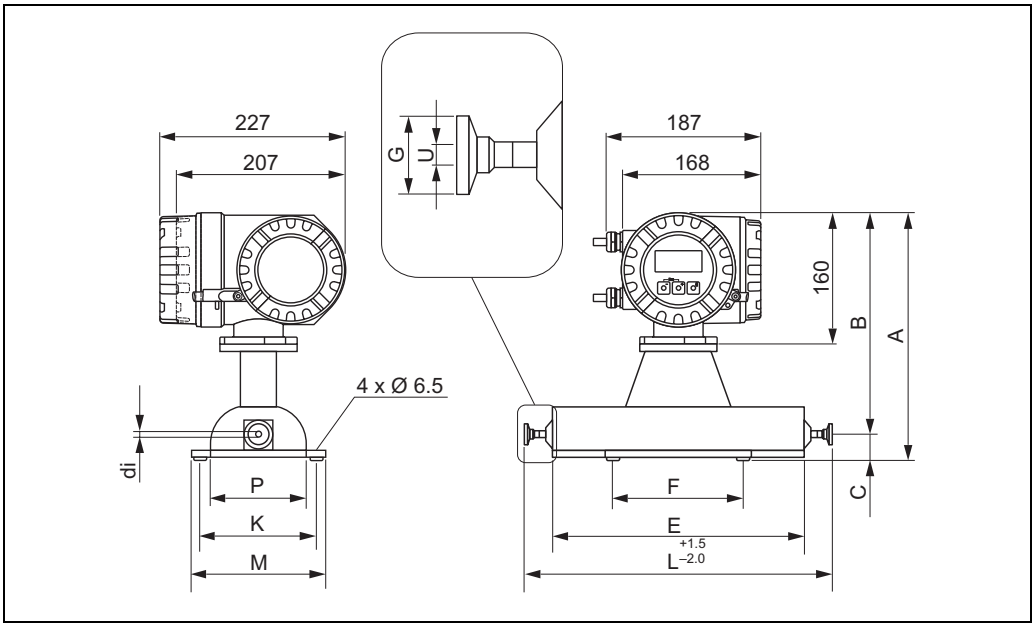
Dimensions: 4-VCO-4-connection (welded)



4-VCO-4-connection: 1.4539/904L, Alloy C-22											
DN	A	B	C	E	F	G	K	L	M	P	U / di
2 [1]	305	273	32	310	160	SW 11/16"	145	372	165	120	1.8
2 [2]	305	273	32	310	160	SW 11/16"	145	372	165	120	1.4
4 [1]	315	283	32	435	220	SW 11/16"	175	497	195	150	3.5
4 [2]	315	283	32	435	220	SW 11/16"	175	497	195	150	3.0

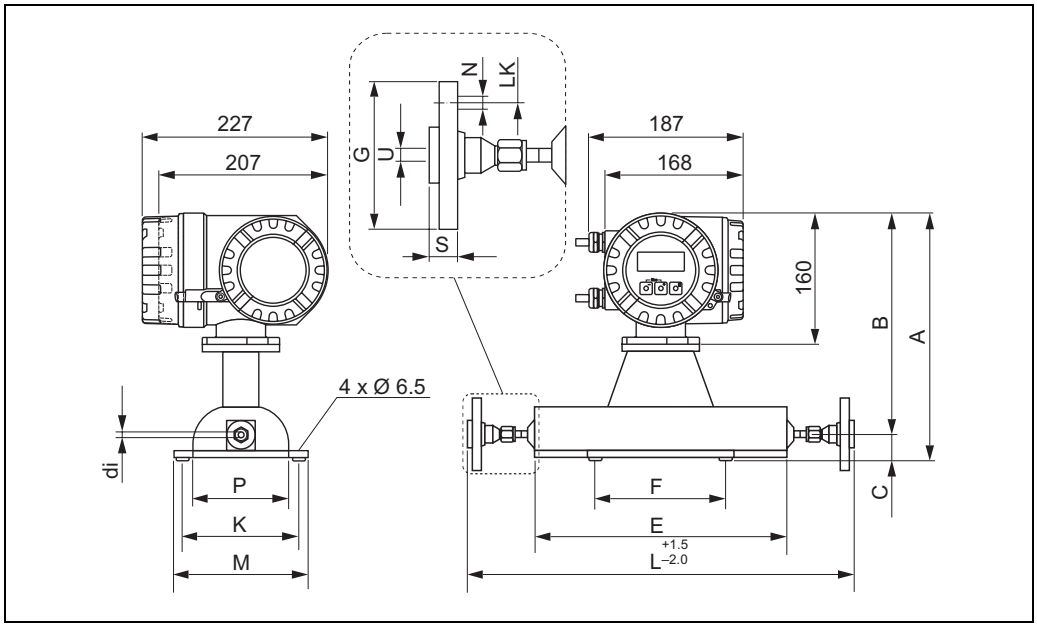
[1] 3A version can be supplied (Ra ≤ 0.4 µm/240 grit). Only for 1.4539/904L
[2] High pressure version

Dimensions: 1/2" Tri-Clamp connection (welded)



1/2" Tri-Clamp connection / 3A version [1]:1.4539/904L												
DN	A	B	C	E	F	G	K	L	M	P	U	di
2	305	273	32	310	160	25	145	378	165	120	9.5	1.8
4	315	283	32	435	220	25	175	503	195	150	9.5	3.5
[1] 3A version (Ra ≤ 0.8 µm/150 grit. option: Ra ≤ 0.4 µm/240 grit).												

Dimensions 4-VCO-4-connection with mounting kit:
DN 15 flange EN 1092-1 (DIN 2501), JIS or 1/2" flange ANSI



Mounting kit DN 15 flange EN 1092-1 (DIN 2501) PN 40: 1.4539/904L, Alloy C-22															
DN	A	B	C	E	F	G	K	L	M	N	P	S	LK	U	di
2	305	273	32	310	160	95	145	475	165	4 x Ø14	120	28	65	17.3	1.8
4	315	283	32	435	220	95	175	600	195	4 x Ø14	150	28	65	17.3	3.5
Loose flanges (not wetted) made of stainless steel 1.4404/316L															

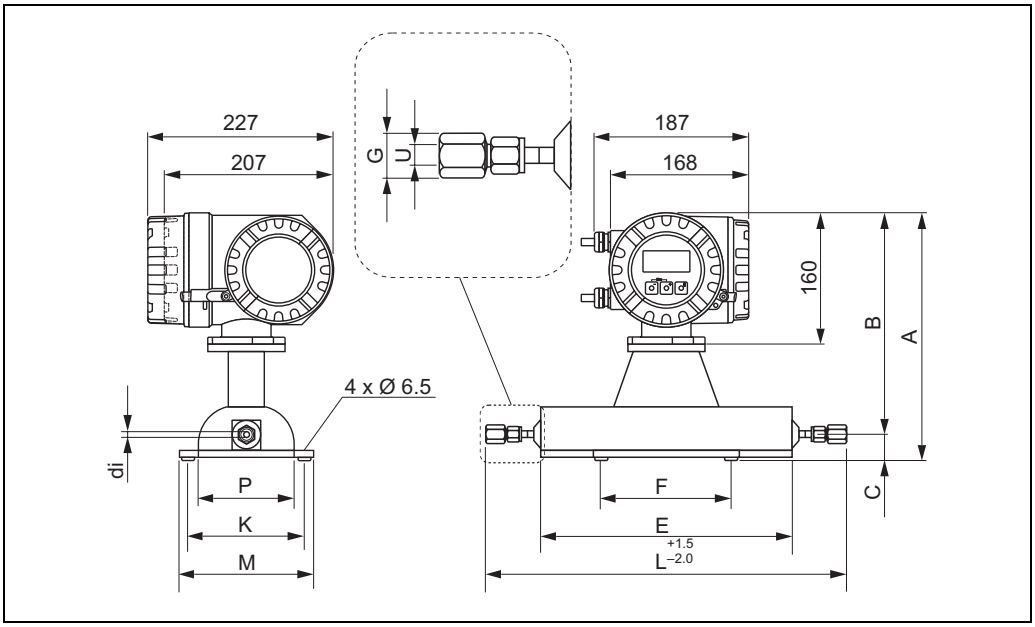
Mounting kit DN 15 flange (JIS) 10K: 1.4539/904L, Alloy C-22															
DN	A	B	C	E	F	G	K	L	M	N	P	S	LK	U	di
2	305	273	32	310	160	95	145	475	165	4 x Ø15	120	28	70	15.0	1.8
4	315	283	32	435	220	95	175	600	195	4 x Ø15	150	28	70	15.0	3.5
Loose flanges (not wetted) made of stainless steel 1.4404/316L															

Mounting kit DN 15 flange (JIS) 20K: 1.4539/904L, Alloy C-22															
DN	A	B	C	E	F	G	K	L	M	N	P	S	LK	U	di
2	305	273	32	310	160	95	145	475	165	4 x Ø15	120	14	70	15.0	1.8
4	315	283	32	435	220	95	175	600	195	4 x Ø15	150	14	70	15.0	3.5

Mounting kit 1/2" flange (ANSI) Cl 150:1.4539/904L, Alloy C-22																
DN		A	B	C	E	F	G	K	L	M	N	P	S	LK	U	di
2	1/12"	305	273	32	310	160	88.9	145	475	165	4 x Ø15.7	120	17.7	60.5	15.7	1.8
4	1/8"	315	283	32	435	220	88.9	175	600	195	4 x Ø15.7	150	17.7	60.5	15.7	3.5
Loose flanges (not wetted) made of stainless steel 1.4404/316L																

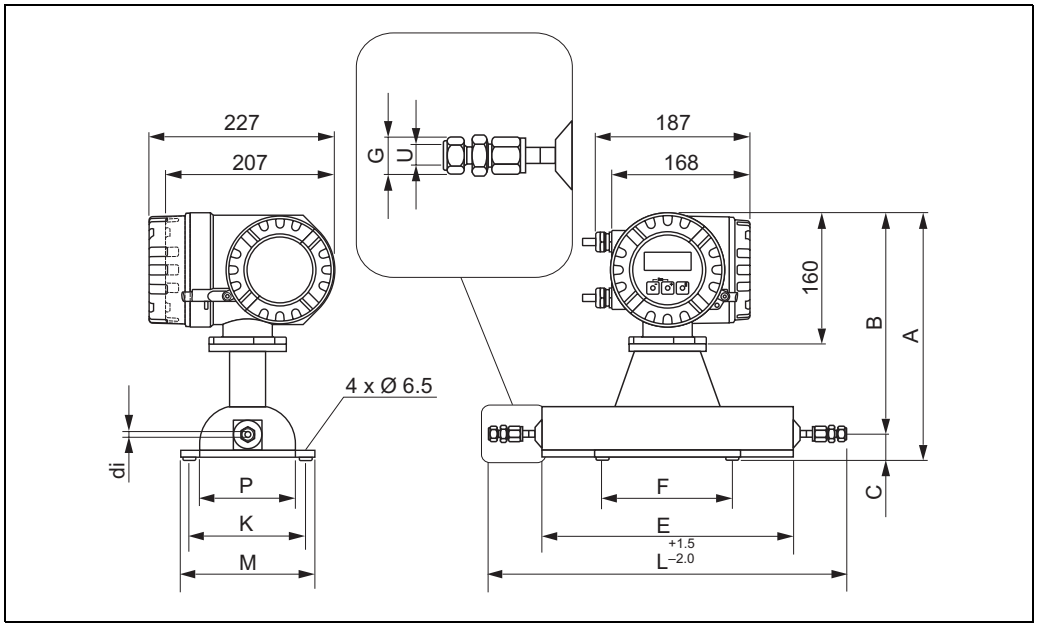
Mounting kit 1/2" flange (ANSI) Cl 300: 1.4539/904L, Alloy C-22																
DN		A	B	C	E	F	G	K	L	M	N	P	S	LK	U	di
2	1/12"	305	273	32	310	160	95.2	145	475	165	4 x Ø15.7	120	20.7	66.5	15.7	1.8
4	1/8"	315	283	32	435	220	95.2	175	600	195	4 x Ø15.7	150	20.7	66.5	15.7	3.5
Loose flanges (not wetted) made of stainless steel 1.4404/316L																

Dimensions 4-VCO-4-connection with mounting kit: 1/4" NPT-F



Mounting kit 1/4" NPT-F connection: 1.4539/904L, Alloy C-22												
DN	A	B	C	E	F	G	K	L	M	P	U	di
2	305	273	32	310	160	SW 3/4"	145	378	165	120	1/4" NPT	1.8
2[1)]	305	273	32	310	160	SW 3/4"	145	378	165	120	1/4" NPT	1.4
4	315	283	32	435	220	SW 3/4"	175	503	195	150	1/4" NPT	3.5
4[1)]	315	283	32	435	220	SW 3/4"	175	568	195	150	1/4" NPT	3.0
[1)] High pressure version only available as 1.4539/904L												

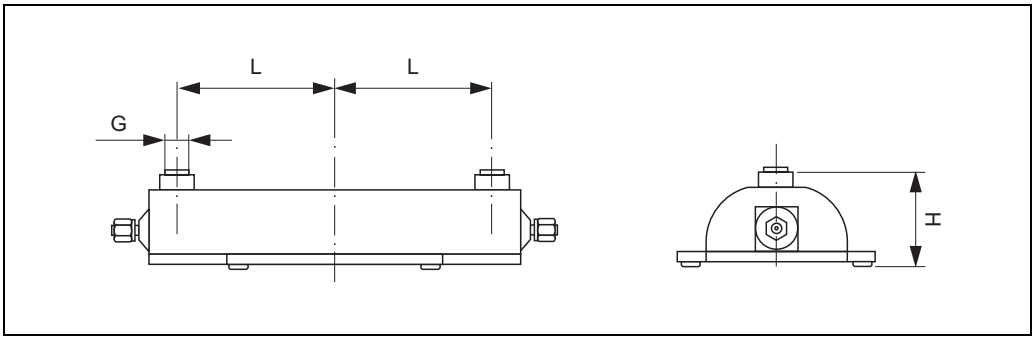
Dimensions 4-VCO-4-connection with mounting kit: 1/8" or 1/4" SWAGELOK



Mounting kit SWAGELOK connection: 1.4539/904L												
DN	A	B	C	E	F	G	K	L	M	P	U	di
2	305	273	32	310	160	SW 7/16"	145	441.6	165	120	1/8"	1.8
2	305	273	32	310	160	SW 9/16"	145	441.6	165	120	1/4"	1.8
2[1)]	305	273	32	310	160	SW 7/16"	145	441.6	165	120	1/8"	1.4
2[1)]	305	273	32	310	160	SW 9/16"	145	441.6	165	120	1/4"	1.4
4	315	283	32	435	220	SW 9/16"	175	571.6	195	150	1/4"	3.5
4[1)]	315	283	32	435	220	SW 9/16"	175	571.6	195	150	1/4"	3.0
[1)] High pressure version												

Purge connections / pressure vessel monitoring

Caution!
The pressure vessel is filled with dry nitrogen (N_2). Do not open the purge connections unless the containment can be filled immediately with a dry inert gas. Use only low gauge pressure to purge. Maximum pressure: 5 bar.



DN	L	H	G
2	130.0	102.0	1/2" NPT
4	192.5	192.5	1/2" NPT

Weight

- Compact version: see table below
- Remote version
  - Sensor: see table below
  - Wall-mount housing: 5 kg

Promass A / DN	**2**	**4**
Compact version	11	15
Remote version	9	13

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

Material

Transmitter housing:

- Compact housing: stainless steel 1.4301/304
- Compact housing: powder coated die-cast aluminium
- Wall-mount housing: powder coated die-cast aluminium
- Remote field housing: powder-coated die-cast aluminium

Sensor housing / containment:

Acid and alkali-resistant outer surface
Stainless steel 1.4301/304

Connection housing, sensor (remote version):

- Stainless steel 1.4301/304

Process connections

- Mounting kit for flanges EN 1092-1 (DIN 2501) / ANSI B16.5 / JIS B2238 → stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022.
  Loose flanges → stainless steel 1.4404/316L
- VCO coupling → stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022
- Tri-Clamp (OD tubes) (1/2") → stainless steel 1.4539/904L
- Mounting kit for SWAGELOK (1/4", 1/8") → stainless steel 1.4401/316
- Mounting kit for NPT-F (1/4") → stainless steel 1.4539/904L1.4539/904L, Alloy C-22 2.4602/N 06022

Measuring tube(s):

- Stainless steel 1.4539/904L, Alloy C-22 2.4602/N 06022

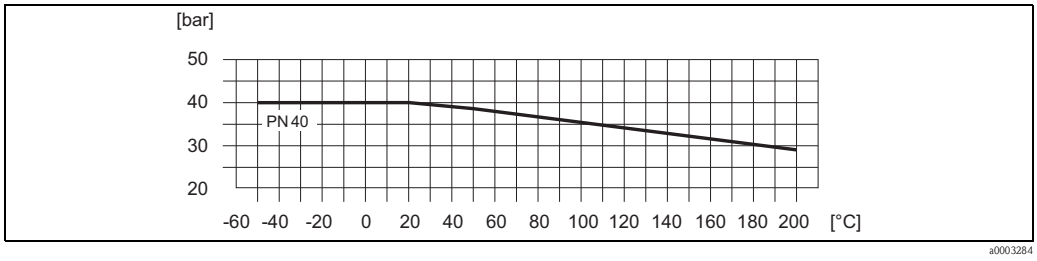
Seals:

Welded process connections without internal seals

Material load curves

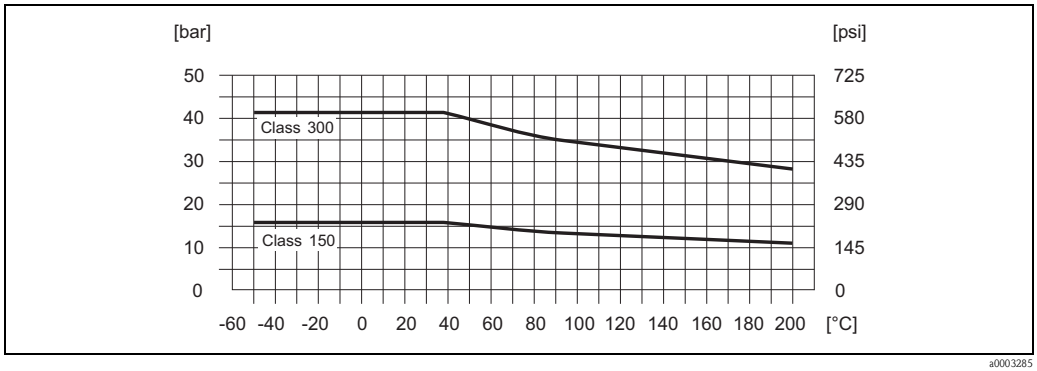
Flange connections to EN 1092-1 (DIN 2501) (mounting kit)

Wetted parts (flange, measuring tube): 1.4539/904L, Alloy C-22
Loose flanges (not wetted): 1.4404/316L



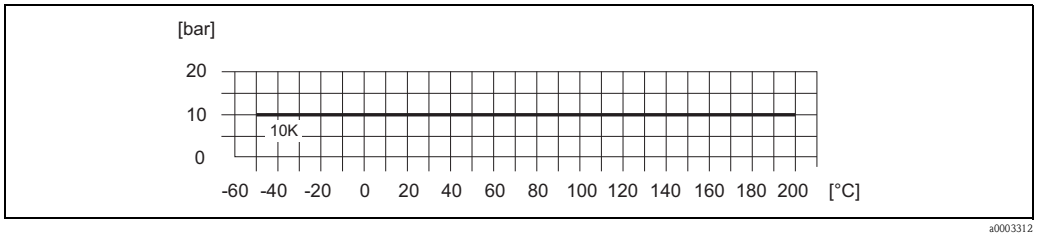
Flange connections to ANSI B16.5 (mounting kit)

Wetted parts (flange, measuring tube): 1.4539/904L, Alloy C-22
Loose flanges (not wetted): 1.4404/316L



Flange connections to JIS B2238 (mounting kit)

Wetted parts (flange, measuring tube): 1.4539/904L, Alloy C-22
Loose flanges (not wetted): 1.4404/316L

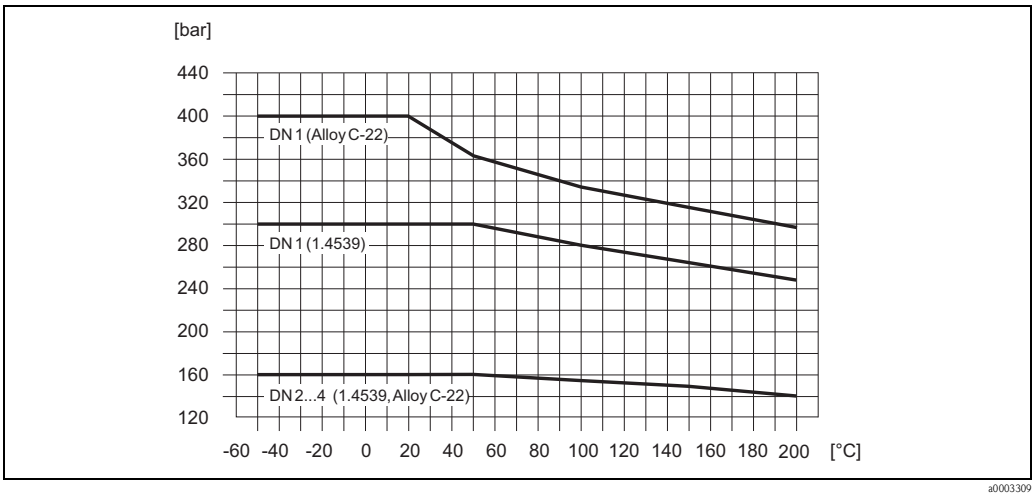


Promass A: Tri-Clamp process connection

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.

Process connection: 4-VCO-4, 1/4" NPT-F, SWAGELOK

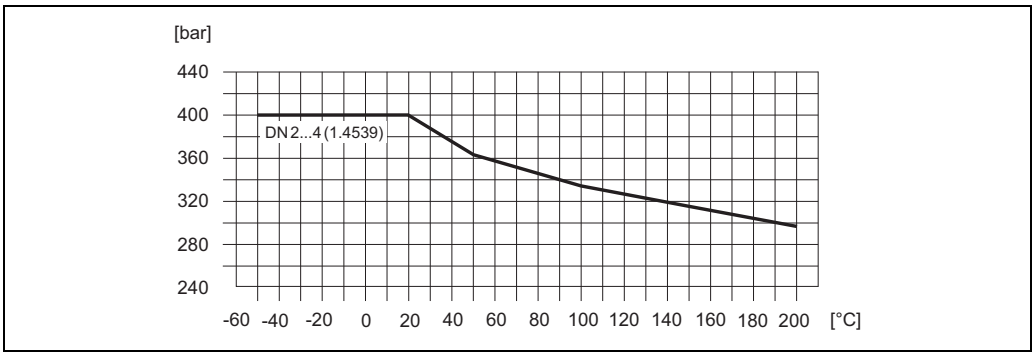
- 4-VCO-4-coupling (welded): 1.4539/904L, Alloy C-22
- 1/4" NPT threaded adapter (screwed, mounting kit): 1.4539/904L, Alloy C-22
- 1/4" or 1/8" SWAGELOK threaded joint (screwed, mounting kit): 1.4401/316



a0003309

Process connections for high pressure version (DN 2...4)

- 4-VCO-4-coupling (welded): 1.4539/904L, Alloy C-22
- 1/4" NPT threaded adapter (screwed, mounting kit): 1.4539/904L
- 1/4" or 1/8" SWAGELOK threaded joint (screwed, mounting kit): 1.4401/316



a0003310

Process connections

- Welded process connections: 4-VCO-4 coupling, 1/2" Tri-Clamp
- Screwed on process connections: flanges EN 1092-1 (DIN 2501), ANSI, JIS; 1/4" NPT threaded adapter; 1/8" or 1/4" SWAGELOK threaded joints

Human interface

Display elements

- Liquid-crystal display: backlit, four lines 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.

Unified control concept for both types of transmitter:

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

Language groups

Language groups available for operation in different countries:

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

The language group is changed using the "ToF Tool - Fieldtool Package" operating program.

Remote operation

Operation via HART

Certificates and approvals

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.

C-Tick mark

The measuring system is in conformity with the EMC requirements of the Australian Communications Authority (ACA).

Ex approval

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

Sanitary compatibility

- 3A approval

Other standards and guidelines

- EN 60529
  Degrees of protection by housing (IP code).
- EN 61010
  Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures.
- EN 61326/A1 (IEC 1326)
  "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 43
  Standardisation of the signal level for the breakdown information of digital transmitters with analogue output signal.
- NAMUR NE 53
  Software of field devices and signal-processing devices with digital electronics

Pressure measuring device approval

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

Approval for custody transfer

Promass 84 is a flowmeter suitable for custody transfer measurement for liquids (other than water).
The requirements of the following test centres are taken into consideration:

- PTB, Germany
- NMi, The Netherlands
- Other approvals are in preparation.
  The Endress+Hauser service organisation can provide detailed information.

Information on custody transfer measurement see Page 19 (“Custody Transfer Measurement” Section)

Suitability for custody transfer measurement

PTB and NMi approval for determining the mass and volume of liquids, other than water, and of fuel gases. The device is qualified to OIML R117, DIN 19217.

Promass	DN	PTB approval		
		For liquids other than water		
		Mass counter	Volume counter	Density measuring unit
A	2...4	YES	YES	YES

Promass	DN	NMi approval	
		For liquids other than water as	
		Mass counter	Volume counter
A	2...4	YES	YES

Ordering information

The Endress+Hauser 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 and the sensor. The Endress+Hauser service organisation can provide detailed information on request.

Documentation

❑ Technical Information Promass 84F, 84M (TI067D/06/en)

❑ Operating Instructions Promass 84 (BA 109D/06/en)

❑ Description of Device Functions Promass 84 (BA 110D/06/en)

❑ Supplementary documentation on Ex-ratings: ATEX, FM, CSA

Registered trademarks

KALREZ® and VITON®
Registered trademarks of Firma E.I. Du Pont de Nemours & Co., Wilmington, USA

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

SWAGELOK®
Registered trademark of Swagelok & Co., Solon, USA

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

HistoROM™, S-DAT®, T-DAT™, F-CHIP®, ToF Tool - Fieldtool® Package, Fieldcheck®, Applicator®
Registered or registration-pending trademarks of Endress+Hauser Flowtec AG, Reinach, CH

International Head Quarter

Endress+Hauser
GmbH+Co. KG
Instruments International
Colmarer Str. 6
79576 Weil am Rhein
Deutschland

Tel. +49 76 21 9 75 02
Fax +49 76 21 9 75 34 5
www.endress.com
info@ii.endress.com

Endress+Hauser

People for Process Automation

TI068D/06/en/03.05
50109206
FM+SGML6.0 ProMoDo