



Level



Pressure



Flow



Temperature



Liquid
Analysis



Registration



Systems
Components



Services



Solutions

Technical Information

Proline t-mass 65F, 65I

Thermal Mass Flow Measuring System
Direct Mass Flow Measurement of Gases



Application

For measuring the mass flowrate of a wide range of gas types e.g.

- Compressed air
- Natural gas flow to boilers / dryers
- Carbon Dioxide flow in breweries
- Biogas and aeration air in waste water plants
- Gas production (e. g. Ar, N₂, CO₂, He, O₂)
- Leakage detection

Approvals for hazardous area:

- ATEX, FM, CSA

Connection to all common process control systems:

- HART, PROFIBUS DP, MODBUS RS485

Your benefits

Direct measurement of gas mass flow. Provides temperature as an output.

The **Proline transmitter concept** comprises:

- Modular device and operating concept resulting in a higher degree of efficiency
- Quick setup operating menus for ease of commissioning
- On board software freely allows the selection of up to 20 pure gases and creation of mixed gases with a maximum of 8 components (e. g. Biogas)

The **t-mass sensors** offer:

- Negligible pressure drop or loss
- Wide turndown of up to 100:1
- Insertion version can be programmed for circular pipe or rectangular ducting installation
- Each device individually calibrated and delivered with a traceable certificate
- Can be calibrated with flow conditioner on request.
- Optional cold tap device for insertion allowing ease of removal/replacement for low pressure and non-toxic gas applications.

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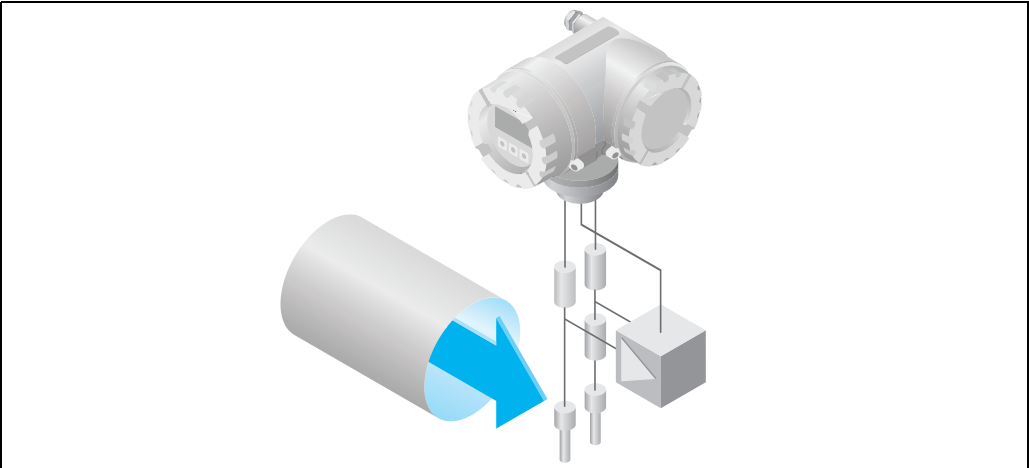
Function and system design

Measuring principle

Thermal dispersion principle

The thermal principle operates by monitoring the cooling effect of a gas stream as it passes over a heated transducer (PT100).

Gas flowing through the sensing section passes over two PT 100 RTD transducers one of which is used conventionally as a temperature sensing device, whilst the other is used as a heater. The temperature sensor monitors the actual process values whilst the heater is maintained at a constant differential temperature above this by varying the power consumed by the sensor. The greater the mass flow, the greater the cooling effect and power required to maintain the differential temperature. The measured heater power is therefore a measure of the gas mass flowrate.

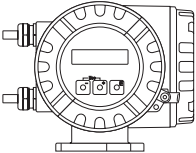
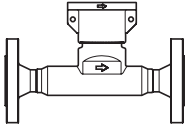
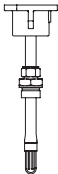


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Measuring system

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 mounted physically separate from one another.

Transmitter	
t-mass 65  a0003671	<ul style="list-style-type: none">■ Two-line liquid-crystal display■ Configuration using push button operation
Sensor	
F  a0005137	<ul style="list-style-type: none">■ Flanged version■ Nominal diameters DN 15...100■ Sensor body material:<ul style="list-style-type: none">- 1.4404, 316L- CF3M■ Transducer body material:<ul style="list-style-type: none">- 1.4404, 316L, Alloy C22
I  a0005138	<ul style="list-style-type: none">■ Insertion version■ Sensor length 235/335/435/608 for DN 80...1500■ Sensor body material:<ul style="list-style-type: none">- 1.4404, 316/316L■ Transducer body material:<ul style="list-style-type: none">- 1.4404/316L, Alloy C22

Input

Measured variable

Mass flow
Gas temperature

Measuring range (air at ambient conditions)

The measuring range is dependant on the gas selection, line size and use of flow conditioner. Each meter is individually calibrated on air and mathematically converted to suit the customer specific gas, where required. The tables below define the ranges available for air without flow conditioner. Please refer to your Endress+Hauser contact or to Applicator, the selection tool, for other gases and process conditions.

Measuring range for the DIN (EN) / JIS flanged version, metric units:

DN	kg/h		Nm ³ /h at 0°C, 1.013 bar a		scf/min. at 15°C, 1.013 bar a	
	min.	max.	min.	max.	min.	max.
15	0.5	53	0.38	41	0.23	25
25	2	200	1.5	155	1.0	96
40	6	555	4.6	429	3.0	266
50	10	910	7.7	704	5.0	436
80	20	2030	15.5	1570	10	974
100	38	3750	29	2900	18	1800

Measuring range for the ANSI flanged version, US units:

DN	lb/h		Sm ³ /h at 59 °F, 14.7 psi a		scf/min. at 59 °F, 14.7 psi a	
	minimum	maximum	minimum	maximum	minimum	maximum
1/2"	1.1	116	0.4	42	0.23	25
1"	4.4	440	1.6	160	1.0	96
1 1/2"	13.2	1220	4.8	450	3.0	266
2"	22	2002	8	740	5.0	436
3"	44	4466	16	1656	10	974
4"	84	8250	30	3060	18	1800

Measuring range for the insertion version, metric units:

DN	kg/h		Nm ³ /h at 0°C, 1.013 bar a		scf/min. at 15°C, 1.013 bar a	
	min.	max.	min.	max.	min.	max.
80	20	2030	15.5	1570	9.6	974
100	38	3750	29.0	2900	18	1800
150	50	7500	38	5800	24	3600
200	80	12500	62	9666	38	6000
250	120	20000	93	15468	58	9600
300	180	28000	139	21655	86	13440
400	300	50000	232	38670	144	24000
500	500	80000	386	61870	240	38400
600	700	115000	540	88940	336	55200
700	900	159000	696	122970	432	76300
1000	2000	320000	1546	247846	960	153600
1500	2500	720000	1933	556844	1200	345600

In order to achieve optimum performance it is recommended that under operating conditions the maximum velocity is limited to a value below 70 m/sec.

Caution!

The flowrates shown are representative of the calibrated conditions only and do not necessarily reflect what the meter can measure under operating conditions and actual internal pipe dimensions found on site. To correctly size and select a meter, it is recommended that you either contact your local Endress+Hauser representative or refer to the Endress+Hauser software package Applicator.

Examples (in metric units):

Line Size	Gas	Process pressure	Temperature	Max. Flowrate
DN		bar a	°C	kg/h
50	Air	1	25	910
50	Air	3	25	3300
50	CO ₂	1	25	1300
50	CO ₂	3	25	3950
50	Methane	1	25	795
50	Methane	3	25	1500

Input signal

Status input (auxiliary input) for HART version:

U = 3 to 30 V DC, $R_i = 5 \text{ k}\Omega$, galvanically isolated; switch level: ± 3 to ± 30 V DC
Configurable for: totalizer reset, positive zero return, zero point adjustment

Status input (auxiliary input) for MODBUS RS485 version:

U = 3 to 30 V DC, $R_i = 3 \text{ k}\Omega$, galvanically isolated; switch level: ± 3 to ± 30 V DC, independent of polarity
Configurable for: totalizer reset, positive zero return, zero point adjustment

Current input:

Active/passive selectable, galvanically isolated, resolution: 2 μA

- Active: 4 to 20 mA, $R_i \leq 150 \text{ }\Omega$, $U_{\text{out}} = 24 \text{ V DC}$, short-circuit proof
- Passive: 0/4 to 20 mA, $R_i \leq 150 \text{ }\Omega$, $U_{\text{max}} = 30 \text{ V DC}$

Output

Output signal

Current output:

Active/passive selectable, galvanically isolated, time constant selectable (0.0 to 100.0 s), full scale value selectable, temperature coefficient: typically 0.005% o.r./°C, resolution: 0.5 μA

- Active: 0/4 to 20 mA, $R_L < 700 \text{ }\Omega$ (at HART: $R_L \geq 250 \text{ }\Omega$)
- Passive: 4 to 20 mA; supply voltage V_s 18 to 30 V DC; $R_i \geq 700 \text{ }\Omega$

Note!

If the current output is used as a temperature output, please observe the following information:
Class B according to EN 6075

Pulse/frequency output:

Active: 24 V DC, 25 mA (max. 250 mA during 20 msec), $R_L > 100 \text{ }\Omega$

Passive: open collector, 30 V DC, 250 mA, galvanically isolated.

- Frequency output: full scale frequency 2 to 1000 Hz ($f_{\text{max}} = 1250 \text{ Hz}$), on/off ratio 1:1, pulse width max. 2s, time constant selectable (0.0 to 100.0 s)
- Pulse output: pulse value and pulse polarity can be selected, pulse width adjustable (0.5 to 2000 ms).

PROFIBUS DP interface:

- PROFIBUS DP in accordance with IEC 61158, galvanically isolated
- Profile version 3.0
- Data transmission rate: 9.6 kBaud to 12 MBaud
- Automatic data transmission rate recognition
- Signal encoding: NRZ-Code
- Function blocks: 3 x Analog Input, 2 x Totalizer
- Output data: Mass flow, Corrected volume flow, Temperature, Totalizer 1 to 2
- Input data: Positive zero return (ON/OFF), Zero point adjustment, Totalizer control and Pressure display value
- Bus address can be set at the measuring device via miniature switches or using local display (optional)

MODBUS RS485 interface:

- MODBUS device type: slave
- Address range: 1 to 247
- Bus address can be set at the measuring device via miniature switches or the on-site display (optional)
- Supported function codes: 03, 04, 06, 08, 16, 23
- Broadcast: supported with the function codes 06, 16, 23
- Physical interface: RS485 in accordance with EIA/TIA-485 standard
- Supported baudrate: 1200, 2400, 4800, 9600, 19200, 38400, 57600, 115200 Baud
- Transmission mode: RTU or ASCII
- Response times:
 - Direct data access = typically 25 to 50 ms
 - Auto-scan buffer (data block) = typically 3 to 5 ms

Signal on alarm**Current output:**

Failsafe mode selectable (e.g. in accordance with NAMUR Recommendation NE 43)

Current input:

Failsafe value selectable

Pulse/frequency output:

Failsafe mode selectable

Status output:

“Non conductive” in the event of fault or power supply failure.

Relay output:

“De-energized” in the event of fault or power supply failure.

PROFIBUS DP:

Status and alarm messages in accordance with PROFIBUS Profile Version 3.0.

MODBUS RS485:

If an error occurs, the value NaN (not a number) is output for the measured values.

Load

see “Output signal”

Low flow cut off

Switch points for low flow cut off are programmable

Galvanic isolation

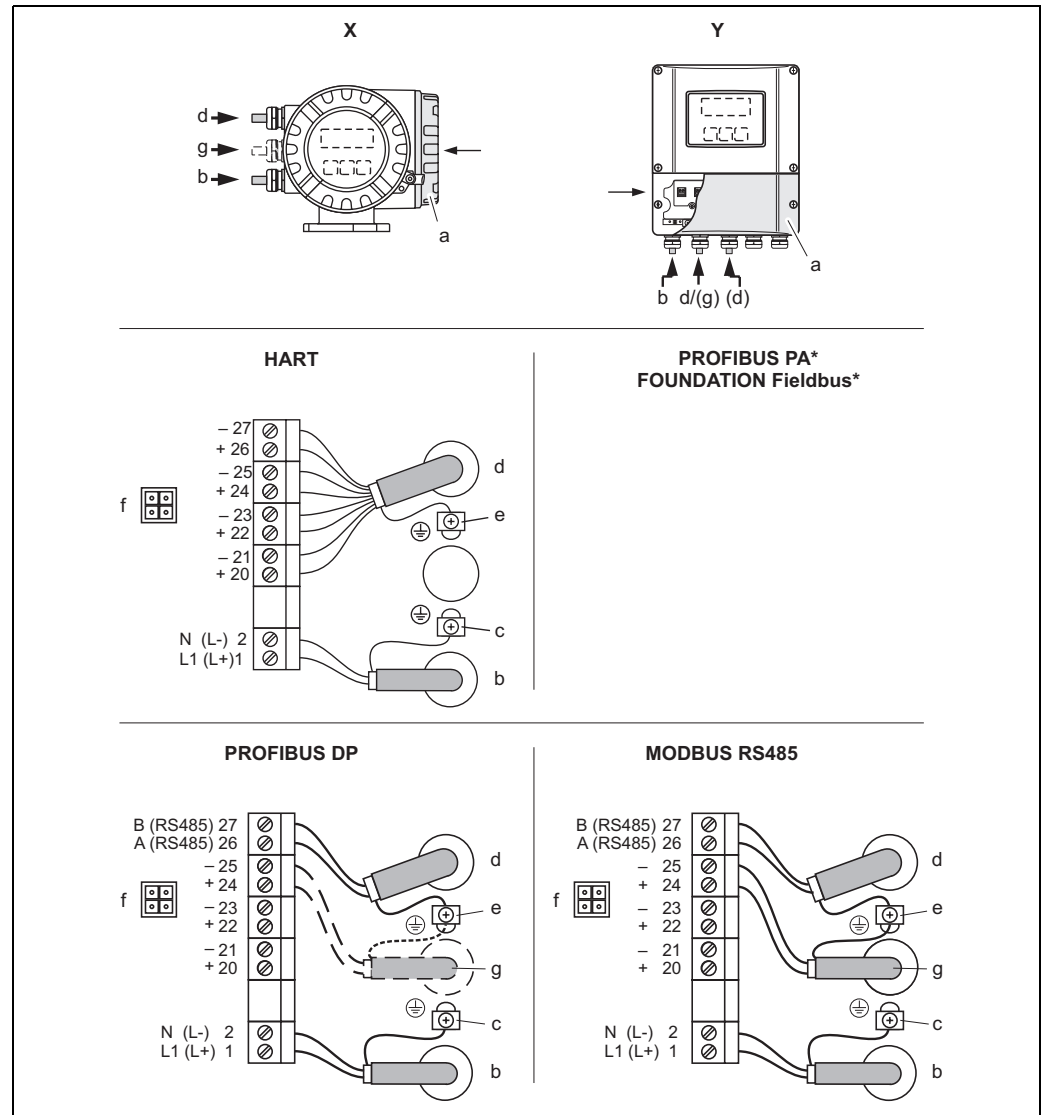
All circuits for inputs, outputs, and power supply are galvanically isolated from each other.

Switching output**Relay output:**

Normally closed (NC) or normally open (NO) contacts available
 (factory setting: relay 1 = NO, relay 2 = NC), max. 30 V / 0.5 A AC; 60 V / 0.1 A DC, galvanically isolated.
 Configurable for: error messages, limit values

Power supply

Electrical connection measuring unit



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

A View X (field housing)

B View Y (wall-mount housing)

*) not available yet (left in deliberately)

a Cover of the connection compartment

b Cable for power supply: 85 to 260 V AC, 20 to 55 V AC, 16 to 62 V DC

Terminal No. 1: L1 for AC, L+ for DC

Terminal No. 2: N for AC, L- for DC

c Ground terminal for protective conductor

d Signal cable: See Terminal assignment → Page 7

Fieldbus cable:

Terminal Nr. 26: PROFIBUS DP / MODBUS RS485 → A (Rx/D/TxD-P)

Terminal Nr. 27: PROFIBUS DP / MODBUS RS485 → B (Rx/D/TxD-N)

e Ground terminal for signal-cable shield / RS485 line

Observe that the stripped and twisted lengths of cable shield to the ground terminal are as short as possible (max. 5 mm)

f Service connector for connecting service interface FXA193 (Fieldcheck, Tof Tool - Fieldtool Package)

g Signal cable: See Terminal assignment → Page 7

PROFIBUS cable for external termination, optional:

Terminal No. 24: +5 V

Terminal No. 25: DGND

MODBUS RS485 cable for status input:

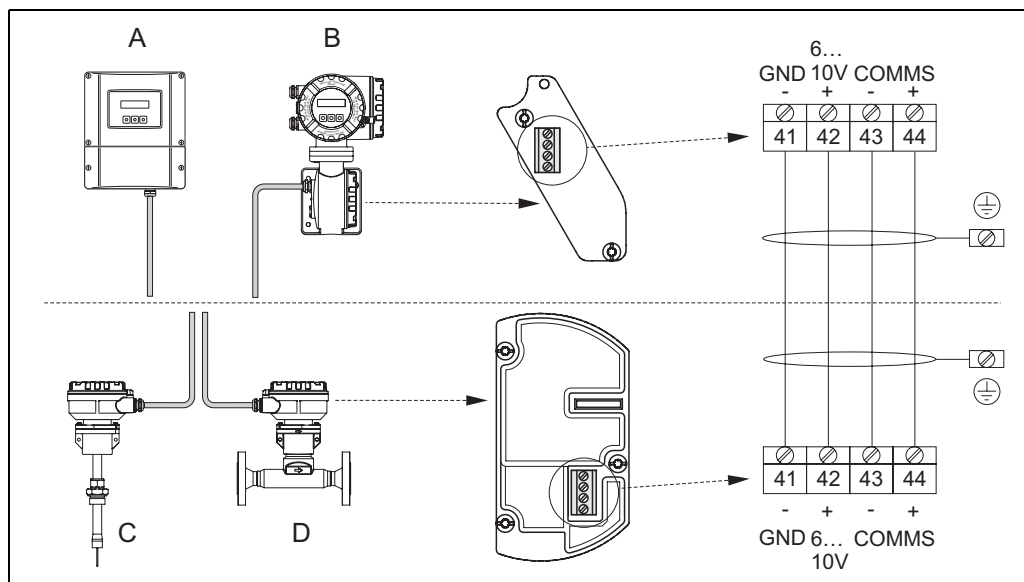
Terminal No. 24: 3 to 30 V DC, $R_t = 3 \text{ k}\Omega$

Terminal No. 25: GND

Terminal assignment

Order variant	Terminal No. (inputs/outputs)			
	20 (+) / 21 (-)	22 (+) / 23 (-)	24 (+) / 25 (-)	26 (+) / 27 (-)
<i>Fixed communication boards (permanent assignment)</i>				
65***_*****A	-	-	Frequency output	Current output HART
65***_*****B	Relay output	Relay output	Frequency output	Current output HART
65***_*****J	-	-	+5V (ext. termination)	PROFIBUS DP
65***_*****Q	-	-	Status input	MODBUS RS485
65***_*****R	-	-	Current output 2 Ex i, active	Current output 1 Ex i active, HART
65***_*****S	-	-	Frequency output Ex i, passive	Current output Ex i Active, HART
65***_*****T	-	-	Frequency output Ex i, passive	Current output Ex i Passive, HART
65***_*****U	-	-	Current output 2 Ex i, passive	Current output 1 Ex i passive, HART
<i>Flexible communication boards</i>				
65***_*****5	Status input	Current input	Frequency output	Current output HART
65***_*****6	Status input	Current input	Current output 2	Current output HART
65***_*****8	Status input	Frequency output	Current output 2	Current output HART

Electrical connection remote version



- A Wallmount housing; Non-hazardous area and zone 2 (ATEX II3G)
 B Wallmount housing; Zone 1 (ATEX II2G)
 C Remote sensor insertion version
 D Remote sensor flanged version

Wire colors (when supplied by Endress+Hauser):
 Terminal no. 41 = white; 42 = brown; 43 = green; 44 = yellow
 (Colour code according to DIN 47100)

Warning!

Do not provide separate power to remote sensor. The power must be provided by the transmitter.

Supply voltage	85 to 260 V AC, 45 to 65 Hz 20 to 55 V AC, 45 to 65 Hz 16 to 62 V DC
Cable entries	Power-supply and signal cables (inputs/outputs): <ul style="list-style-type: none"> ■ Cable entry M20 x 1.5, 8 to 12 mm ■ Thread for cable entries, G 1/2", 1/2" NPT Connecting cable for remote version: <ul style="list-style-type: none"> ■ Cable entry M20 x 1.5, 8 to 12 mm ■ Thread for cable entries, G 1/2", 1/2" NPT
Remote version cable specifications	<ul style="list-style-type: none"> ■ 2 x 2 x 0.5 mm² PVC cable with common shield (2 twisted pairs) ■ Conductor resistance: $\leq 40 \Omega/\text{km}$ ■ Capacitance, core/shield: $\leq 0.001 \mu\text{F}/\text{m}$ ■ Inductance: $\leq 0.9 \mu\text{H}/\text{m}$ ■ Operating voltage: $\geq 250 \text{ V}$ ■ Temperature range: $-40^\circ\text{C} \dots +105^\circ\text{C}$ ■ Overall nominal diameter: 8.5 mm ■ Maximum cable length: 100 m <p>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 IEC/EN 61326, and NAMUR recommendation NE 21/43.</p> <p>Note! For cable specifications for hazardous area devices please see the additional Ex documentation.</p>
Power consumption	AC: 85 to 260 V = 18.2 W ; 20 to 55 V = 14 W ; (including sensor) DC: 8 W (including sensor)
Power supply failure	Lasting minimum 1 power cycle <ul style="list-style-type: none"> ■ EEPROM/HistoROM T-DAT saves measuring system data if the power supply fails ■ HistoROM S-DAT is on exchangeable data storage chip with sensor specific data (pipe type, nominal diameter, serial number, flow conditioner, zero point, etc.) ■ Totalizer stops at the last value determined
Potential equalisation	No measures necessary For devices in hazardous areas please refer to the additional Ex documentation

Performance characteristics

Reference calibration conditions	<ul style="list-style-type: none"> ■ Accredited according to ISO/IEC 17025 ■ Traceable to National Standards ■ Temperature controlled to within $\pm 0.5^\circ\text{C}$ at atmospheric pressure and humidity controlled
Maximum measured error	<p>Flanged version:</p> <p>$\pm 1.5 \%$ of reading for 100 % to 20 % of full scale at reference conditions $\pm 0.3 \%$ of full scale for 20 % to 1 % of full scale at reference conditions</p> <p>Insertion version:</p> <p>$\pm 1.5 \%$ of reading plus $\pm 0.5 \%$ of full scale</p> <p>Note!</p> <ul style="list-style-type: none"> ■ Calibration gas is normally air at reference calibration conditions and with a fully developed flow profile. ■ On site performance is dependant on the standard of installation.
Repeatability	0.5 % for velocities above 0.2 m/s
Response time	Typically less than 2 seconds for 63 % of a given step change (in either direction)

Operating conditons: Installation

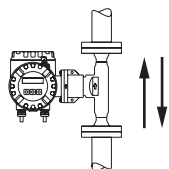
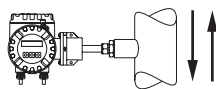
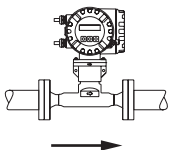
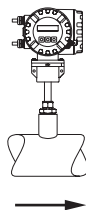
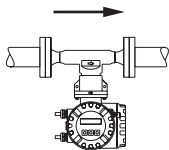
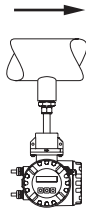
Thermal meters require a fully developed flow profile as a prerequisite for correct flow measurement. For this reason, please note the following points when installing the device.

Installation instructions

Orientation

The device can generally be installed in any position in the piping. In the case of wet/dirty gases, upward flow is preferred in vertical pipes to minimise condensation/contamination on or around the sensing element. In particular, where free condensation can occur (e.g. Biogas) the sensor should be orientated to prevent water collecting on or around the sensing elements (e.g. do not install the sensor at a low point in the installation without adequate drainage).

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

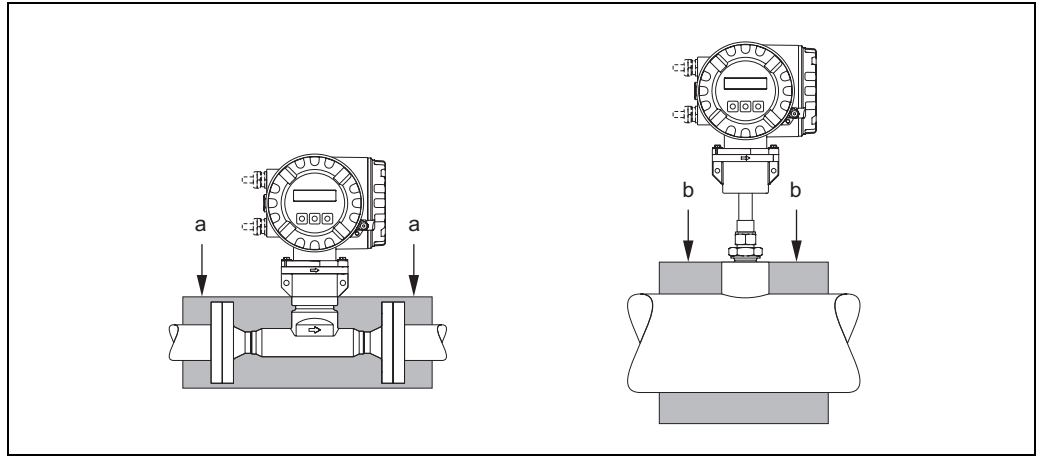
	Flanged version		Insertion version	
Vertical orientation				
 a0005107	compact ✓✓	remote ✓✓	 a0005110	compact ✓ (see note below) remote ✓✓
Horizontal orientation:				
 a0005108	compact ✓✓	remote ✓✓	 a0005111	compact ✓✓ remote ✓✓
Horizontal orientation:				
 a0005109	compact ✗	remote ✗	 a0005112	compact ✗ remote ✗
✓✓ = Recommended orientation ✓ = Orientation recommended in certain situations; not recommended in high vibration or unstable installations ✗ = Not recommended				

Caution!

When mounting an insertion meter in a vertical line it is recommended that a remote version is used or support is provided for the compact version.

Thermal insulation

When the gas is very humid or saturated with water (eg. Biogas) the pipeline and flowmeter body should be insulated to prevent water droplets condensing on the pipe wall and/or flow transducer. In extreme cases of moisture and temperature variation, it may be advisable to provide trace heating of the pipework and/or sensor body.



a = Maximum insulation height for the flanged version

b = Maximum insulation height for the insertion version

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Inlet and outlet runs

The sensitivity of the thermal dispersion principle to low flow rates means the flowmeter can also be sensitive to internal disturbances in the flowing gas stream (e.g. swirl) especially in the larger pipe diameters (\geq DN 150). As a general rule the installed thermal flow sensor should always be installed as far away as possible from any flow disturbances. See ISO14511 for further information.

Process components or pipework configuration

When disturbances (e. g. pipe elbows, reducers, valves, T-pieces etc.) are located upstream of the thermal meter, precautions must be taken to minimise any effects on the measuring performance. The figure on the following page illustrates the minimum recommended inlet and outlet runs expressed in multiples of the pipe diameter, longer lengths should always be used if they are available in the metering run. Regardless of any other consideration, the minimum recommendations for inlet and outlet runs on either side of the sensor are:

Inlet runs:

Minimum 15 x DN for the flanged version (65F)

Minimum 20 x DN for the insertion version (65I)

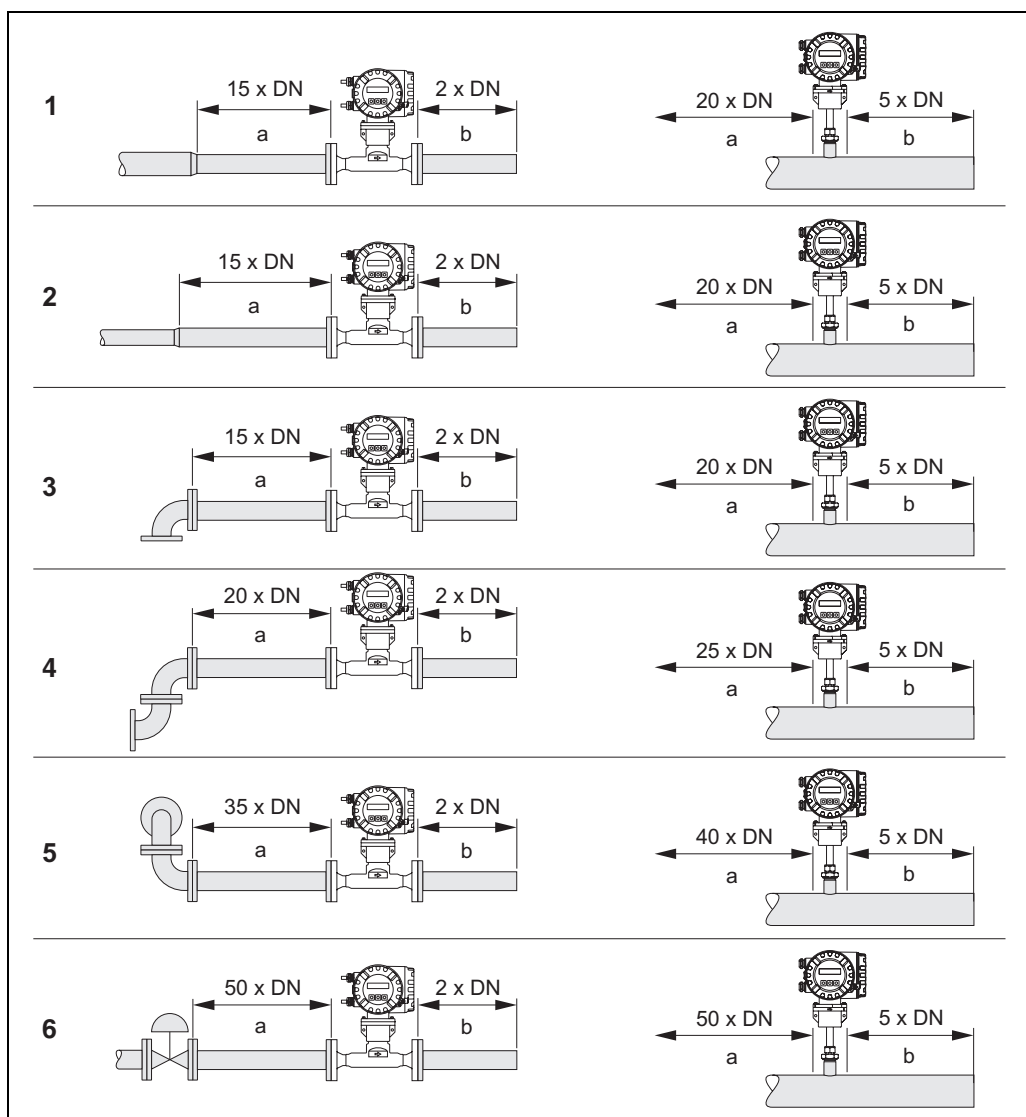
Outlet runs:

Minimum 2 x DN for the flanged version (65F)

Minimum 5 x DN for the insertion version (65I)

Note!

- These are minimum values, increasing these dimensions will often improve the flowmeter performance.
- Where two or more disturbances are located upstream of the meter, the longest recommended upstream pipe run is to be observed as an absolute minimum.
- It is always recommended to install control valves downstream of the flowmeter.
- For very light gases such as Helium and Hydrogen all upstream distances should be doubled.



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The figure above illustrates the minimum recommended inlet and outlet runs expressed in multiples of the pipe diameter.

1 = Reduction

2 = Extension

3 = 90° elbow or T-piece

4 = 2 x 90° elbow

5 = 2 x 90° elbow, 3-dimensional

6 = Control valve (where possible a modulating control valve should be mounted downstream of a flowmeter)

a = Inlet run

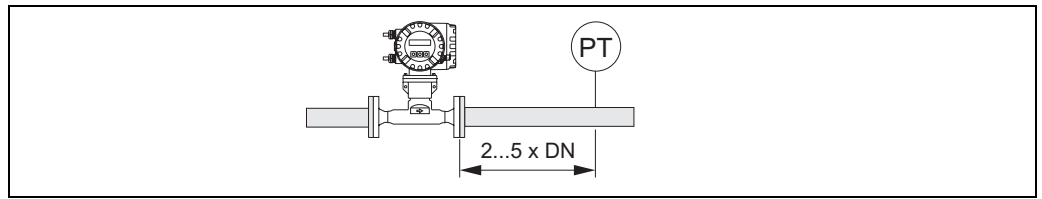
b = Outlet run

Caution!

Wherever possible mount any control and butterfly shut off valves downstream of flowmeter.

Outlet runs with pressure measuring points

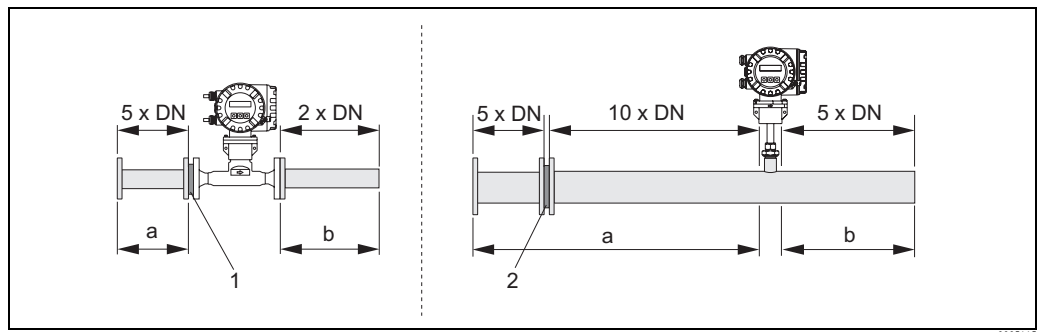
The pressure measuring point should be installed downstream of the measuring device, so that there is no potential influence of the pressure transmitter process connection on the flow entering the measuring point.



Installing a pressure measuring point (PT = pressure transmitter)

Perforated plate flow conditioner

It is recommended to install a perforated plate flow conditioner if the recommended inlet runs are not available.



1 = Flow conditioner with flanged version / 2 = Flow conditioner with insertion version

a = Inlet run / b = Outlet run

Flow conditioner for use with insertion sensors

For the majority of gas types, the flow conditioner must be installed at a distance of 10 x DN upstream of the sensor. A further 5 pipe diameters inlet run is required upstream of the actual conditioner itself.

Note!

Due to the range of pipe diameters it is not possible to calibrate insertion meters with a flow conditioner if ordered together. The conditioners used are based on the Mitsubishi design which are available from line sizes 80 mm to 300 mm.

Flow conditioner for use with flanged sensors

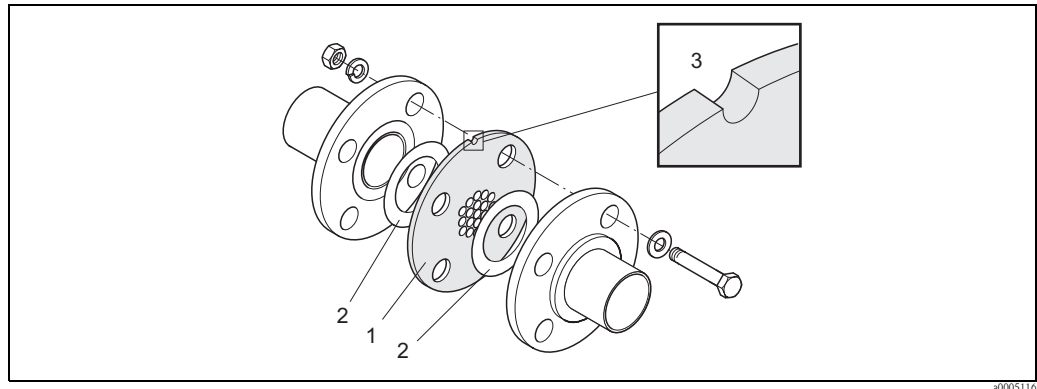
This is a special Endress+Hauser version designed specially for use with the t-mass F sensor (Sizes DN 25...100). The flow conditioner should be fitted immediately upstream of the flanged sensor. A further 5 pipe diameters inlet run is required upstream of the actual conditioner itself.

For optimum performance, it is advised that the t-mass F sensor and flow conditioner are ordered at the same time such that they are calibrated together. To retrospectively fit a flow conditioner will have a small effect on the measurement performance.

Note!

The use of other types of flow conditioners, other than the Endress+Hauser flow conditioner, with the t-mass F sensor will have an impact on the measurement performance due to the effects of flow profile and pressure drop.

The flow conditioner is fitted between two piping flanges and centered with mounting bolts.



Flow conditioner mounting arrangement

1 = Perforated plate flow conditioner

2 = Seal/gasket

3 = Notch for positioning

Note!

The flow conditioner has a notch to indicate the mounting position. Mount vertically.

Pressure loss calculation

$$\Delta p = \text{constant} \cdot \frac{\dot{m}^2}{\rho} \cdot \frac{1}{D^4}$$

a0005243-en

Pressure loss: Δp in mbar

Mass flow : \dot{m} in kg/h

Density: ρ in kg/m³

Diameter: D in mm

Constant = 1876

Calculation example:

$\dot{m} = 148$ kg/h

$\rho = 5.94$ kg/m³ (at 5 bar abs at 20 °C)

D = 28.5 mm (for a DN 25, PN 40 meter)

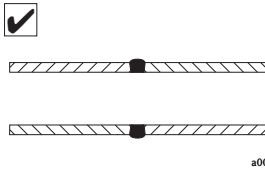
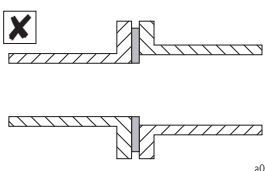
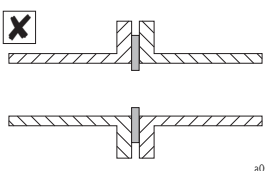
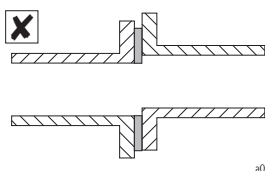
$$\Delta p = 1876 \cdot \frac{148^2}{5.94} \cdot \frac{1}{28.5^4} = 10.5 \text{ mbar}$$

a0005244-en

Pipework requirements

Good installation practice should be followed at all times:

- Cleaned pipe and flange welded joints
- Correctly sized gaskets
- Correctly aligned flanges and gaskets
- The use of seamless pipe immediately upstream of the flowmeter.
- The use of pipework with a matching internal diameter to that of the flowmeter to ensure that no step disturbance greater than 1 mm can occur at the meter inlet or outlet, 3 mm for diameters > DN 200.
- As a general comment, anything that disturbs the smoothness of the internal pipe wall (see figure below) should be eliminated; the goal should be a smooth uninterrupted internal surface.
For further information please refer to ISO 14511.

 <p>a0005103</p>		
Cleaned and flange welded joints		
 <p>a0005104</p>	 <p>a0005105</p>	 <p>a0005106</p>
Pipe diameter one is not equal pipe diameter two	Incorrectly sized gaskets	Incorrectly aligned flanges and gaskets

Insertion version

Insertion depth

When installing the sensor, the following three dimensions need to be taken into account to allow the correct insertion length to be specified:

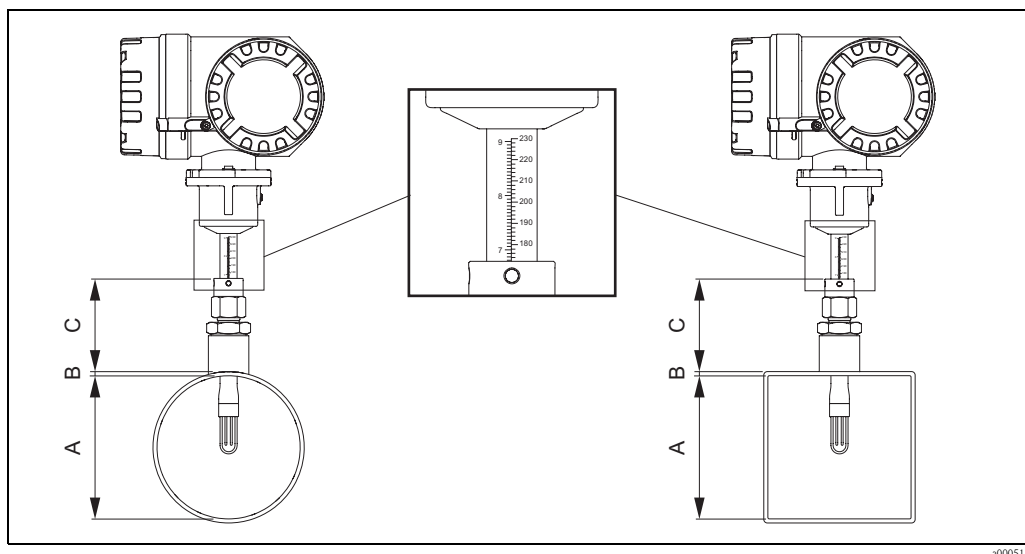
- A = Internal diameter of the circular pipe or for a rectangular duct, the duct height if the sensor is to be mounted vertically or duct width if it is to be mounted horizontally
- B = Pipe wall thickness
- C = Height of the mounting boss on the pipe or duct including the sensor fitting and cold/hot tap if fitted.

The tube section is supplied with a graduated scale along its length calibrated in millimetres or inches. It is important that the sensor be installed so that the top of the adjustable fitting is aligned with the value on the scale that is equal to the following calculated value:

- For pipe diameters < DN 100:
 $(0.3 \times A) + B + C + 2 \text{ mm}$
- For pipe diameters \geq DN 100:
 $(0.2 \times A) + B + C + 3 \text{ mm}$

When the sensor is at the correct insertion depth the sensor must next be aligned for the correct flow direction. After alignment, the compression fitting must be tightened to secure and seal the insertion tube.

It is essential that all installation dimensions are supplied at the time of order to allow correct manufacture and calibration, especially when the mounting boss is provided by the customer. The same requirement exists for insertion sensors supplied to fit DN80...100 pipe sizes (regardless of the type of process connection) since they require calibration with the identical mechanical setup as the final installation.



a0005118

Note!

- Insertion sensors mounted in DN 80 and DN 100 pipes are calibrated in the factory at the actual line size specified, all insertion sensors for pipe sizes \geq DN 150 are calibrated on a DN 175 pipe and numerically scaled to suit the process pipe size (this pipe configuration together with the engineering units selection is programmable via the integral keyboard and display when fitted).
- Unless stated otherwise, any installation guidance assumes that a standard mounting boss provided by Endress+Hauser is being used.

Vertical alignment

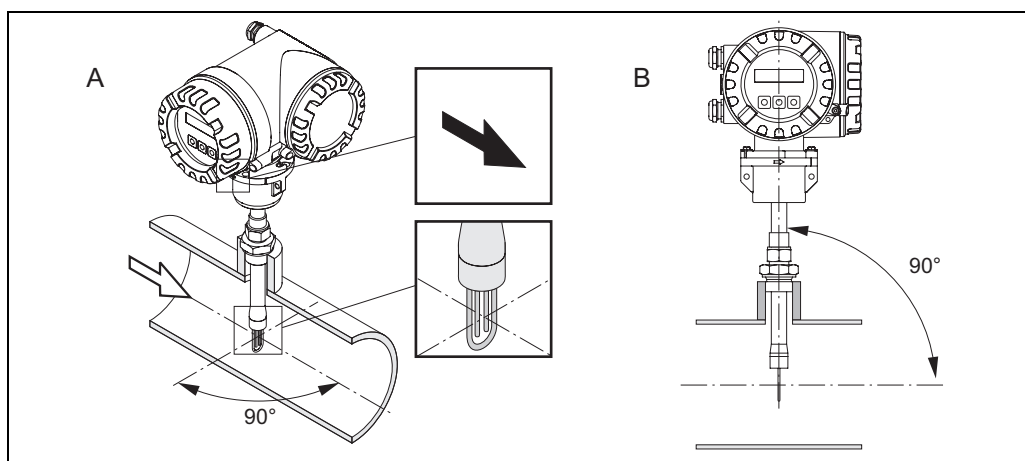
It is important that the sensor mounting boss is welded to the pipe or duct such that the sensor is mounted at 90 degrees to the flow direction. Any deviation from this angle in any plane may cause flow disturbances around the measuring point that could cause errors.

Flow direction alignment

It is very important that the sensor is aligned correctly with the direction of flow. There are two guidelines for correct alignment:

- The arrows on the sides of the sensor housing assembly are pointing in the same direction as the flow.
- The graduated scale on the insertion tube section should be aligned directly upstream of the flow direction.

To ensure optimum exposure of the measuring transducers to the flowing gas stream, the sensor must not be rotated more than 7 degrees from this alignment.



a0005117

It is important to keep the 90° degree angle

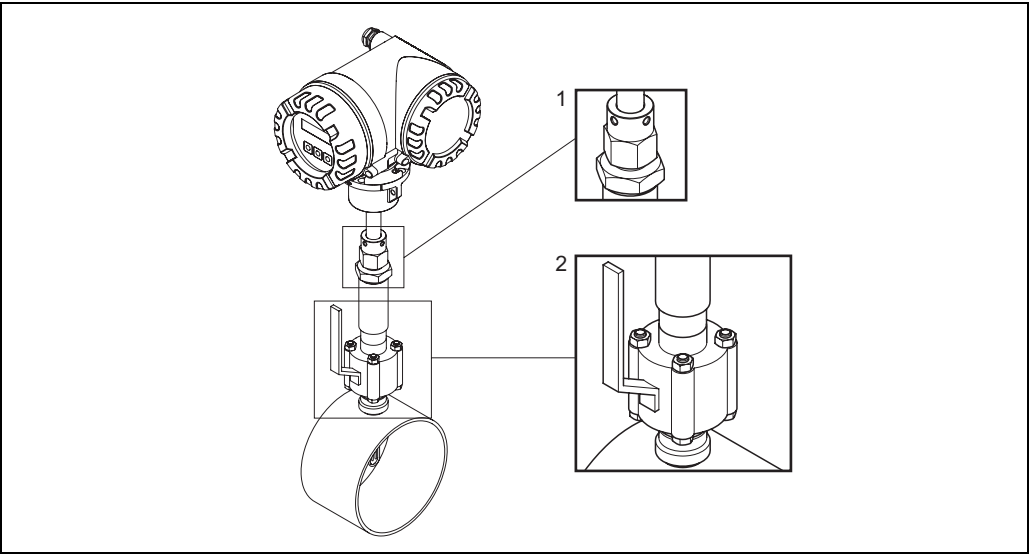
A = Vertical alignment

B = Flow direction alignment

Insertion version with cold tap process connection

The device can be fitted to a “cold tap” process connection.

It allows the removal of an insertion meter from a pipe or duct when the process is stopped and no pressure and extreme temperature are present. Following removal the isolation valve permits the restarting of the process.



Cold tap version

1 = Compression gland

2 = Isolation valve

Length of connecting cable Maximum 100 meters, remote version

Operating conditions: Environment

Ambient temperature range	Standard: -20 °C...+60 °C; -40 °C available on request
	Note!
	<ul style="list-style-type: none">■ Install the device in a shaded location. Avoid direct sunlight, particularly in warm climatic regions. (a protective hood is available on request)■ At ambient temperatures below -20 °C the readability of the display may be impaired.
	It must be remembered that the sensor operating principle is based on a heat loss mechanism, therefore the sensor performs best when the ambient and/or gas temperatures are relatively stable.
Storage temperature	-40 °C...+80 °C, recommended +20 °C
Degree of protection	Standard: IP 67 for transmitter and sensor
Shock resistance	In accordance with IEC 60068-2-31
Vibration resistance	Acceleration up to 1 g, 10 to 150 Hz, following IEC 60068-2-6
Electromagnetic compatibility (EMC)	To IEC/EN 61326 and NAMUR recommendation NE 21

Operating conditions: Process

Medium temperature range

Sensor

t-mass F:

−40 °C...+100 °C

t-mass I:

−40 °C...+130 °C

Seals:

t-mass F:

Viton −20 °C...+100 °C

Kalrez −20 °C...+100 °C

EPDM −40 °C...+100 °C

t-mass I:

Nitrile −35 °C...+130 °C

Kalrez −20 °C...+130 °C

EPDM −40 °C...+130 °C

Pressure loss

2 mbar maximum (without flow conditioner)

Medium pressure range (nominal pressure)

t-mass F:

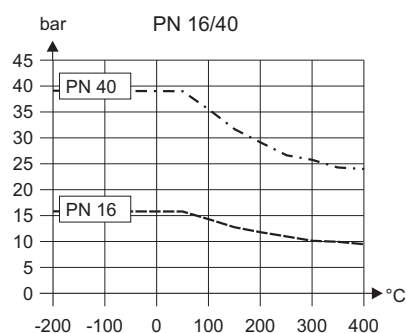
−0.5 bar...40 bar gauge

t-mass I:

−0.5 bar...20 bar gauge

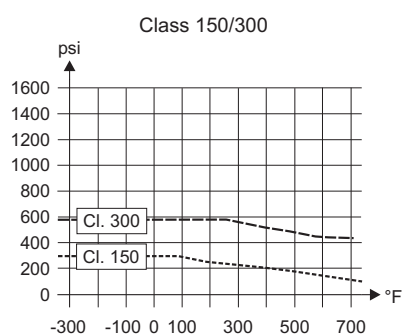
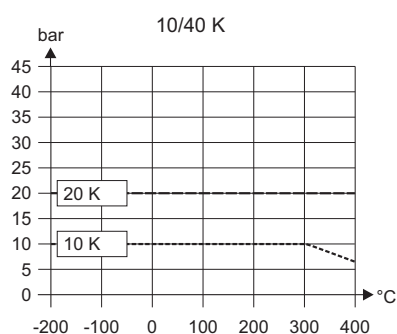
Medium pressure

Pressure temperature curve to EN (DIN), stainless steel



a0005240

Pressure temperature curve to ANSI 16.5 and JIS B2238, stainless steel

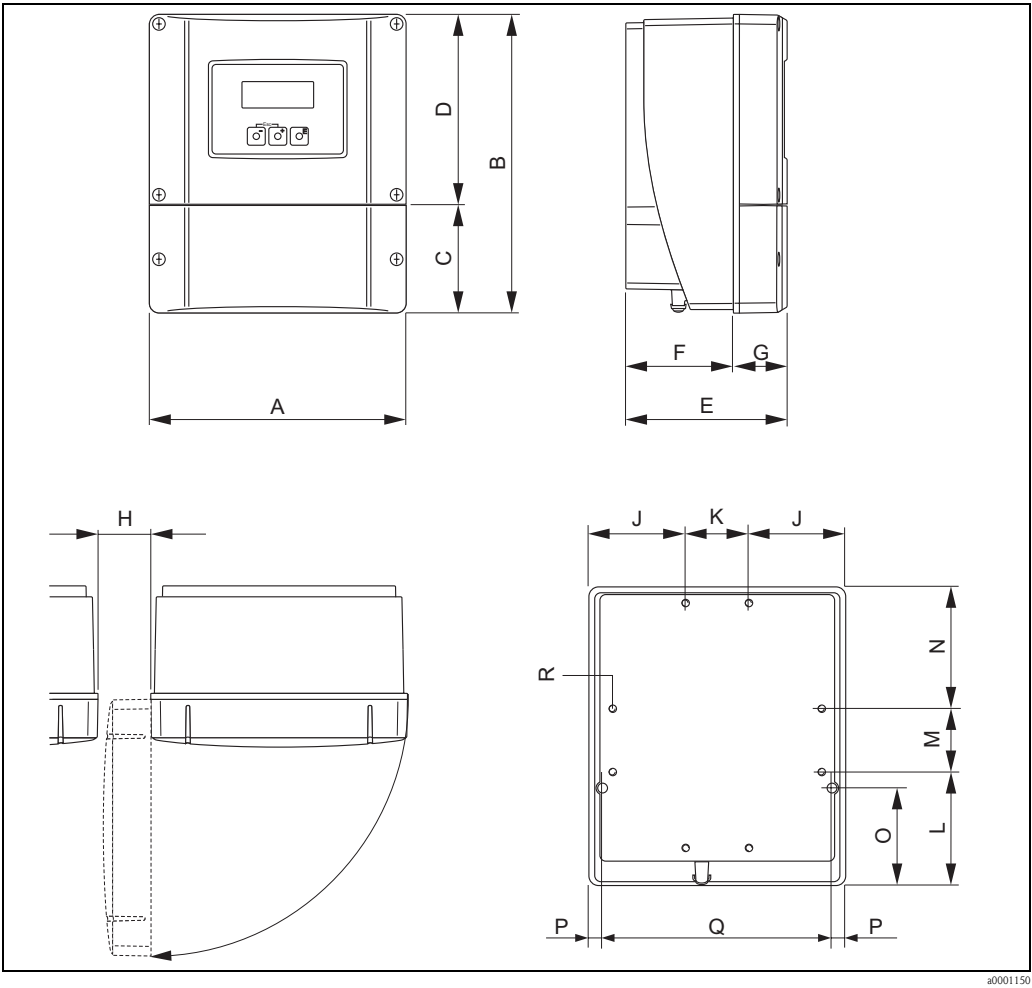


a0005241

Mechanical construction

Design / dimensions

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



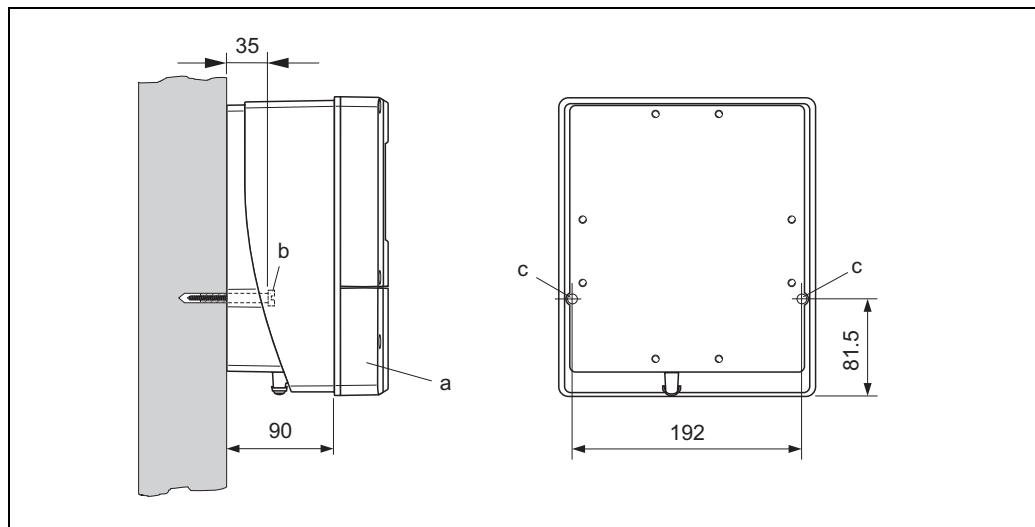
Metric units [mm]

A	B	C	D	E	F	G	H	J	K	L	M	N	O	P	Q	R
215	250	90.5	159.5	135	90	45	>50	81	53	95	53	102	81.5	11.5	192	8xM5

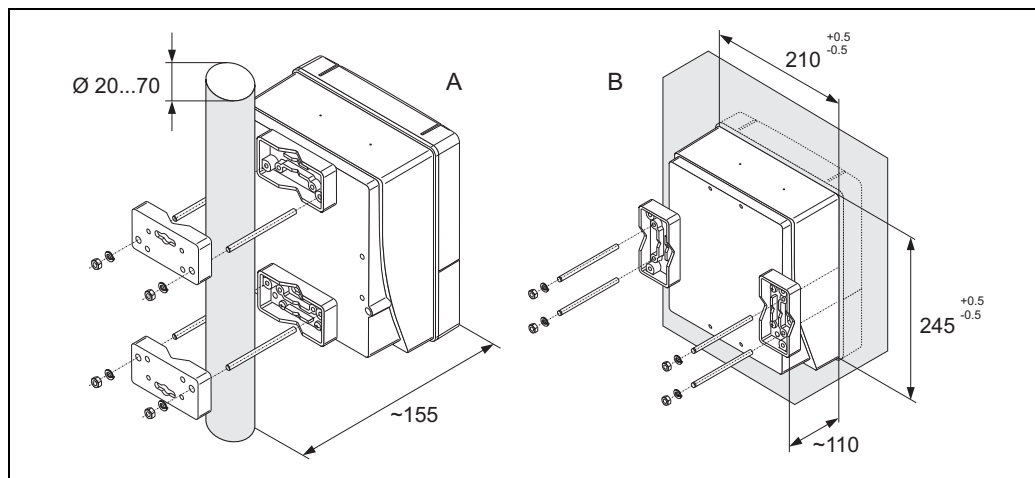
Installing the wall-mount transmitter housing

Caution!

- Make sure that the ambient temperature does not go beyond the permissible range (– 20 °C...+60 °C), optional (– 40 °C...+60 °C). Install the device in a shaded location. Avoid direct sunlight.
- Always install the wall-mount housing in such a way that the cable entries are pointing down.

Mounted directly on the wall

20001130-en

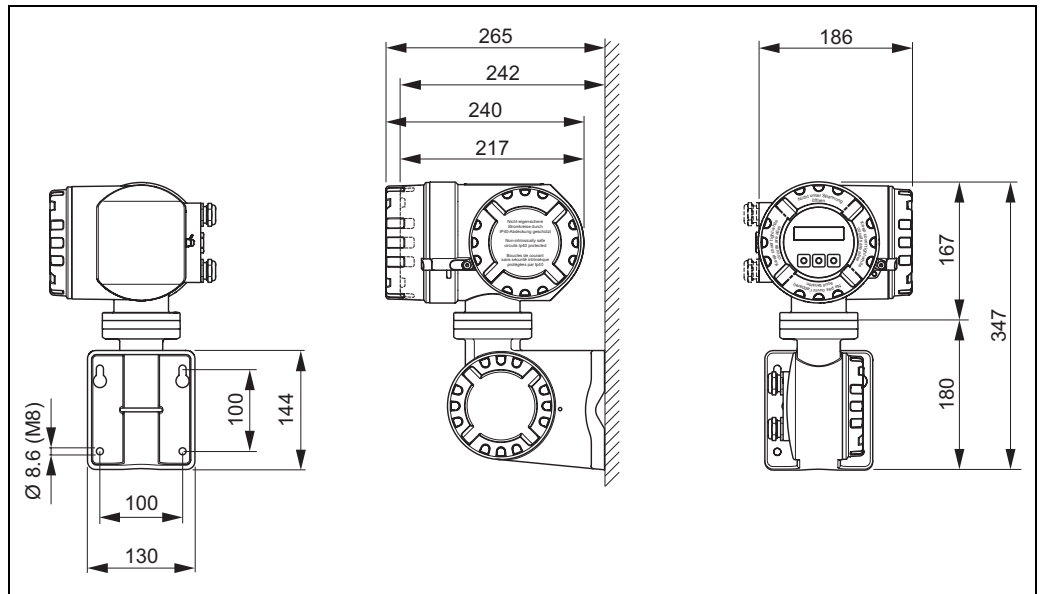
*a = Wallmount housing**b = Securing screws (M6): maximum \varnothing 6.5 mm; Screw head: maximum \varnothing 10.5 mm**c = Appropriate bores in the housing**Pipe mounting and installation in control panel*

20005250-en

*A = Pipe mounting of wallmount housing**B = Installation in control panel of wallmount housing***Caution!**

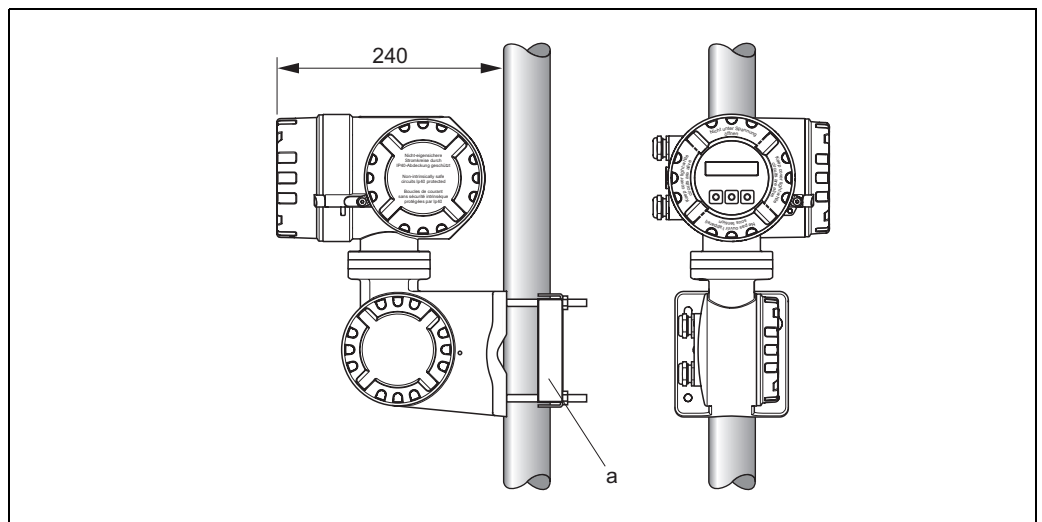
If a warm pipe is used for installation, make sure that the housing temperature does not exceed the maximum permitted value of +60 °C.

Dimensions: Remote field housing (II2GD / zone 1)



a0005156-en

Pipe mounting of the remote field housing

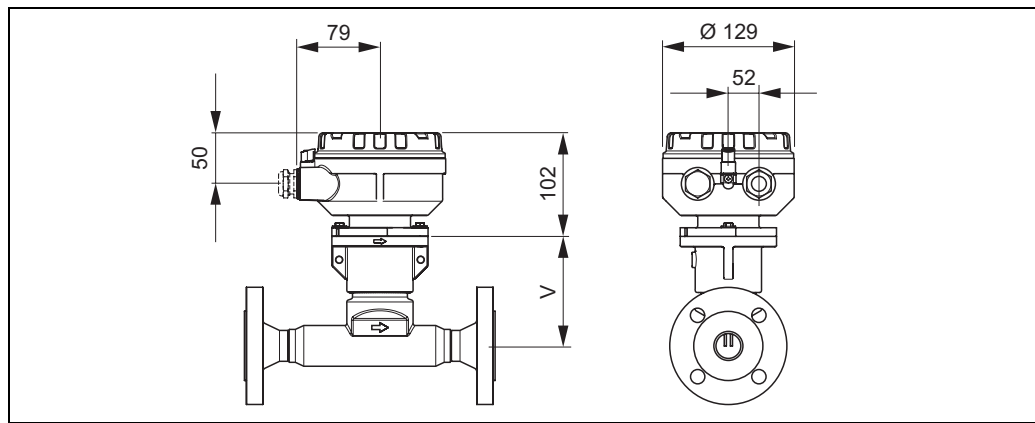


a0005157-en

a = Pipe mounting (separate mounting set, see accessories)

Caution!

If a warm pipe is used for installation, make sure that the housing temperature does not exceed the maximum permitted value of +60 °C.

Dimensions: Remote sensor housing flanged version (II2GD / zone 1)

a0005158-en

For dimension V of the flanged remote sensor version please refer to Page 23



Surface roughness (flange): EN 1092-1 Form B1 (DIN 2526 Form C), Ra 6.3 to 12.5 μm

¹⁾ Flange with groove to EN 1092-1 Form D (DIN 2512N) available

Surface roughness (flange): EN 1092-1 Form B1 (DIN 2526 Form C), Ra 6.3 to 12.5 μm

¹⁾ Flange with groove to EN 1092-1 Form D (DIN 2512N) available

Flange JIS B2238/ 10K / Sched 40: 1.4404/316L/316

Surface roughness (flange): Ra 3.2 to 6.3 µm

DN	di	B	G	L	LK	N	P	S	T	U	V
50	49.2	278.5	155	400	120	4 x Ø19.1	250.0	16	150.0	52.7	118.5
80	73.7	291.0	185	640	150	4 x Ø19.1	400.0	18	240.0	78.1	131.0
100	97.0	303.0	210	800	175	4 x Ø19.1	500.5	18	299.5	102.3	143.0

Flange JIS B2238/ 10K / Sched 80: 1.4404/316L/316

Surface roughness (flange): Ra 3.2 to 6.3 µm

DN	di	B	G	L	LK	N	P	S	T	U	V
50	49.2	278.5	155	400	120	4 x Ø19.1	250.0	16	150.0	49.2	118.5
80	73.7	291.0	185	640	150	4 x Ø19.1	400.0	18	240.0	73.7	131.0
100	97.0	303.0	210	800	175	4 x Ø19.1	500.5	18	299.5	97.0	143.0

Flange JIS B2238/ 20K / Sched 40: 1.4404/316L/316

Surface roughness (flange): Ra 3.2 to 6.3 µm

DN	di	B	G	L	LK	N	P	S	T	U	V
15	13.9	276.5	95	245	70	4 x Ø15	132.5	14	112.5	16.1	116.5
25	24.3	276.5	125	245	90	4 x Ø19	132.5	16	112.5	27.2	116.5
40	38.1	273.5	140	320	105	4 x Ø19	200	18	120	41.2	113.5
50	49.2	278.5	155	400	120	8 x Ø19	250	18	150	52.7	118.5
80	73.7	291.0	200	640	160	8 x Ø23	400	22	240	78.1	131.0
100	97	303.0	225	800	185	8 x Ø23	500.5	24	299.5	102.3	143.0

Flange JIS B2238/ 20K / Sched 80: 1.4404/316L/316

Surface roughness (flange): Ra 3.2 to 6.3 µm

DN	di	B	G	L	LK	N	P	S	T	U	V
15	13.9	276.5	95	245	70	4 x Ø15	132.5	14	112.5	13.9	116.5
25	24.3	276.5	125	245	90	4 x Ø19	132.5	16	112.5	24.3	116.5
40	38.1	273.5	140	320	105	4 x Ø19	200	18	120	38.1	113.5
50	49.2	278.5	155	400	120	8 x Ø19	250	18	150	49.2	118.5
80	73.7	291.0	200	640	160	8 x Ø23	400	22	240	73.7	131.0
100	97	303.0	225	800	185	8 x Ø23	500.5	24	299.5	97	143.0



Flange ANSI B16.5 / CI 300 / Sched 40: 1.4404/316L/316

Surface roughness (flange): N9 / 250 µinch

DN [inch]	di [inch]	B [inch]	G [inch]	L [inch]	LK [inch]	N [inch]	P [inch]	S [inch]	T [inch]	U [inch]	V [inch]
1/2"	0.87	10.88	3.75	9.6	2.62	4 x Ø 5/8	5.22	0.56	4.43	0.62	4.59
1"	1.28	10.88	4.88	9.6	3.50	4 x Ø 3/4	5.22	0.69	4.43	1.05	4.59
1 1/2"	1.74	10.77	6.12	12.6	4.50	4 x Ø 7/8	7.87	0.81	4.72	1.61	4.47
2"	2.21	10.96	6.50	15.7	5.00	8 x Ø 3/4	9.84	0.88	5.90	2.07	4.66
3"	3.29	11.46	8.25	25.2	6.62	8 x Ø 7/8	15.7	1.12	9.45	3.07	5.16
4"	4.29	11.93	10.00	31.5	7.88	8 x Ø 7/8	19.7	1.25	11.8	4.03	5.63

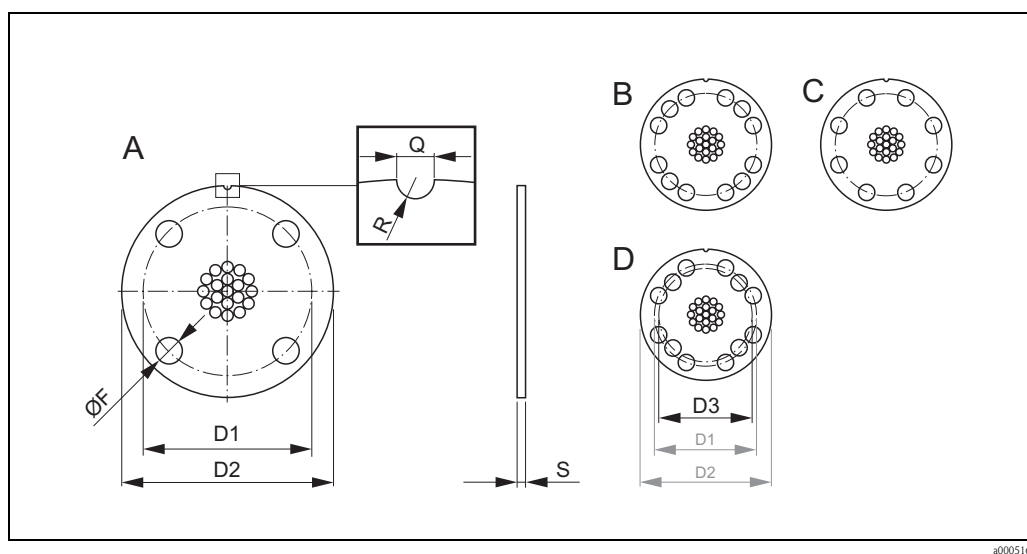
Flange ANSI B16.5 / CI 300 / Sched 80: 1.4404/316L/316

Surface roughness (flange): N9 / 250 µinch

DN [inch]	di [inch]	B [inch]	G [inch]	L [inch]	LK [inch]	N [inch]	P [inch]	S [inch]	T [inch]	U [inch]	V [inch]
1/2"	0.87	10.88	3.75	9.6	2.62	4 x Ø 5/8	5.22	0.56	4.43	0.55	4.59
1"	1.28	10.88	4.88	9.6	3.50	4 x Ø 3/4	5.22	0.69	4.43	0.96	4.59
1 1/2"	1.74	10.77	6.12	12.6	4.50	4 x Ø 7/8	7.87	0.81	4.72	1.50	4.47
2"	2.21	10.96	6.50	15.7	5.00	8 x Ø 3/4	9.84	0.88	5.90	1.94	4.66
3"	3.29	11.46	8.25	25.2	6.62	8 x Ø 7/8	15.7	1.12	9.45	2.90	5.16
4"	4.29	11.93	10.00	31.5	7.88	8 x Ø 7/8	19.7	1.25	11.8	3.82	5.63



Insertion version length	V	W	L	L _R
235	235	244.5	467.5	409.5
335	335	344.5	567.5	509.5
435	435	444.5	667.5	609.5
608	608	617.5	840.5	782.5

Dimensions, flow conditioner: According to EN (DIN) / JIS / ANSI


a0005166

							EN (DIN)			
							PN 16		PN 40	
DN [mm]	Type	D1 [mm]	D2 [mm]	F [mm]	Q [mm]	R [mm]	S [mm]	Weight [kg]	S [mm]	Weight [kg]
25	A	83	105	13	5	2.5	–	–	4.5	0.3
40	A	108	135	17	5	2.5	–	–	7.0	0.7
50	A	123	150	17	5	2.5	–	–	8.5	1.0
80	C	158	185	17	5	2.5	–	–	13.0	2.3
100	C	187	220	22	5	2.5	17.0	4.1	17.0	4.1

							JIS 10K/20K			
							Sched 40		Sched 80	
DN [mm]	Type	D1 [mm]	D2 [mm]	F [mm]	Q [mm]	R [mm]	S [mm]	Weight [kg]	S [mm]	Weight [kg]
25	A	87	115	17	5	2.5	4.5	0.4	4.0	0.4
40	A	102	130	17	5	2.5	6.5	0.7	6.0	0.7
50	B	117	145	17	5	2.5	8.5	1.2	8.0	1.1
80	C	157	188	21	5	2.5	12.5	3.0	12.0	2.8
100	C	182	214	21	5	2.5	16.5	5.1	15.5	4.8

								ANSI Cl. 150/300			
								Sched 40		Sched 80	
DN [inch]	Type	D1 [inch]	D2 [inch]	D3 [inch]	F [inch]	Q [inch]	R [inch]	S [inch]	Weight [lb]	S [inch]	Weight [lb]
1"	A	3.36	4.33	–	0.67	0.2	0.1	0.18	0.8	0.16	0.7
1 1/2"	A	4.31	5.51	–	0.85	0.2	0.1	0.26	1.9	0.24	1.7
2"	D	4.80	5.90	4.55	0.75	0.2	0.1	0.33	2.8	0.31	2.7
3"	D	6.41	7.67	5.67	0.87	0.2	0.1	0.49	7.0	0.42	6.8
4"	C	7.75	8.97	–	0.81	0.2	0.1	0.65	11.7	0.61	11.9

Weight

- Compact version: see table below
- Remote version
 - Sensor: see table below
 - Wall-mount housing: (non hazardous area and zone 2 ATEX II3G)
 - 5 kg
 - Remote field housing: (zone 1 ATEX II2GD)
 - 7 kg

Weights in kg

t-mass F / DN	15	25	40	50	80	100
Compact version	7.5	8.0	12.5	12.5	18.7	27.9
Remote version (sensor only)	5.5	6.0	10.5	10.5	16.7	25.9

Weights in kg

t-mass I / sensor length	235	335	435	608
Compact version	6.4	6.6	7.0	7.4
Remote version (sensor only)	4.4	4.6	5.0	5.4

For flanged versions, all values (weight) refer to devices with EN/DIN PN 40 flanges.

Materials**Transmitter housing:**

- Compact housing: powder coated die-cast aluminium
- Wall-mount housing: powder coated die-cast aluminium
- Remote field housing: powder-coated die-cast aluminium

Connection housing, sensor (remote version):

powder coated die-cast aluminium

t-mass F sensor:*Sensor body:*

- DN 15...25: stainless steel cast CF3M - A351
- DN 40...100: 1.4404 to EN10216-5 and 316/316L to A312

Flanges (process connections):

According to EN 1092-1 (DIN 2501/DIN 2512N) / ANSI B16.5 / JIS B2238
 → stainless steel 1.4404 to EN 10222-5 and 316L/316 to A182

Transducer body:

- 1.4404 to EN10272 and 316L to A479
- Alloy C22 and UNS N06022 to B574

Transducer elements:

- 1.4404 to EN10217-7 / 316L to A249 or
- 1.4404 to EN 10216-5 / 316L to A213
- Alloy C22 and UNS N06022 to B626

O-ring seals:

EPDM, Kalrez, Viton

t-mass I sensor:*Insertion tube:*

Sensor length 235, 335, 435, 608:
1.4404 to EN 10216-5 and 316/316L to A312

Transducer body:

- 1.4404 to EN10272 and 316L to A479
- Alloy C22 and UNS N06022 to B574

Transducer elements:

- 1.4404 to EN10217-7 / 316L to A249 or
- 1.4404 to EN 10216-5 / 316L to A213
- Alloy C22 and UNS N06022 to B626

Compression fitting:

1.4404 to EN 10272 and 316/316L to A479

Compression fitting seal:

PEEK

Bonded seals:

EPDM, Kalrez, Nitrile
316/316L (outer ring)

Low pressure retractable insertion fitting (Cold tap):*Lower tube section:*

1.4404 to EN 10272 and 316/316L to A479

Upper tube section:

1.4404 to EN 10216-5 and 316/316L to A312

Ball valve:

1.4408 to EN 10213-4 and CF8M

Seal:

PTFE

Process connections

t-mass F:
Flanges according EN 1092-1, JIS B2238 and ANSI B16.5

t-mass I:
G 1 A or 1" MNPT thread

Note!

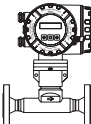
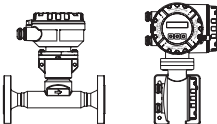
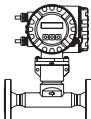
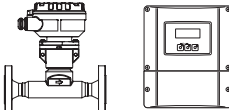


For both the flanged and insertion meters it is possible to have wetted parts degreased for oxygen service.
Contact your Endress+Hauser service representative for further details.

Human interface

Display elements	<ul style="list-style-type: none">■ Liquid-crystal display: backlit, two lines■ 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	<ul style="list-style-type: none">■ Local operation with three keys (-, +, E)■ Quick Setup menus for straight forward commissioning
Remote operation	Remote operation via HART, PROFIBUS DP, MODBUS RS485

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 meets the EMC requirements of the Australian Communications and Media Authority (ACMA).
Ex approval	Information about currently available Ex versions (ATEX, FM, CSA, etc.) 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.

Hazardous area		Safe area
II2GD / Cl. 1 Div. 1	II3G / Cl. 1 Div. 2	
 	 	
		

Example of t-mass devices in the hazardous area (Example t-mass 65F)

PROFIBUS DP 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: The device can also be operated with certified devices of other manufacturers (interoperability)
MODBUS certification	The measuring device meets all the requirements of the MODBUS/TCP conformity test and has the “MODBUS/TCP Conformance Test Policy, Version 2.0”. The measuring device has successfully passed all the test procedures carried out and is certified by the “MODBUS/TCP Conformance Test Laboratory” of the University of Michigan.
Other standards and guidelines	EN 60529: Degrees of protection by housing (IP code) EN 61010-1 Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures.

EN 61326/A1 (IEC 61326)

“Emission in accordance with Class A requirements”. Electromagnetic compatibility (EMC- requirements)

NAMUR NE 21:

Electromagnetic compatibility (EMC) of industrial process and laboratory control equipment.

NAMUR NE 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 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/EC (Pressure Equipment Directive) and are designed according to sound engineering practice. For larger nominal diameters, optional approvals according to Cat. III are available when required (dependant on fluid and process pressure).

Ordering information

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

To ensure each meter is programmed to individual requirements, the following information is essential:

- Gas type if not air (composition if more than one gas in % volume)
- Gas pressure
- Gas temperature
- Line size – internal diameter
- 20 mA range required
- Flow engineering units (kg/h etc.)

Accessories

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

Device-specific accessories

Accessory	Description	Order code
Mounting boss	Mounting boss for the t-mass insertion version	DK6MB - *
Cable remote version	Connecting cable for the remote version	DK6CA - *

Measuring principle-specific accessories

Accessory	Description	Order code
Mounting set for transmitter	Mounting set for remote version. Suitable for: – Wall mounting – Pipe mounting – Installation in control panel Mounting set for aluminium field housing: Suitable for pipe mounting (3/4" to 3")	DK6WM - *
Cold Tap mounting set	Insertion mounting set for low pressure	DK6ML - *
Hot Tap mounting set	Insertion mounting set for high pressure	Contact your local Endress+Hauser sales representative for more information.
Flow conditioners	Perforated plate flow conditioners for various line sizes and schedules. (t-mass F sensor only)	Contact your local Endress+Hauser sales representative for more information.

Communication-specific accessories

Accessory	Description	Order code
HART Communicator DXR 375 handheld terminal	Handheld terminal for remote parameterisation and for obtaining measured values via the current output HART (4 to 20 mA).	DXR375 - * * * * Contact your local Endress+Hauser sales representative for more information.

Service-specific accessories

Accessory	Description	Order code
Applicator	Software for selecting and configuring flowmeters. Applicator can be downloaded from the Internet or ordered on CD-ROM for installation on a local PC.	DKA80 - * Contact your local Endress+Hauser sales representative for more information.
ToF Tool - Fieldtool Package	Modular software package consisting of the service program "ToF Tool" for configuration and diagnosis of ToF level measuring devices (time-of-flight measurement) and the "Fieldtool" service program for the configuration and diagnosis of Proline flowmeters. The Proline flowmeters are accessed via a service interface or via the service interface FXA 193. Contents of the "ToF Tool - Fieldtool Package": – Commissioning, maintenance analysis – Configuring flowmeters – Service functions – Visualisation of process data – Trouble-shooting – Controlling the "Fieldcheck" tester/simulator	DXS10 - * * * * * Contact your local Endress+Hauser sales representative for more information.
Fieldcheck	Tester/simulator for testing flowmeters in the field. When used in conjunction with the "ToF Tool - Fieldtool Package" software package, test results can be imported into a database, printed and used for official certification.	50098801 Contact your local Endress+Hauser sales representative for more information.

Accessory	Description	Order code
FieldCare	FieldCare is Endress+Hauser's FDT based Plant Asset Management Tool. It can configure all intelligent field devices in your plant and supports you in managing them. By using status information, it also provides a simple but effective means of checking their health.	Please refer to the product page of the Endress+Hauser Internet page: www.endress.com

Documentation

- ❑ Technical information (TI069D/06/en)
- ❑ Operating Instructions HART (BA111D/06/en)
- ❑ Operating Instructions PROFIBUS DP (BA113D/06/en)
- ❑ Operating Instructions MODBUS (BA115D/06/en)
- ❑ Description of Device Functions HART (BA112D/06/en)
- ❑ Description of Device Functions PROFIBUS DP (BA114D/06/en)
- ❑ Description of Device Functions MODBUS (BA116D/06/en)
- ❑ Ex documentation for ATEX (II2G) (XA089D/06/A3)
- ❑ Ex documentation for ATEX (II3G) (XA090D/06/A3)
- ❑ Ex documentation for FM/CSA (Div. 1) (XA091D/06/en)

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