Level Pressure Flow Temperature Liquid Analysis Registration Systems Components Services Solutions

Technical Information

Proline Prosonic Flow 92F

Ultrasonic Flow Measuring System
2-Wire loop powered inline flowmeter

Application
The flowmeter is ideally suited for applications in process control and utility measurement in practically all sectors of industry such as the chemical and petrochemical industry, energy production and district heating.

- Loop powered transmitter (2-Wire)
- Accuracy up to ±0.3% (optional)
- Fluid temperatures up to 150 °C
- Process pressures up to 40 bar
- Galvanically isolated pulse output available

Approvals for hazardous area:
- ATEX, FM, CSA

Connection to common process control systems:
- HART, PROFIBUS PA

Relevant safety aspects:
- Pressure Equipment Directive (PED)

Your benefits
The calibrated Inline version Prosonic Flow 92F is for measuring flow of conductive and especially non-conductive liquids such as solvents and hydrocarbons.

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

The **Proline Prosonic Flow sensors** comprises:
- Available as a 2, 3 or 4 beam version
- New innovative loop powered fourbeam design facilitates a reduced requirement for upstream pipework (≤ 5 pipe diameter)
- Calibration traceable to international standards
- No pressure drop
- Maintenance free due to no moving parts

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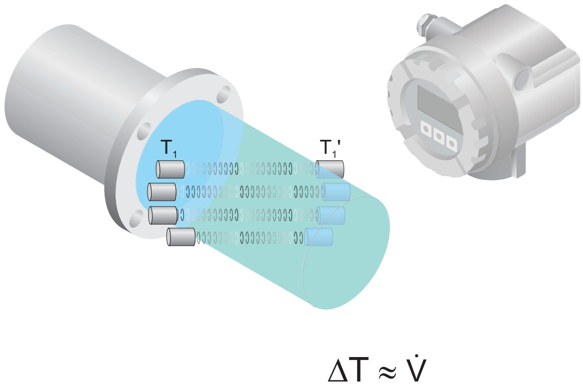
Table of contents

Function and system design

Measuring principle

A Prosonic Flow inline flowmeter measures the flow rate of the passing fluid by using sensor pairs located on opposite sides of the meter body and at an angle so that one of the sensors in the pair is slightly downstream. The flow signal is established by alternating an acoustic signal between the sensor pairs and measuring the time of flight of each transmission. Then utilizing the fact that sound travels faster with the flow versus against the flow, this differential time (Δ T) can be used to determine the fluids velocity between the sensors.
The volume flow rate is established by combining all the flow velocities determined by the sensor pairs with the cross sectional area of the meter body and extensive knowledge about fluid flow dynamics. The design of the sensors and their position ensures that only a short straight run of pipe upstream of the meter is required after typical flow obstructions such as bends in one or two planes. Advance digital signal processing facilitates constant validation of the flow measurement reducing susceptibility to multiphase flow conditions and increases the reliability of the measurement.



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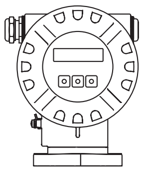
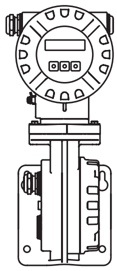
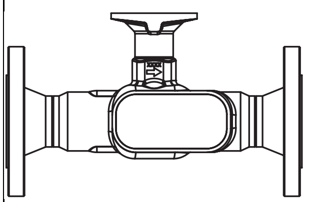
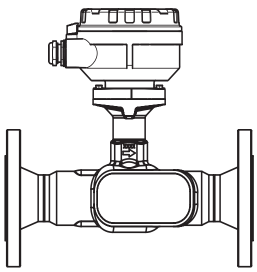
Measuring system

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

Transmitter

Prosonic Flow 92	Prosonic Flow 92 remote version	
 a0005962	 a0005963	▪ Two line liquid crystal display ▪ Operation with push buttons (only HART version) ▪ 2-Wire loop powered ▪ Optional explosion proof housing

Sensor

F	F (remote Version)	
 a0005966	 a0005967	▪ Universal sensor for fluid temperatures up to 150°C ▪ Nominal diameters DN 25 to 150, 1"…6" ▪ Tube material: stainless steel ▪ Process pressures up to 40 bar Remote version: ▪ Optional IP68 housing ▪ Standard remote cable length of 10 and 30 meters ▪ Optional remote cable length made to order up to a maximum 50 meters

Input

Measured variable

Flow velocity (transit time difference proportional to flow velocity)

Measuring range

Typically v = –10 to 10 m/s with the specified accuracy

Nominal diameters	Range for full scale values (liquids) $m_{min(F)}$ to $m_{max(F)}$
25	0 to 300 dm³/min
40	0 to 700 dm³/min
50	0 to 1100 dm³/min
80	0 to 3000 dm³/min
100	0 to 4700 dm³/min
150	0 to 600 m³/h

Output

Outputs in general

The following measured variables can generally be output via the outputs:

	Current output	Freq. output	Pulse output	Status output
Volume flow	X	X	X	Limit value
Sound velocity	X	X	–	Limit value
Flow velocity	X	X	–	Limit value
Signal strength	X	X	–	Limit value

Output signal

Current output:

Current output:
- 4 to 20 mA with HART
- Full scale value and time constant (0 to 100 s) can be set

Pulse/status output/Frequency output:

Open collector, passive, galvanically isolated
- Non-Ex, Ex d - version:
  Umax = 35 V, with 15 mA current limiting, Ri = 500
- Ex i version:
  Umax = 30 V, with 15 mA current limiting, Ri = 500

The pulse/status output can be configured as:
- Pulse output:
  - Pulse value and pulse polarity can be selected,
  - Pulse width can be configured (0.005 to 2s)
  - Pulse frequency max. 100 Hz
- Status output:
  Can be configured for diagnosis code messages or flow limit values
- Frequency output:
  End frequency 0 to 1000 Hz (fmax = 1250 Hz)

PROFIBUS PA interface

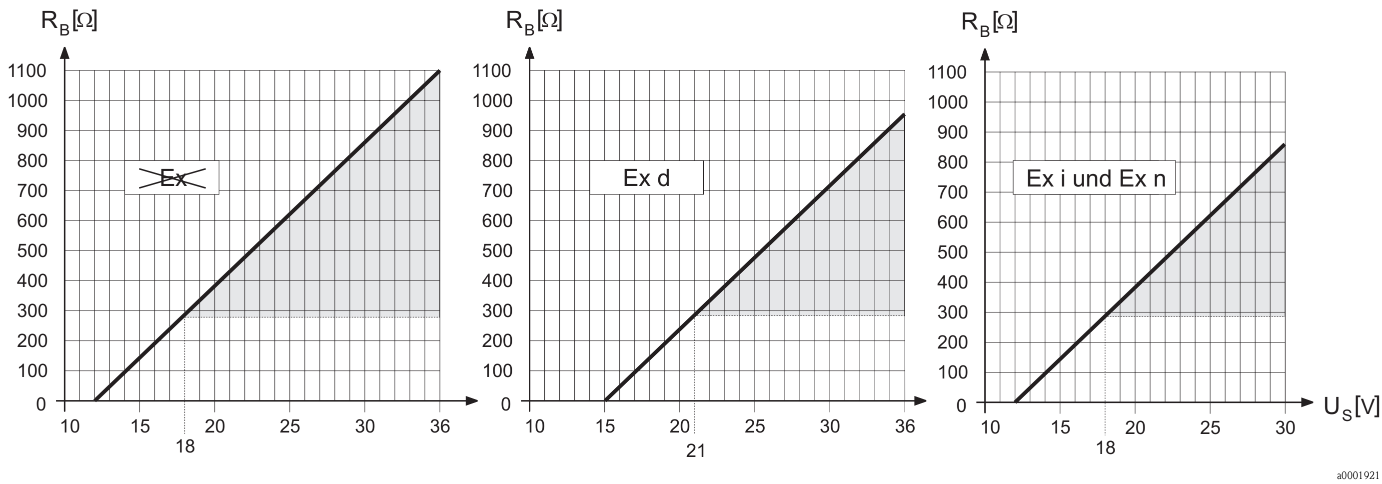
- PROFIBUS PA in accordance with IEC 61158 (MBP), galvanically isolated
- Profile Version 3.01
- Data transmission rate: 31.25 kBaud
- Current consumption: 16 mA
- Permitted supply voltage: 9 to 32 V; 0.5 W
- Bus connection with integrated reverse polarity protection
- Error current FDE (Fault Disconnection Electronic): 0 mA
- Signal coding: Manchester II
- Bus address can be configured via miniature switches at the device or operating program

Signal on alarm

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

Status output:
"Non conductive" in the event of fault or power supply failure.

Load



Behavior of load and supply voltage

The area marked in gray indicates the permissible load (with HART: min. 250 .)
The load is calculated as follows:

$$R_B = \frac{(U_S - U_{Kl})}{(I_{max} - 10^{-3})} = \frac{(U_S - U_{Kl})}{0.022}$$

R_B *Load, load resistance*
U_S *Supply voltage:*
- Non-Ex = 12 to 35 V DC
- Ex d = 15 to 35 V DC
- Ex i = 12 to 30 V DC
U_{KL} *Terminal voltage:*
- Non-Ex = min. 12 V DC
- Ex d = min. 15 V DC
- Ex i = min. 12 V DC
$I_{max.}$ *Output current (22.6 mA)*

Low flow cutoff

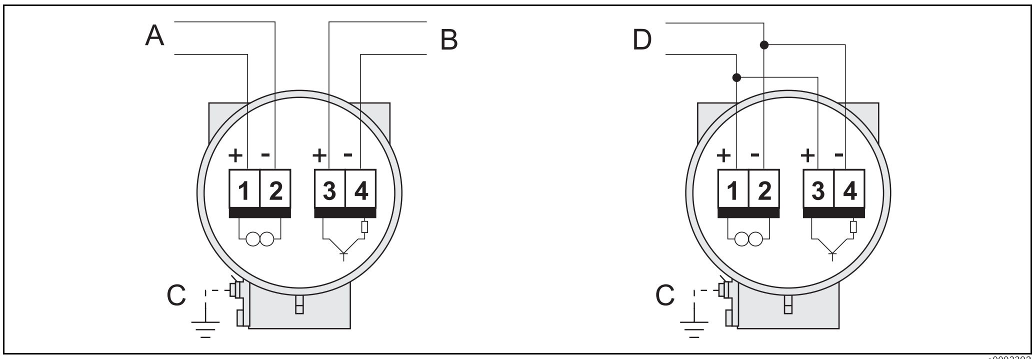
Switch points for low flow cutoff can be selected as required.

Galvanic isolation

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

Power supply

Electrical connection measuring unit



A – HART: power supply, current output
– PROFIBUS PA: 1 = PA+, 2 = PA–

B Optional frequency output (not for PROFIBUS PA), can also be operated as Pulse or status output

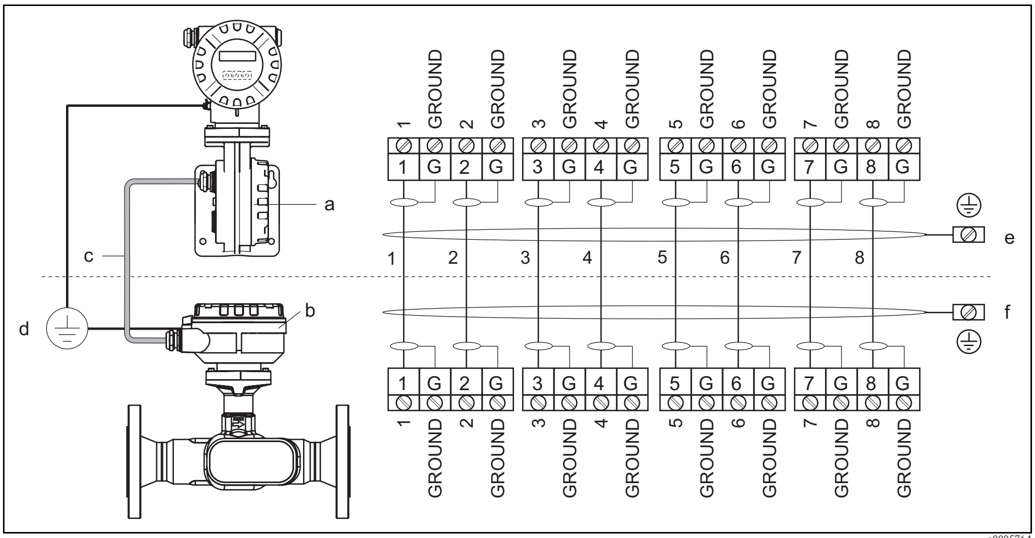
C Ground terminal (relevant for remote version)

D PFM (pulse-frequency modulation) wiring

Terminal assignment

Order version	Terminal No. (inputs/outputs)			
	1	2	3	4
92***-***********W	HART current output		–	
92***-***********A	HART current output		Pulse/status output/frequency output	
92F**-***********H	PA+	PA–	–	

Electrical connection remote version



Connecting the remote version

a Cover of the connection compartment (transmitter)
b Cover of the connection compartment (sensor)
c Connecting cable (signal cable)
d Identical potential matching for sensor and transmitter
e Connect the shielding to the ground terminal in the transmitter housing and keep it as short as possible
f Connect the shielding to the ground terminal in the connection housing

Supply voltage

HART:

Non-Ex: 12 to 35 V DC (with HART: 18 to 35 V DC)
Ex i: 12 to 30 V DC (with HART 18 to 30 V DC)
Ex d: 15 to 35 V DC (with HART: 21 to 35 V DC)

PROFIBUS PA:

9...32 V DC

Cable entries

Power supply and signal cables (inputs/outputs):
- Cable entry M20 x 1.5 (8 to 12 mm)
- Thread for cable entries, 1/2" NPT, G 1/2" (not for threaded version)

Remote version cable specifications

- Use a connecting cable with a continuous service temperature range of at least: –40 °C to (permitted max. ambient temperature plus 10 °C) or
- The cables are available with a fixed length of 10 m and 30 m and optionally available with variable lengths ranging from 1 m to max. 50 m.

Power supply failure

- Totalizer stops at the last value determined (can be configured).
- All settings are kept in the T-DAT.
- Diagnosis code messages (incl. value of operated hours counter) are stored.

Performance characteristics

Reference calibration conditions

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

Maximum measured error

For a Reynolds number > 10 000, the accuracy of the system for the given flow velocities is:

DN 25 to DN150 (1" to 6")

0.5 to 10 m/s (1.6 to 32.8 ft/s)	±0.5% o.r. ±0.01% o.f.s
< 0.5 m/s (<1.6 ft/s)	±0.035% o.f.s

optional for DN 80 to DN150 (3" to 6")

0.5 to 10 m/s (1.6 to 32.8 ft/s)	±0.3% o.r. ±0.01% o.f.s
< 0.5 m/s (<1.6 ft/s)	±0.025% o.f.s

o.r. = of reading; o.f.s = of current full scale value

Repeatability

± 0.2% o.r. (of reading)

Operating conditions: Installation

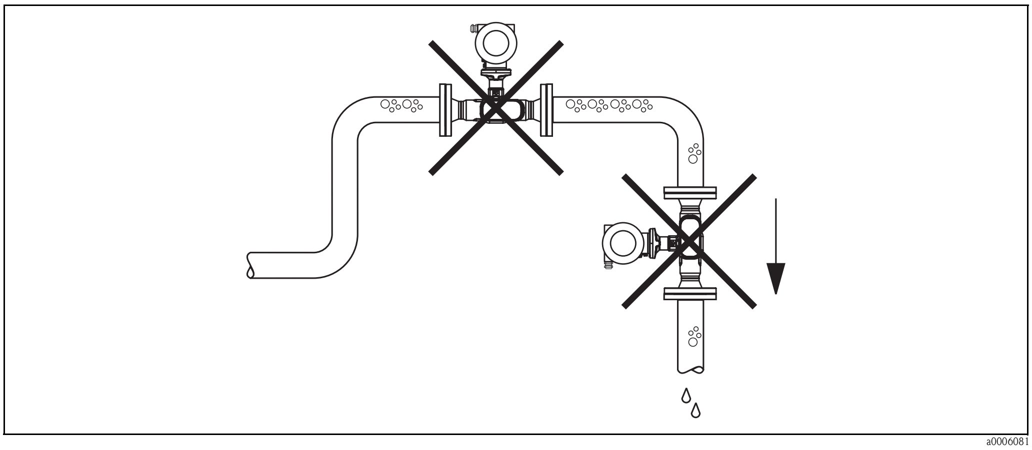
Note the following points:
- No special measures such as supports are necessary. External forces are absorbed by the construction of the instrument.
- The flowmeter flanges must be coplanar with connecting flanges and free from tension.
- The maximum permitted ambient temperatures (→ Page 10) and fluid temperatures (→ Page 11) must be observed.
- Pay particular attention to the notes on orientation and piping insulation on the following pages.
- The correct operation of the measuring system is not influenced by pipe vibrations.

Installation instructions

Mounting location

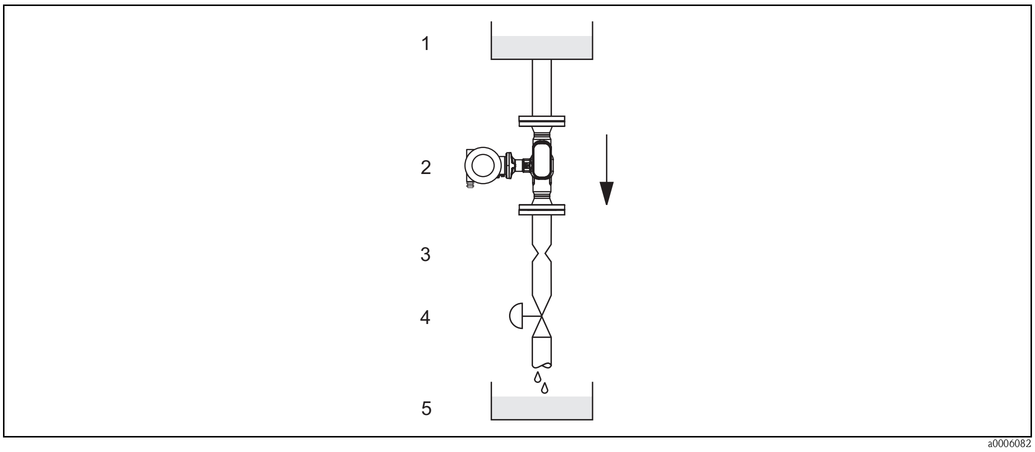
Entrained air or gas bubbles in the measuring tube can result in an increase in measuring errors.
Avoid the following mounting locations in the pipe:

- 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.

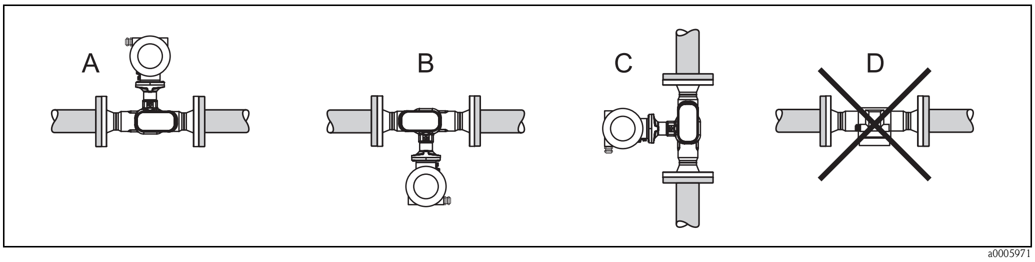


Installation in a down pipe (e.g. for batching applications)

1 = Supply tank , 2 = Sensor, 3 = Orifice plate, pipe restriction , 4 = Valve, 5 = Batching tank

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).



Orientations A, B and C recommended, orientation D only recommended under certain circumstances

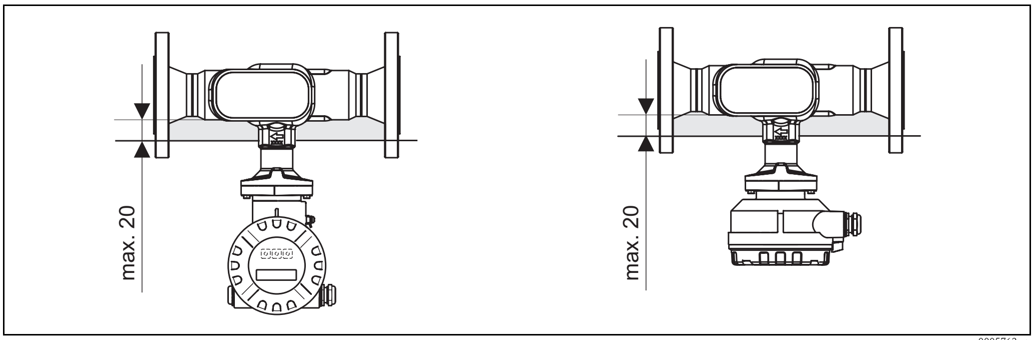
Heating

Some fluids require heat to be transfered 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 shield the sensor

Thermal insulation

Some fluids require suitable measures to avoid heat transfer at the sensor. A wide range of materials can be used to provide the required thermal insulation.



A maximum insulation thickness of 20 mm must be observed in the area of the electronics/neck..

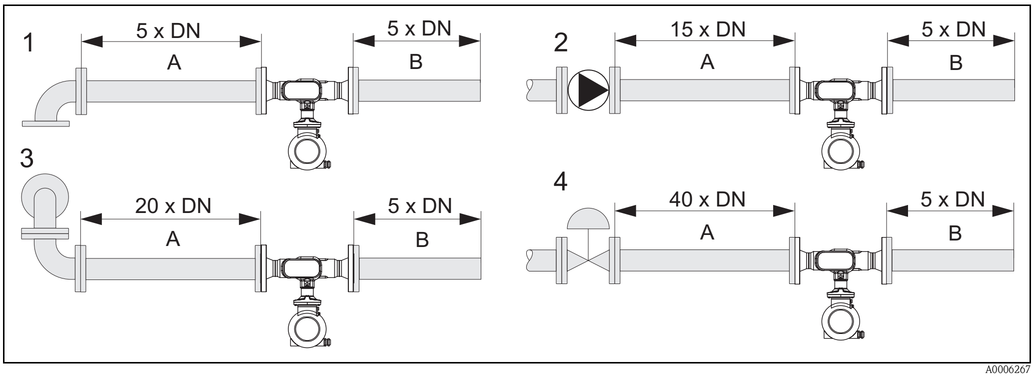
If the device is installed horizontally (with transmitter head pointing upwards), an insulation thickness of min. 10 mm is recommended to reduce convection. The maximum insulation thickness of 20 mm must not be exceeded.

Limiting flow

Information on limiting flow is provided under “Measuring range” in the technical data section.

Inlet and outlet runs

If possible, install the sensor well clear of fittings such as valves, T-pieces, elbows, etc. As a minimum, the inlet and outlet runs shown below must be observed to achieve the specified accuracy of the device. The longest inlet run shown must be observed if two or more flow disturbances are present.



Minimum inlet and outlet runs with various flow obstructions

A = Inlet run, B = Outlet run, 1 = 90° elbow or T-piece, 2 = Pump, 3 = 2 x 90° elbow, out of plane, 4 = Control valve

Length of connecting cable (Remote version)

→ Page 7

Operating conditions: Environment

Ambient temperature range	*Compact version* ■ Standard: –40 to +60 °C ■ EEx-d / EEx-i version: –40 to +60°C ■ ATEX II 1/2 GD version/dust ignition-proof: –20 to +60°C Display can be read between –20 °C to +70 °C *Remote version* ■ Sensor: – Standard: –40 to +80 °C – EEx-d / EEx-i version: –40 to +80°C – ATEX II 1/2 GD version/dust ignition-proof: –20 to +60°C ■ Transmitter: – Standard: –40 to +80 °C – EEx-i version: –40 to +80°C – EEx-d version: –40 to +60°C – ATEX II 1/2 GD version/dust ignition-proof: –20 to +60°C Display can be read between –20 °C to +70 °C ✎ Note! When mounting outside, protect from direct sunlight with a protective cover (order number 543199), especially in warmer climates with high ambient temperatures.
Storage temperature	Standard: –40 to +80 °C EEx-d / EEx-i version: –40 to +80°C ATEX II 1/2 GD version/dust ignition-proof: –20 to +60°C
Degree of protection	■ Transmitter Prosonic Flow 92: IP 67 (NEMA 4X) ■ Sensor Prosonic Flow F Inline: IP 67 (NEMA 4X) Optional: IP 68 (NEMA 6P)
Shock resistance	In accordance with IEC 68-2-31
Vibration resistance	Acceleration up to 1 g, 10 to 150 Hz, following IEC 68-2-6
Electromagnetic compatibility (EMC)	To EN 61326/A1 (IEC 1326) and NAMUR recommendation NE 21

Operating conditions: process

Fluid temperature range

Sensor: –40 to +150 °C

Medium pressure range (nominal pressure)

DIN PN 16 to 40 / ANSI Cl 150, Cl 300 / JIS 10K, 20K

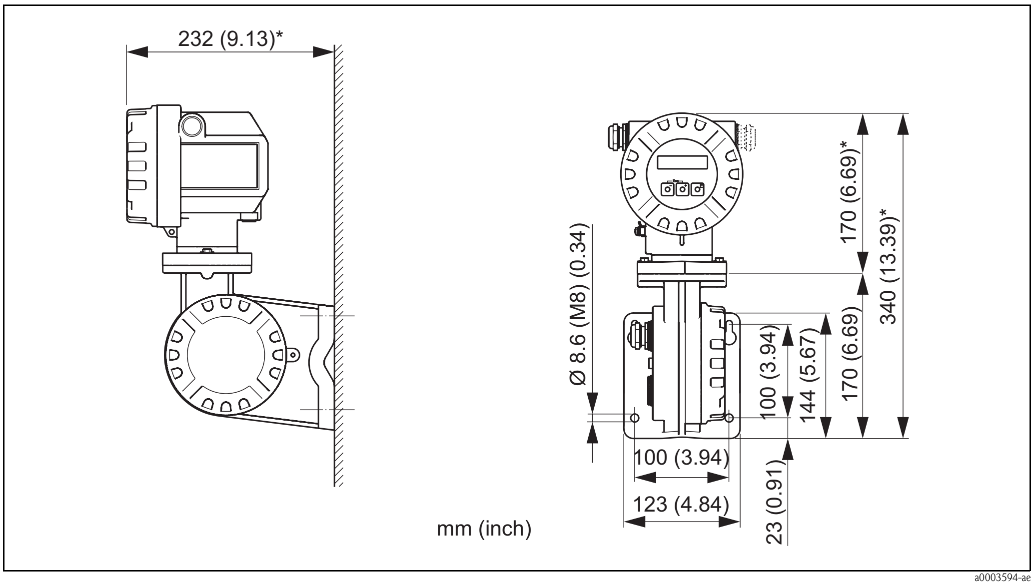
Pressure loss

Pressure loss is negligible if the sensor is installed in a pipe of the same nominal diameter.

Mechanical construction

Design, dimensions, weights

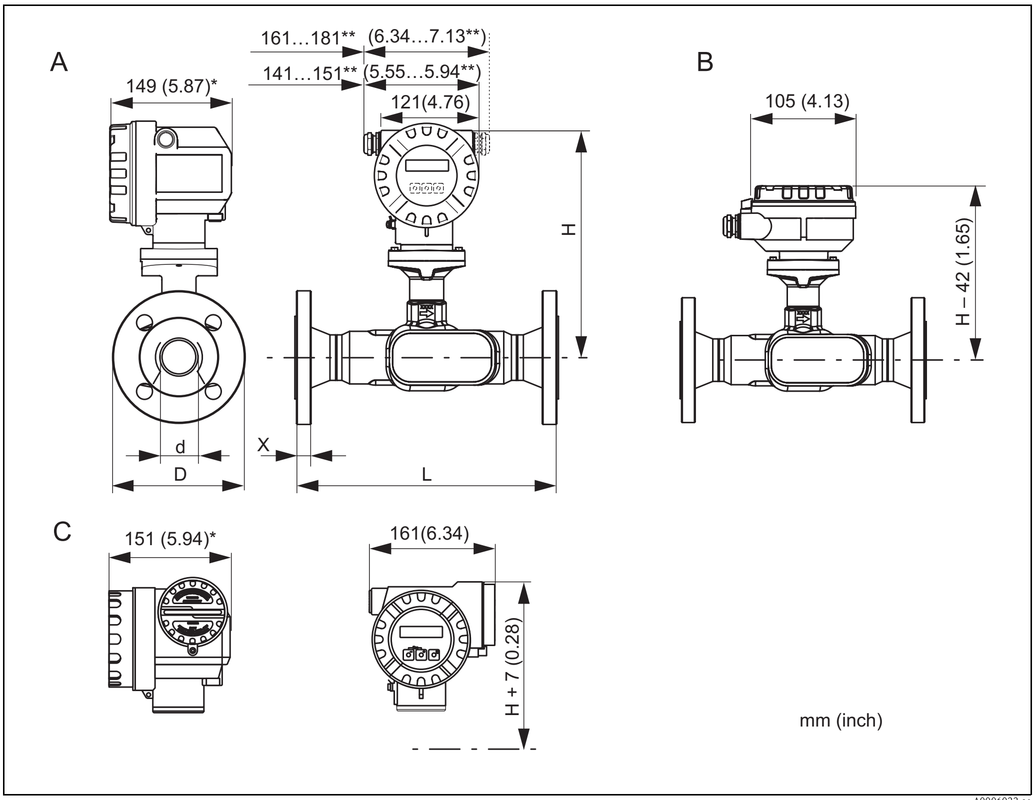
Dimensions of transmitter, remote version



** The following dimensions differ depending on the version:*
– The dimension 232 mm changes to 226 mm in the blind version (without local operation).
– The dimension 170 mm changes to 183 mm in the Ex d version.
– The dimension 340 mm changes to 353 mm in the Ex d version.

Dimensions of Prosonic Flow 92F

Flanged version to:
- EN 1092-1 (DIN 2501), Ra = 6.3 to 12.5 µm
  Raised face to: EN 1092-1 Form B1 (DIN 2526 Form C), PN 10 to 40, Ra = 6.3 to 12.5 µm
- ANSI B16.5, Class 150 to 300, Ra = 125 to 250 µin
- JIS B2238, 10 to 40K, Ra = 125 to 250 µin



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A Standard- and Ex -i version
B Remote version
C Ex d version (Sensor)

** The following dimensions change as follows in the blind version (without local operation):*
– Standard, and Ex i version: the dimension 149 mm changes to 142 mm in the blind version.
– Ex d version: the dimension 151 mm changes to 144 mm in the blind version.

*** The dimension depends on the cable gland used..*

Note!
The weight data refer to the compact version.
The weight of the remote version is approx. 0.9 kg greater.

Prosonic Flow 92F metric units: According to EN 1092-1 (DIN 2501)							
DN	Pressure rating	d [mm]	D [mm]	H [mm]	L [mm]	X [mm]	Weight [kg]
25	PN 40	28.5	115.0	284.5	300	18	10
40	PN 40	43.1	150.0	287.0	315	18	12
50	PN 40	54.5	165.0	291.5	325	20	14
80	PN 40	82.5	200.0	310.5	390	24	24
100	PN 16	107.1	220.0	323.5	460	20	32
	PN 40	107.1	235.0			24	35
150	PN 16	159.3	285.0	426.5	650	22	93
	PN 40	159.3	300.0			28	100

Prosonic Flow 92F metric units: According to JIS B2238								
DN	Pressure rating		d [mm]	D [mm]	H [mm]	L [mm]	X [mm]	Weight [kg]
25	Schedule 40	20K	27.2	125.0	284.5	300	16	10
	Schedule 80	20K	24.3	125.0			16	
40	Schedule 40	20K	41.2	140.0	287.0	315	18	12
	Schedule 80	20K	38.1	140.0			18	
50	Schedule 40	10K	52.7	155.0	291.5	325	16	13
		20K	52.7	155.0			18	
	Schedule 80	10K	49.2	155.0			16	
		20K	49.2	155.0			18	
80	Schedule 40	10K	78.1	185.0	310.5	390	18	24
		20K	78.1	200.0			22	28
	Schedule 80	10K	73.7	185.0			18	25
		20K	73.7	200.0			22	28
100	Schedule 40	10K	102.3	210.0	323.5	460	18	36
		20K	102.3	225.0			24	44
	Schedule 80	10K	97.0	210.0			18	36
		20K	97.0	225.0			24	44
150	Schedule 40	10K	151.0	280.0	426.5	650	22	95
		20K	151.0	305.0			28	111
	Schedule 80	10K	146.3	280.0			22	98
		20K	146.3	305.0			28	115

Prosonic Flow 92F US units: According to ANSI B16.5								
Size	Pressure rating		d [inch]	D [inch]	H [inch]	L [inch]	X [inch]	Weight [lbs]
1"	Schedule 40	Cl. 150	1.05	4.25	11.20	11.81	0.62	20
		Cl. 300	1.05	4.88			0.75	22
	Schedule 80	Cl. 150	0.96	4.25			0.62	20
		Cl. 300	0.96	4.88			0.75	22
1½"	Schedule 40	Cl. 150	1.61	5.00	11.30	12.40	0.69	24
		Cl. 300	1.61	6.12			0.81	29
	Schedule 80	Cl. 150	1.50	5.00			0.69	24
		Cl. 300	1.50	6.12			0.81	29
2"	Schedule 40	Cl. 150	2.07	6.00	11.48	12.80	0.75	29
		Cl. 300	2.07	6.50			0.88	31
	Schedule 80	Cl. 150	1.94	6.00			0.75	29
		Cl. 300	1.94	6.50			0.88	33
3"	Schedule 40	Cl. 150	3.07	7.50	12.22	15.35	0.94	53
		Cl. 300	3.07	8.25			1.12	62
	Schedule 80	Cl. 150	2.90	7.50			0.94	55
		Cl. 300	2.90	8.25			1.12	62
4"	Schedule 40	Cl. 150	4.03	9.00	12.97	18.11	0.96	79
		Cl. 300	4.03	10.00			1.25	97
	Schedule 80	Cl. 150	3.82	9.00			0.96	79
		Cl. 300	3.82	10.00			1.25	97
6"	Schedule 40	Cl. 150	6.07	11.00	16.79	25.59	1.00	209
		Cl. 300	6.07	12.50			1.44	245
	Schedule 80	Cl. 150	5.76	11.00			1.00	216
		Cl. 300	5.76	12.50			1.44	254

Weight

See dimension table Page 12 ff.

Material

Transmitter housing and connection housing, sensor (remote version):

Compact housing: powder coated die cast aluminium

Sensor

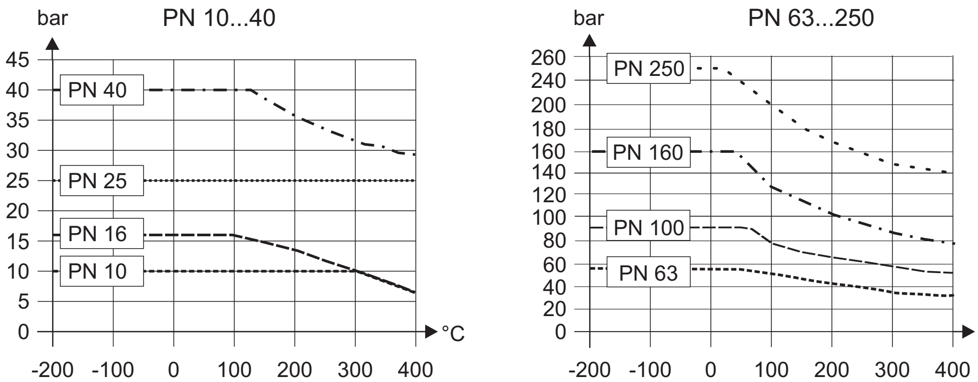
Stainless steel, ASTM A351-CF3M, in conformity with NACE MR0175 and MR0103

Flanges

- EN (DIN) welded on flanges made of 1.4404 (AISI 316L)
- ANSI and JIS welded on flanges made of F316/F316L, in conformity with NACE MR0175 and MR0103

Material load diagram

Pressure-temperature curve to EN (DIN), stainless steel



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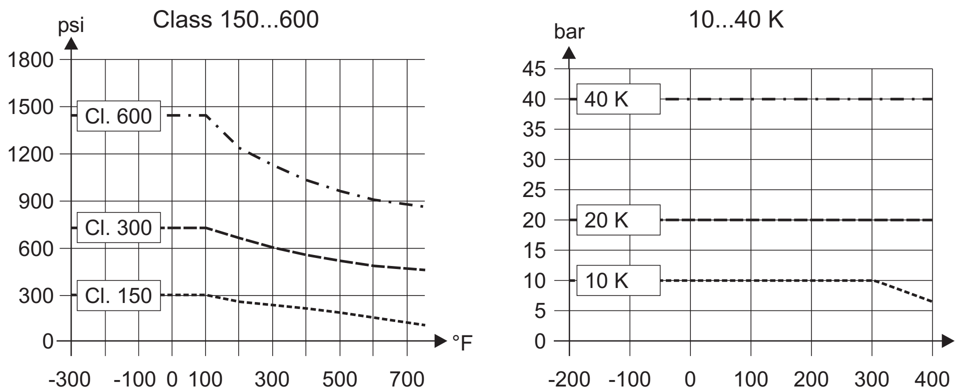
Pressure-temperature curve to ANSI B16.5 and JIS B2238, stainless steel



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Human interface

Display elements

- Liquid crystal display: double spaced with 16 characters per line
- Selectable display of different measured values and status variables
- At ambient temperatures below –20 °C the readability of the display may be impaired.

Operating elements (HART)

- Local operation with three keys (–, +, E)
- Application specific Quick Setup menus for straightforward commissioning
- Operating elements accessible also in Ex-zones

Remote operation

Remote operation possible via:

- HART
- PROFIBUS PA
- FieldCare
- ToF Tool - Fieldtool Package (Endress+Hauser software package for complete configuration, commissioning and diagnosis)

Certificates and approvals

CE mark	The device is in conformity with the statutory requirements of the EC Directives. Endress+Hauser confirms successful testing of the device by affixing the CE mark.
C-tick	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) can be supplied by your Endress+Hauser sales organization. All explosion protection data are given in a separate documentation which is available upon request.
Certification PROFIBUS PA	The flowmeter has successfully passed all test procedures and is certified and registered by the PNO (PROFIBUS User Organization). The device thus meets all the requirements of the specifications following: ▪ Certified to PROFIBUS PA Profile Version 3.0 (device certification number: on request) ▪ The device can also be operated with certified devices of other manufacturers (interoperability)
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 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 Standardization 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. ▪ ANSI/ISA-S.61010-1(82.02.01) CSA-C22.2 No. 1010.1 ANSI/UL 61010-1 Safety requirements for Electrical Equipment for Measurement and Control and Laboratory Use. Pollution degree 2 ▪ NACE Standard MR0103 Standard Material Requirements - Materials Resistant to Sulfide Stress Cracking in Corrosive Petroleum Refining Environments ▪ NACE Standard MR0175 Standard Material Requirements - Sulfide Stress Cracking Resistant Metallic Materials for Oilfield Equipment
Pressure Equipment Directive	flowmeters 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 organization 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.

Documentation

- Flow measuring technology (FA005D/06)
- Supplementary documentation on Ex-ratings: ATEX, FM, CSA
- Operating Instructions Prosonic Flow 92 (BA121D/06)
- Operating Instructions Prosonic Flow 92 PROFIBUS PA (BA122D/06)

Registered trademarks

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Registered trademark of HART Communication Foundation, Austin, USA

PROFIBUS®
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