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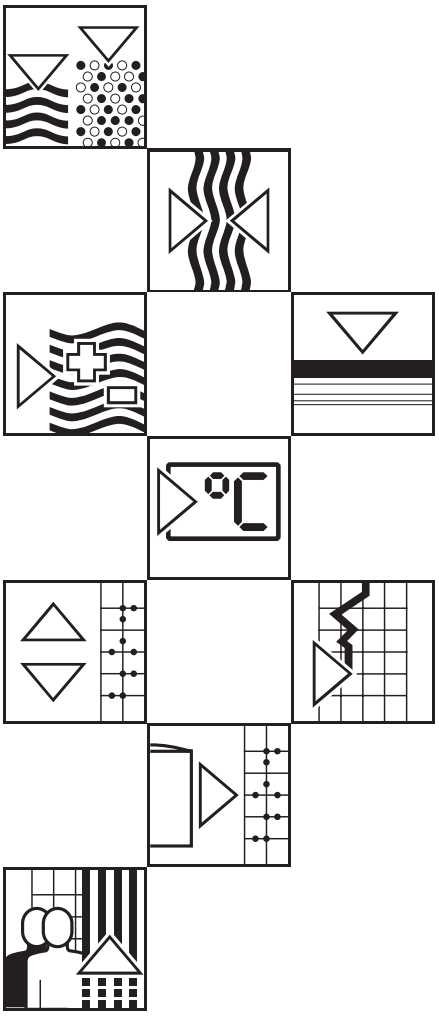
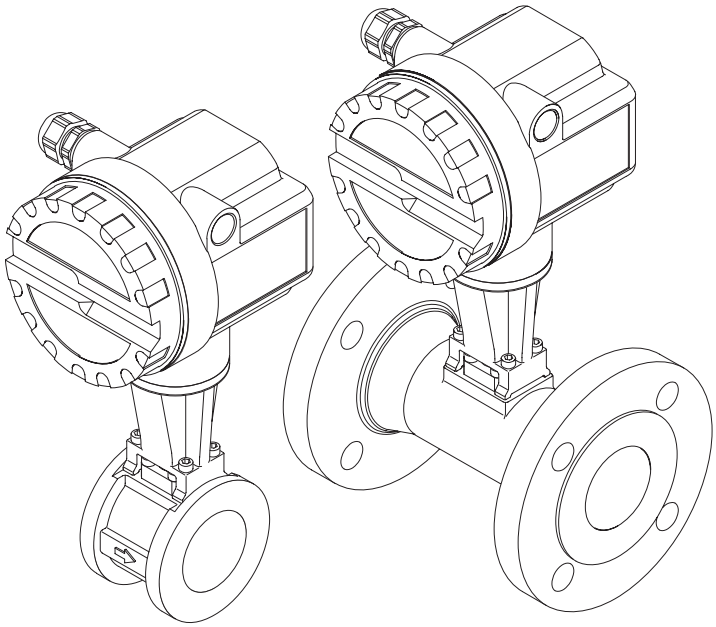
No. 50085726
CV 5.0

prowirl 77
Vortex Flow Measuring System (Version: PFM)

Operating Manual



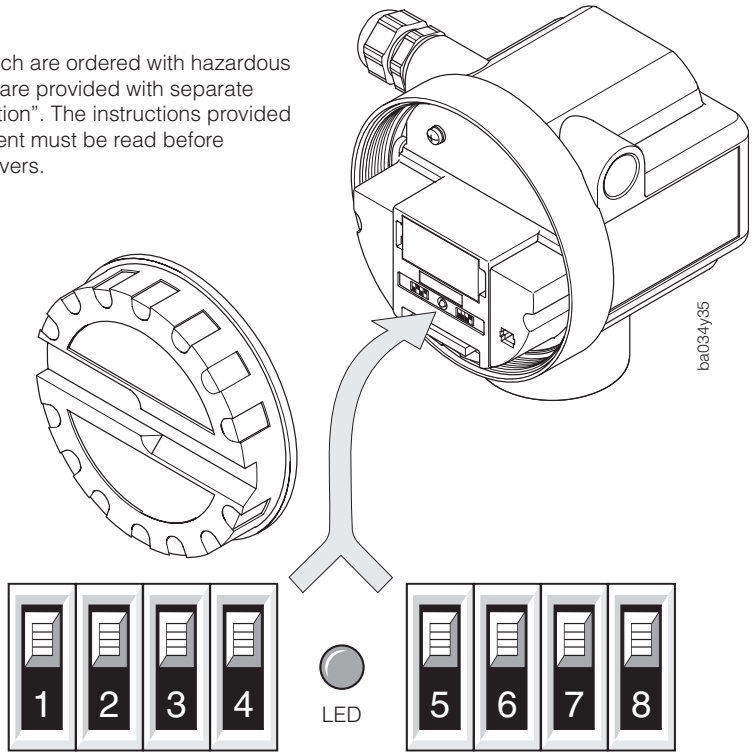


Endress+Hauser
The Power of Know How

Switch settings for PFM version (for copying)

Warning!

Warning!
Instruments which are ordered with hazardous area approvals are provided with separate "Ex documentation". The instructions provided in this supplement must be read before opening any covers.



Switch positions:

OFF = 0

ON = 1

The dip switches shown above are to be set according to the application (gas/liquid) and the nominal diameter of the instrument.

Switch settings for liquid measurement

	DIP switch number								
Nominal diameter	**1**	**2**	**3**	**4**		**5**	**6**	**7**	**8**
DN 15	1	0	0	1		0	1	0	0
DN 25, DN 40	1	0	1	0		1	1	1	0
DN 50	1	0	1	1		1	1	1	0
DN 80	0	0	1	0		1	1	1	0
DN 100	0	0	1	0		1	1	1	0
DN 150...300	0	0	1	1		1	1	1	0

Switch settings for steam and gas measurement

	DIP switch number								
Nominal diameter	**1**	**2**	**3**	**4**		**5**	**6**	**7**	**8**
DN 15, DN 25	1	0	0	0		0	0	0	0
DN 40	0	0	0	0		0	0	0	0
DN 50	0	0	0	0		0	0	1	0
DN 80	0	1	1	1		0	0	1	0
DN 100, DN 150	1	0	0	1		0	1	0	0
DN 200...300	1	1	1	0		0	1	1	0

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1 Safety Instructions

1.1 Correct usage

- Prowirl 77 is only to be used for measuring the volumetric flow rate of saturated steam, superheated steam, gases and liquids.
- The manufacturer assumes no liability for damage caused by incorrect use of the instrument.
- Instruments which are ordered with hazardous area approvals are supplied with separate “Ex documentation”, which is an integral part of this Operating Manual. The instructions and connected loads provided in this supplement must be closely observed! An appropriate pictogram is shown on the front page of the Ex documentation according to the approval given and the test centre.

1.2 Dangers and notes

All instruments are designed to meet state-of-the-art safety requirements, have been tested, and have left the works in an operationally perfectly safe condition.
The devices were developed according to EN 61010 “Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures”. A hazardous situation may occur if the flowmeter is not used for the purpose it was designed for or is used incorrectly. Please carefully note the information provided in this Operating Manual indicated by the pictograms:

Warning!
A “warning” indicates actions or procedures which, if not performed correctly, may lead to personal injury or a safety hazard.
Please strictly observe the instructions supplied and proceed carefully.

Warning!

Caution!
A “caution” indicates actions or procedures which, if not performed correctly, may lead to faulty operation or destruction of the instrument. Please strictly observe the respective instructions.

Caution!

Note!
A “note” indicates actions or procedures which, if not performed correctly, may indirectly affect operation or lead to an unexpected instrument response.

Note!

1.3 Operational safety

- The Prowirl 77 measuring system fulfills the general safety regulations according to EN 61010 and the interference immunity regulations (EMC) according to European standard EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2 as well as NAMUR recommendations.
- Housing ingress protection IP 67 according to EN 60529.

1.4 Personnel for installation, start-up and operation

- Mounting, electrical installation, start-up and maintenance of the instrument may only be carried out by trained personnel authorised by the operator of the facility. Personnel must absolutely and without fail read and understand this Operating Manual before carrying out its instructions.
- The instrument may only be operated by personnel who are authorised and trained by the operator of the facility. All instructions in this manual are to be observed.
- In case of corrosive fluids, the compatibility of the material of all wetted parts such as meter body, bluff body, sensor and gaskets is to be verified. This also applies to fluids used to clean the Prowirl 77 flowmeter. Endress+Hauser will be pleased to provide any help required.
- The installer has to make sure that the measuring system is correctly wired up according to the wiring diagrams. The measuring system is to be grounded.

There is no longer any contact protection once the housing cover is removed.

Please observe all provisions valid for your country pertaining to opening, repair and installation of electrical devices.

1.5 Repairs, dangerous chemicals

The following procedures must be carried out before a Prowirl 77 is sent to Endress+Hauser for repair:

- A note must be enclosed with the instrument, containing a description of the fault, the application and the chemical and physical properties of the fluid being measured.
- Remove all residue which may be present. Pay special attention to the gasket grooves and crevices where fluid may be present. This is especially important if the fluid is dangerous to health, e.g. corrosive, poisonous, carcinogenic, radioactive, etc.
- No instrument should be returned to us without all dangerous material being removed first.

Incomplete cleaning of the instrument may result in waste disposal requirements or cause harm to personnel (burns, etc.). Any costs arising from this will be charged to the operator of the instrument.

1.6 Technical improvements

The manufacturer reserves the right to modify technical data without prior notice. Your local E+H Sales Office will supply you with all current information and any updates to this Operating Manual.

2 System Description

The Prowirl 77 vortex flowmeter measures the volumetric flow of steam, gases and liquids for fluid temperatures in the range of –200...+400 °C and at nominal pressures up to PN 160 / ANSI class 600. Prowirl 77 measures the volumetric flow at operating conditions.

2.1 Prowirl 77 measuring system (PFM version)

A measuring system consists of:
- Prowirl 77 transmitter in the version “PFM”
- Prowirl 77 W, Prowirl 77 F or Prowirl 77 H body

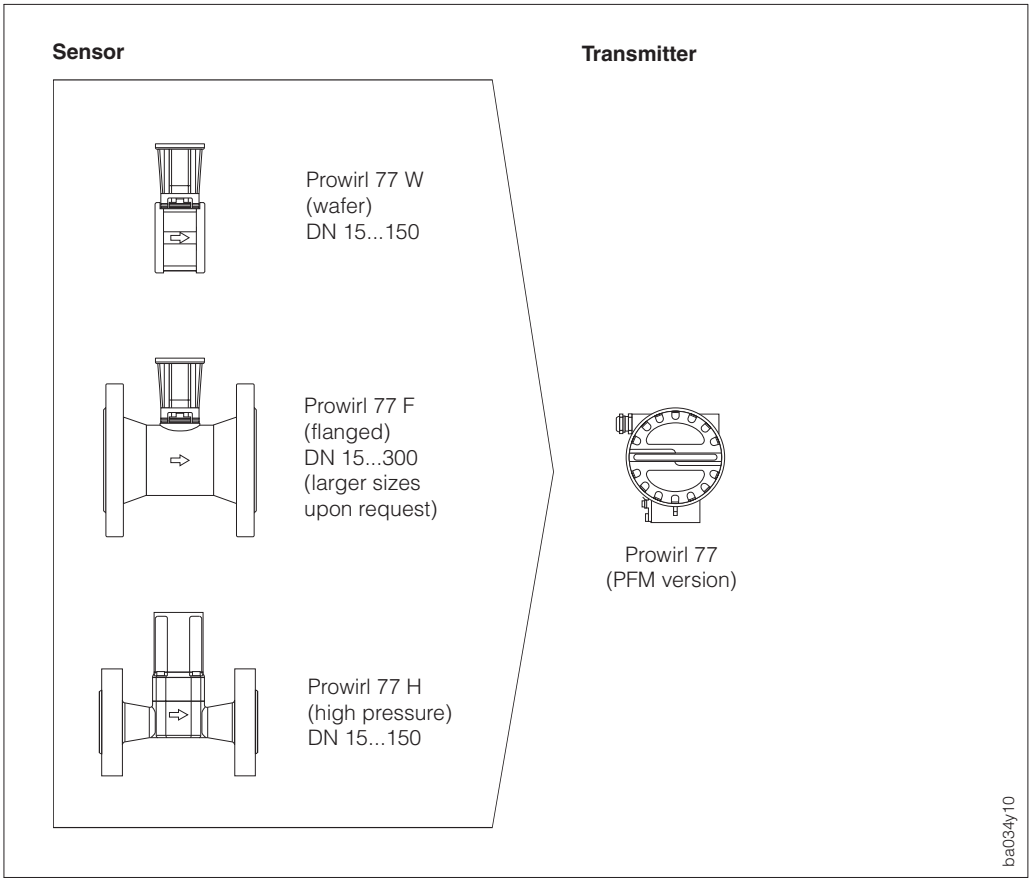


Fig. 1
Prowirl 77 measuring system

The Prowirl 77 transmitter is available in two other versions:
- Version: “4...20 mA/HART”
- Version: “PROFIBUS-PA”

Operation of those versions is not included in this Operating Manual.
Separate Operating Manuals for those instruments are available on request.

The various Prowirl 77 transmitters can be freely combined with all meter body versions. This guarantees flexibility when matching a complete meter to specific industrial process conditions.

3 Mounting and Installation

3.1 General information

Protection IP 67 (EN 60529)
The instruments fulfil all the requirements for IP 67. The following points must always be observed in order to ensure IP 67 protection after installation in the field or after servicing:

- Housing gaskets must be clean and undamaged when inserted in the gasket groove. The gaskets may need to be dried, cleaned or replaced.
- All housing screws and the housing cover must be firmly tightened.
- The cables used for connecting must have an outer diameter in the specified range.
- The cable gland must be firmly tightened (see Fig. 2).
- The cable must loop down before entering the cable gland to ensure that no moisture can enter (see Fig. 2).
- Any unused cable glands are to be replaced with a plug.
- The protective bushing should not be removed from the cable gland.

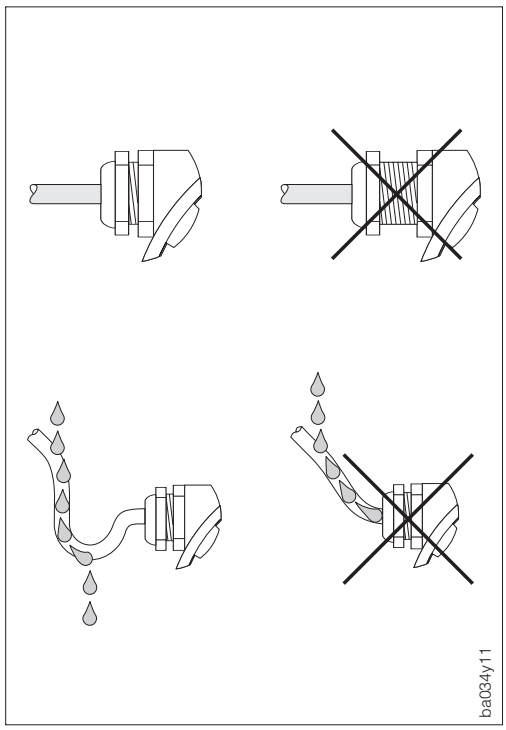


Fig. 2
Protection IP 67

Temperature ranges
- The maximum approved ambient and process temperatures must be observed (see page 28).
- Observe also the instructions on piping insulation and mounting position (see page 11).

3.2 Installation

A vortex flowmeter requires a fully developed flow profile as a prerequisite for measuring volume accurately. The following points must therefore be noted when mounting the Prowirl 77 in the pipeline.

Pipe inner diameter
When ordering, ensure that the nominal diameter and pipe schedule (DIN/ANSI/JIS) are correct, since calibration of the flowmeter and therefore the achieveable accuracy of the measuring point are dependent on these specifications.

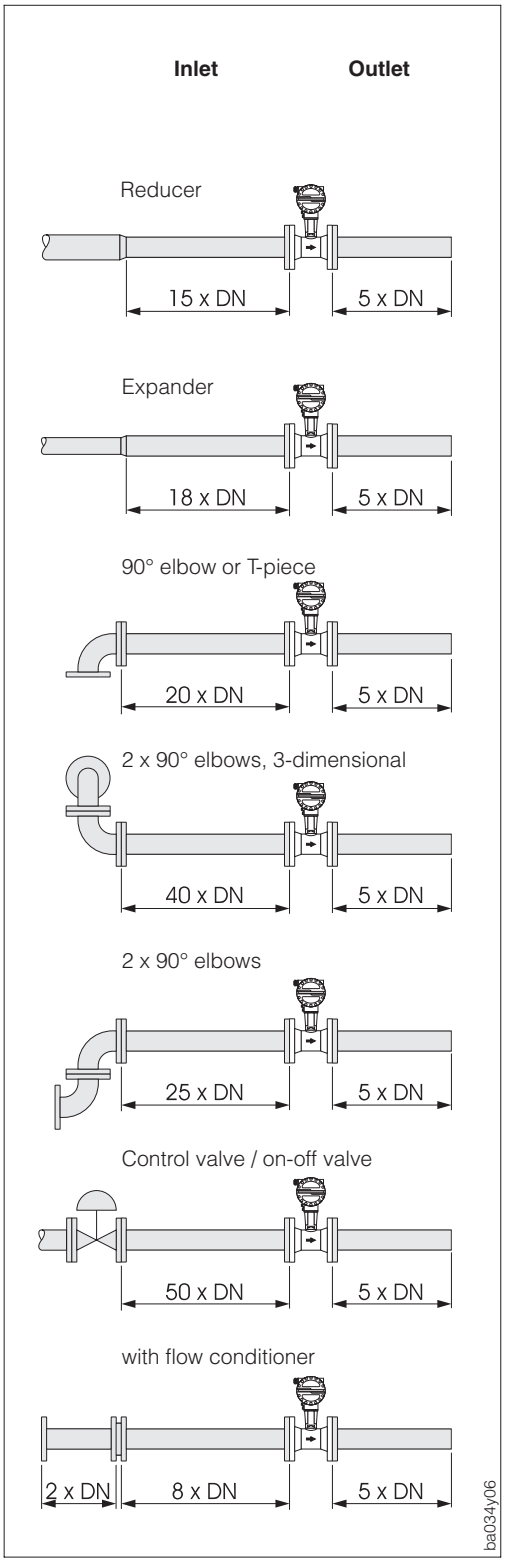


Fig. 3
Inlet and outlet piping requirements

Inlet and outlet sections
To ensure an undisturbed flow profile, the vortex flowmeter should be mounted upstream of any flow disturbances such as pipe elbows, reducers or valves, otherwise the longest possible section of piping should be between the disturbance and the flowmeter.

The figures on the left show the *minimum section of straight piping* downstream of the disturbance as multiples of the nominal diameter of the pipe in DN. If two or more flow disturbances are located upstream, then the longest inlet section recommended should be used.

There must also be a straight outlet section of sufficient length downstream from the flowmeter to ensure that the vortices are properly developed.

Flow conditioner
With limited space and large pipes, it is not always possible to use the inlet sections given above. In such cases the specially developed perforated plate flow conditioner (see pages 25 and 26) can be fitted as shown on the left.

The flow conditioner is held between two piping flanges and centred with the flange bolts. It reduces the length of the inlet section downstream from flow disturbances to 10 x DN while maintaining full measurement accuracy.

Installation site
The Prowirl 77 can be mounted in any position in the piping. An arrow on the meter body shows the direction of flow.

For measuring liquids in vertical pipes, the meter should be installed in upwards directed flow (Fig. A) to ensure a full pipe.

For horizontal pipelines, positions B, C and D are possible. With hot piping (e.g. steam), position C or D must be selected in order to respect the maximum permissible ambient temperature at the electronics.

For ambient temperature → see page 28

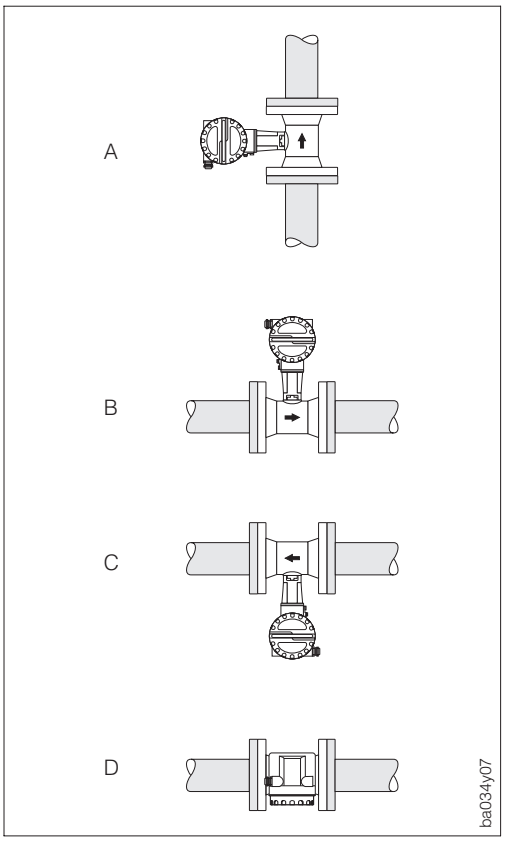


Fig. 4
Orientation

Pressure and temperature measurement points
Pressure and temperature measurement points are to be mounted *downstream* of the Prowirl 77 in order to affect vortex formation as little as possible.

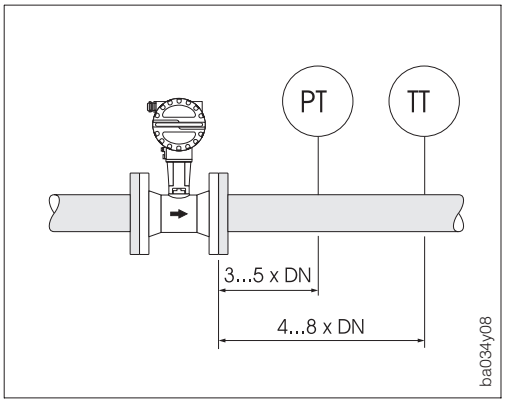


Fig. 5
Mounting pressure and temperature sensors

Pipeline insulation wafer/flanged version
Pipeline insulation is often used to prevent energy loss in hot processes.

Caution!
When insulating, ensure that sufficient pipe stand surface area is exposed. The exposed area serves as a radiator and protects the electronics from overheating.

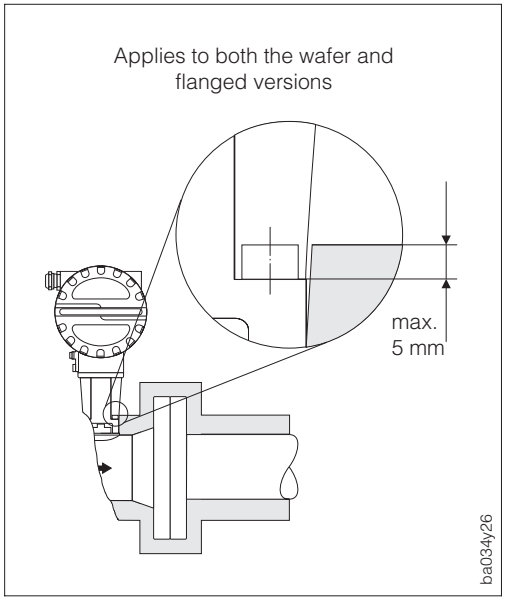


Fig. 6
Pipeline insulation wafer/flanged version

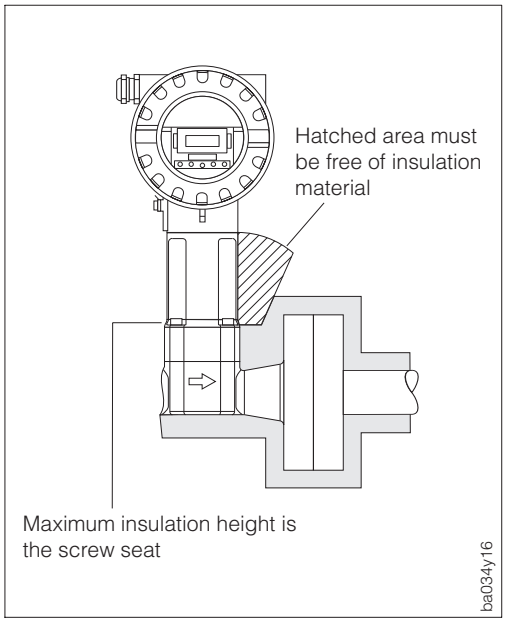


Fig. 7
Piping insulation high pressure version

Piping insulation high pressure version

The pipe stand must be free from insulation in order to guarantee temperature radiation and therefore to keep the electronics from overheating.

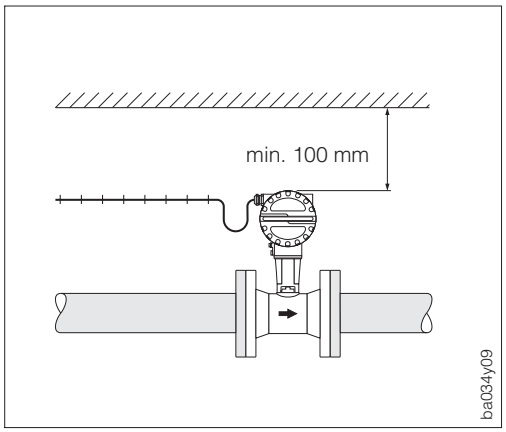


Fig. 8
Minimum spacing for mounting and removing the transmitter housing

Minimum spacing

When servicing or connecting the E+H "Flowjack" simulator, it is necessary to remove the transmitter housing from the housing support.
When installing in the piping, observe the following cable lengths and minimum space:

- Minimum space:
  100 mm in all directions
- Cable length required:
  L + 150 mm

Caution!
Removing the transmitter from the pipe stand is to be carried out by E+H service personnel only!

3.3 Mounting the flowmeter

Caution!

Note the following points before installing the flowmeter:

- Remove all packaging used for transport and protective coverings from the flowmeter before installing the flowmeter in the pipeline.
- Ensure that the inner diameters of the gaskets are identical or larger than those of the meter body and process piping. Gaskets which protrude into the flow affect vortex formation behind the bluff body and lead to inaccurate measurement. Therefore, the gaskets delivered by E+H come with a slightly bigger inner diameter than the measuring pipe.
- Ensure that the direction of the arrow on the meter body agrees with the direction of flow in the pipeline.
- Face-to-face lengths:
  - Prowirl W (wafer version), 65 mm
  - Prowirl F (flanged version) → see page 22
  - Prowirl H (high pressure version) → see page 24

Mounting Prowirl W

Mounting the wafer is carried out using a mounting set consisting of:

- bolts
- centering rings
- nuts
- washers
- gaskets

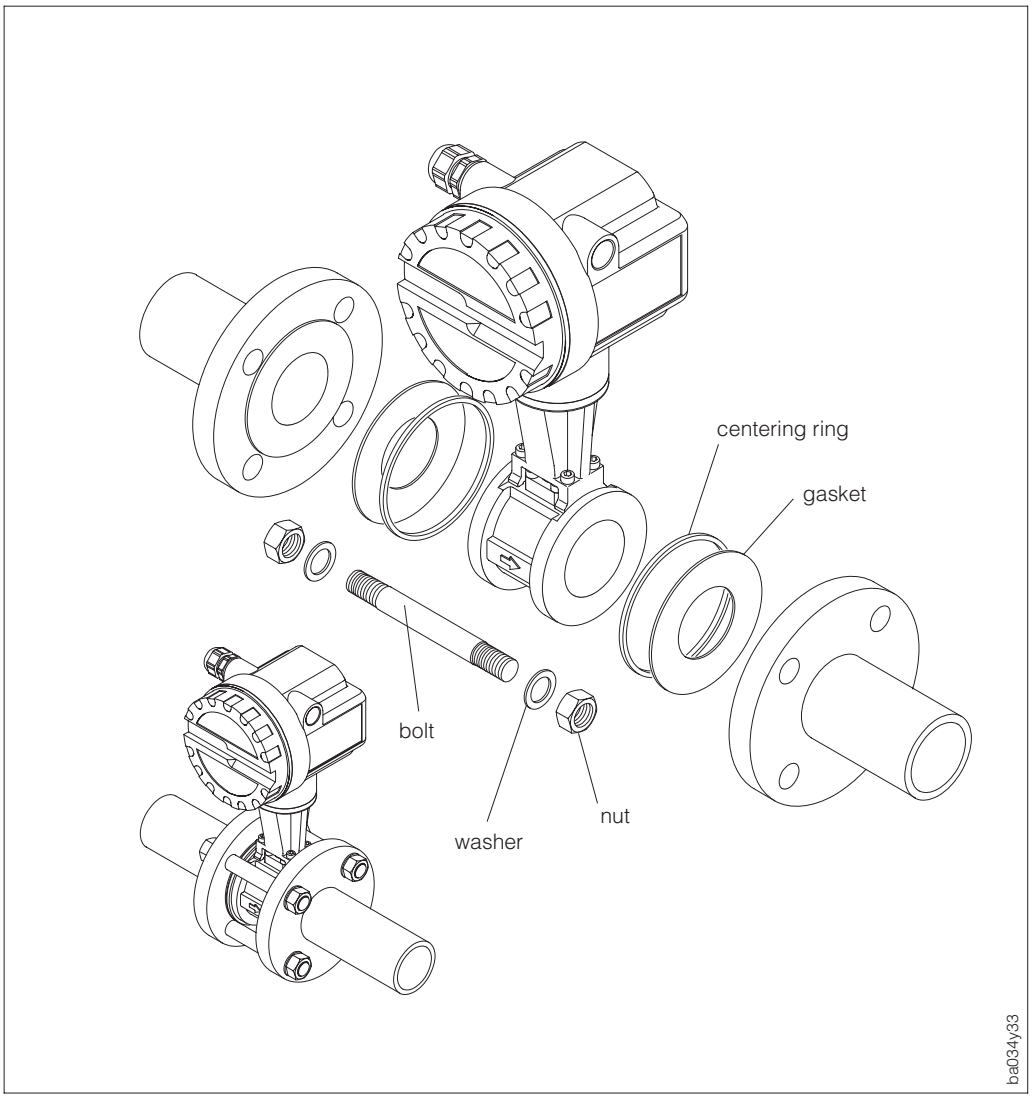


Fig. 9
Mounting the Prowirl W wafer version

3.4 Electronics housing rotation

The electronics housing of Prowirl 77 can be rotated in 90° steps on the pipe stand to put the wiring compartment and the cable gland in the best position.

This is carried out as follows:
① Remove the securing screw at the pipe stand (minimum one turn).
② Pull out the electronics housing to the mechanical stop and then rotate it to the position required (in 90° steps). Push the housing back into the housing support.
③ Fasten the securing screw.

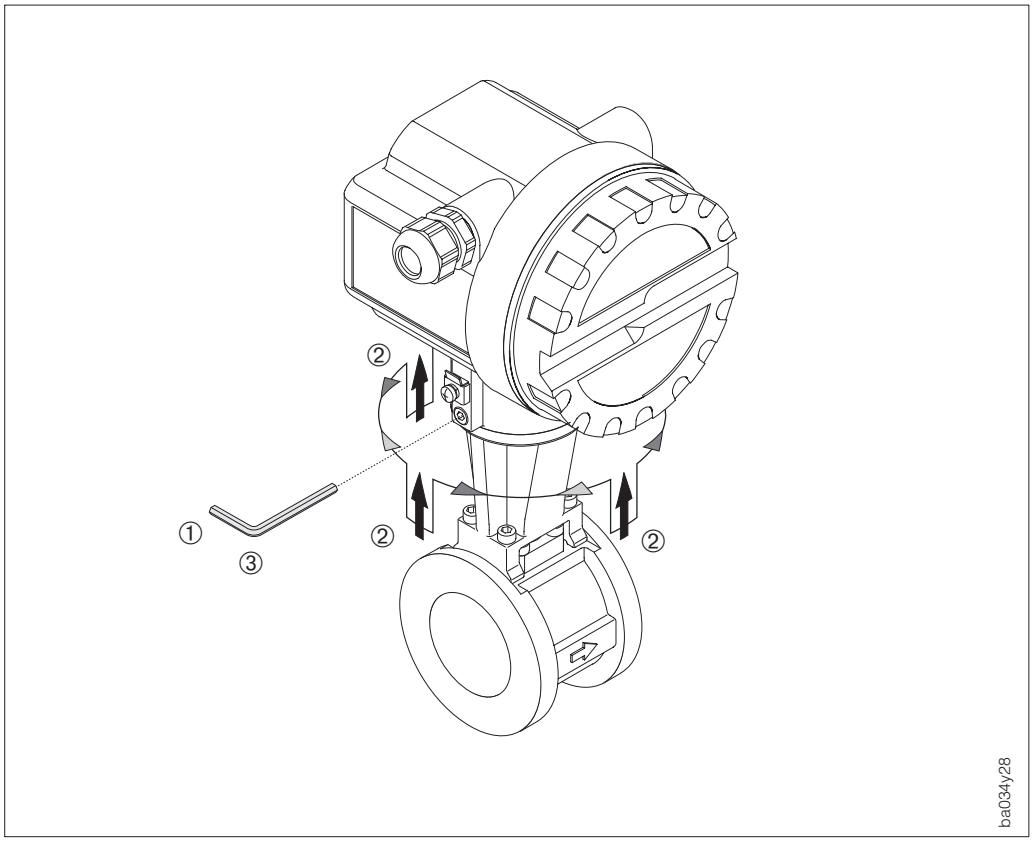


Fig. 10
Rotating the electronics housing

4 Electrical Connection

4.1 Connecting the transmitter

Caution!
- All relevant national installation regulations must be observed.
- When installing an Ex version transmitter, please read the separate Ex documentation supplied.
- The power supply is max. 30 V DC, for the Ex d/XP version max. 36 V DC.

Procedure:
1. Unscrew the front cover.
2. Loosen the Phillips screws on the upper cover plate and let it swing down.
3. Feed the power and signal cables through the cable gland.
4. Wire up according to the wiring diagrams shown on this page.
   The wiring pcb slides out forward for easier access to the terminals.
5. Replace the cover plate and secure.
6. Screw the front cover securely again to the transmitter housing.

4.2 Wiring diagram

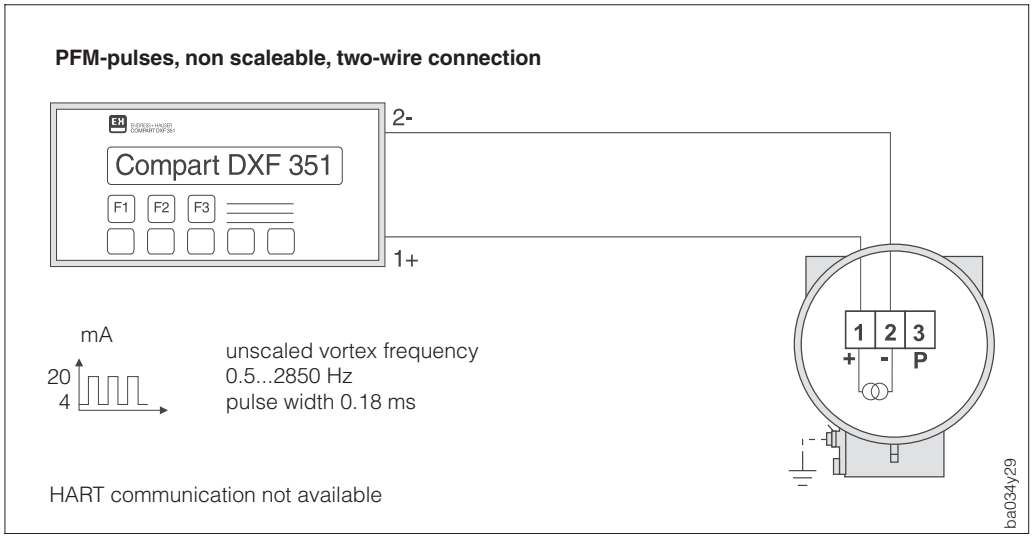


Fig. 11
Wiring diagram Prowirl 77 "PFM"

5 Switch Settings

Factory setting
The DIP switch setting is configured for the correct nominal diameter. The application ("gas" or "liquid") is programmed according to the order; if no specification is made, the device is configured for liquids.

Warning!
Instruments which are ordered with hazardous area approvals are provided with separate "Ex documentation". The instructions provided in this supplement must be read before opening any covers.

① Remove the housing cover.
② Set the DIP switches according to the application (gas/liquid) and the nominal diameter of the instrument.
③ Replace and secure the housing cover.

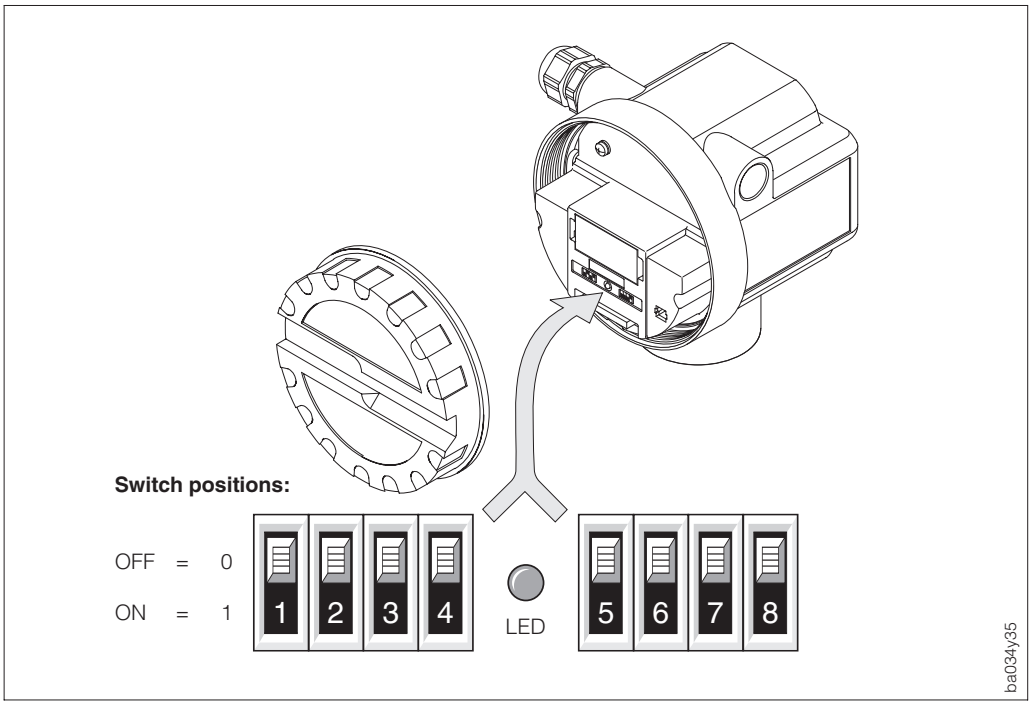


Fig. 12
Position of the DIP switches

Switch settings for liquid measurement

	DIP switch number							
Nominal diameter	1	2	3	4	5	6	7	8
DN 15	1	0	0	1	0	1	0	0
DN 25, DN 40	1	0	1	0	1	1	1	0
DN 50	1	0	1	1	1	1	1	0
DN 80	0	0	1	0	1	1	1	0
DN 100	0	0	1	0	1	1	1	0
DN 150...300	0	0	1	1	1	1	1	0

Switch settings for steam and gas measurement

	DIP switch number							
Nominal diameter	1	2	3	4	5	6	7	8
DN 15, DN 25	1	0	0	0	0	0	0	0
DN 40	0	0	0	0	0	0	0	0
DN 50	0	0	0	0	0	0	1	0
DN 80	0	1	1	1	0	0	1	0
DN 100, DN 150	1	0	0	1	0	1	0	0
DN 200...300	1	1	1	0	0	1	1	0

6 Trouble-shooting

The Prowirl 77 measuring system operates without the need for maintenance. However, if a fault should occur or incorrect measurements are suspected, then the following instructions will be of help in identifying the cause of and remedying any possible errors.

Warning!
- All local regulations and all safety instructions in this Operating Manual are to be strictly observed when making electrical connections.
- All data and regulations on Ex instruments in the separate Ex documentation are to be strictly observed.

The Prowirl 77 measuring system is fitted with an LED to indicate its operating status. The LED can only be seen once the aluminium cover to the electronics compartment has been removed.

LED does not light up
- Has the wiring been done according to the wiring diagram on page 15?
- Is the polarity of the power supply correct?
- Is there a voltage between 12 V and 30 V (for the Ex d/XP version between 15 V and 36 V) at Terminals 1 and 2 ? Check the load on the cabling.

No flow signal
- For liquids: Is the pipeline completely filled? The pipeline must always be completely filled to ensure accurate and reliable flow measurement.
- Have all packing material and protective disks been removed from the meter body?

Poor or strongly varying flow signal
- Is the fluid to be measured single-phase and homogeneous?
  The fluid must be single-phase and homogeneous, and the pipeline always completely filled to ensure accurate and reliable flow measurement. In many cases the measuring result may be improved under poor conditions by taking the following measures:

  – For liquids with low gas content in horizontal pipelines, the flowmeter should be mounted with the head pointing downward or to one side. This improves the measuring signal as the sensor is positioned away from any gas bubbles.
  – For liquids with low solids content, the electronic housing should not be mounted pointing downward.
  – For steam or gas with low liquid content, the electronic housing should not be mounted pointing downward.

- Do the inlet and outlet sections correspond to the mounting instructions on page 10?
- Are gaskets of the correct internal diameter (inner diameter not smaller than the pipeline) and correctly centred?
- Is the static pressure sufficiently large to prevent cavitation at the flowmeter?
- Is the flow within the measuring range of the flowmeter (see “Technical Data” page 27)?
  The start of the measuring range depends on the density and viscosity of the fluid which in turn are functions of temperature. With gases and steam, density is also a function of pressure.

- Are pressure pulsations superimposed on the operating pressure (e.g. due to piston pumps)? These pulsations may affect vortex shedding if they have a similar frequency to that of the vortex shedding itself.
- Have the DIP-switches (see page 17) been set correctly according to the nominal diameter and the application (gas / liquid)?
  The settings determine the filter settings and can thus affect the measuring range.

Flow signal under no-flow conditions

Is the flowmeter subject to vibration greater than 1g?
In such cases flow may be indicated under no-flow conditions depending on frequency and direction of the vibrations.

Remedial procedure on flowmeter:
– Turn the meter 90° in the pipe. The measuring system is most responsive to vibration in the direction of sensor displacement. Excessive vibration has less effect on the measuring system in other axes.

Remedial procedure with mechanical layout of the installation:
– If the source of the vibration (e.g. pump or valve) can be identified, then decoupling or supporting the source can reduce vibration.
– Supporting the pipeline near the flowmeter.

Maintenance / Calibration

If correctly installed, the meter will operate without maintenance. If installed as a production quality-relevant (ISO 9000) measurement point, the Prowirl 77 can be recalibrated by Endress+Hauser on accredited calibration rigs, traceable according to EN 45001, and supplied with an internationally recognized certificate according to EA (European cooperation for Accreditation of Laboratories).

7 Dimensions and Weights

Note!
The Ex d/XP version has a different housing with seperate wiring department cover and slightly differing dimensions and weights. Please refer to the separate Ex documentation.

Note!

7.1 Dimensions Prowirl 77 W

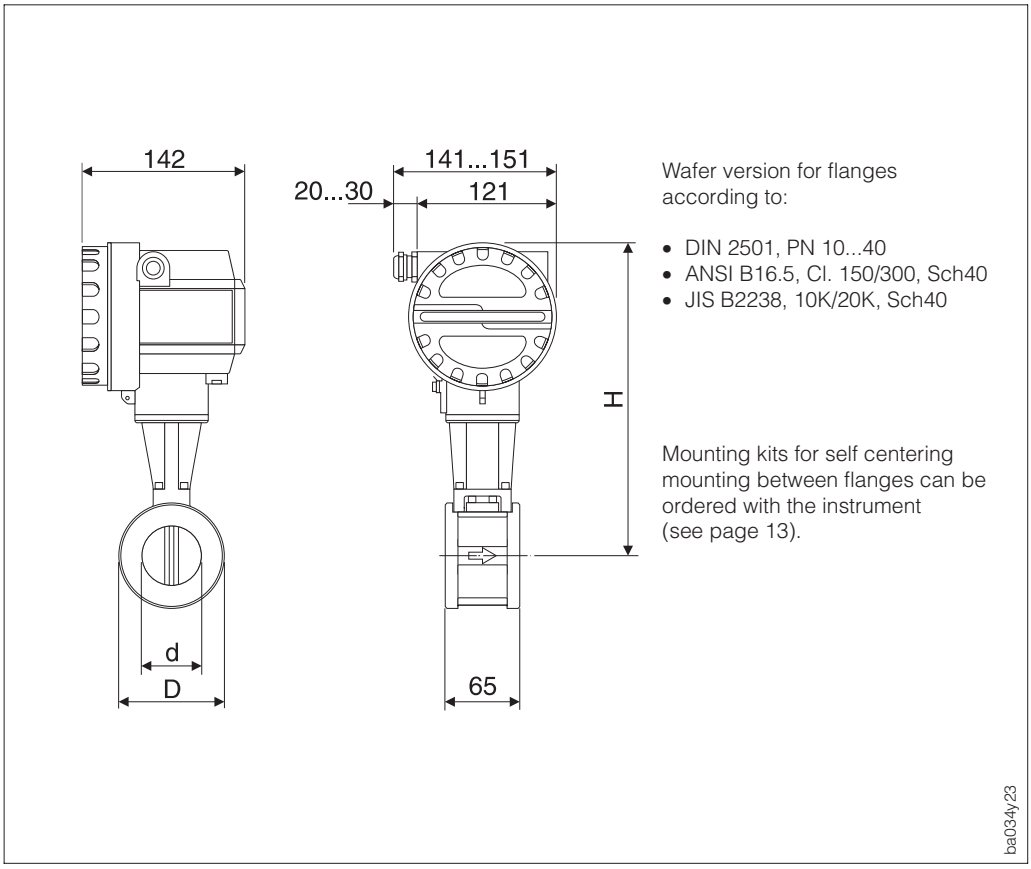


Fig. 13
Dimensions of Prowirl 77 W

For the high/low temperature option, H increases by 40 mm and the weight by approx. 0.5 kg.

DN		d	D	H	Weight
DIN / JIS	ANSI	[mm]	[mm]	[mm]	[kg]
15	½"	16.50	45.0	247	3.0
25	1"	27.60	64.0	257	3.2
40	1½"	42.00	82.0	265	3.8
50	2"	53.50	92.0	272	4.1
80	3"	80.25	127.0	286	5.5
100	4"	104.75	157.2	299	6.5
150	6"	156.75	215.9	325	9.0

7.2 Dimensions Prowirl 77 F

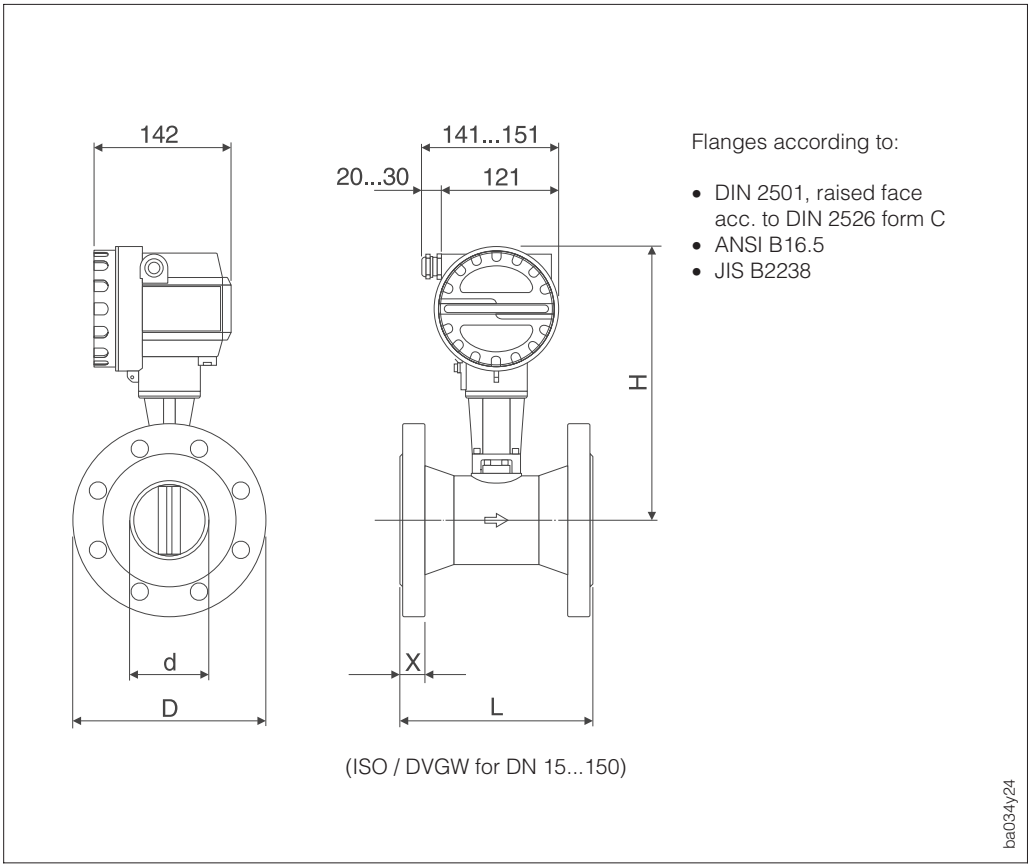


Fig. 14
Dimensions of Prowirl 77 F

For the high/low temperature option, H increases by 40 mm and the weight by approx. 0.5 kg.

DN	Standard	Pressure rating	d [mm]	D [mm]	H [mm]	L [mm]	X [mm]	Weight [kg]
15 / ½"	DIN	PN 40	17.3	95.0	248	200	17	5.0
	ANSI SCHED 40	Cl. 150	15.7	88.9				
		Cl. 300	15.7	95.0				
	ANSI SCHED 80	Cl. 150	13.9	88.9				
		Cl. 300	13.9	95.0				
	JIS SCHED 40	Cl. 20K	16.1	95.0				
	JIS SCHED 80	Cl. 20K	13.9	95.0				
25 / 1"	DIN	PN 40	28.5	115.0	255	200	19	7.0
	ANSI SCHED 40	Cl. 150	26.7	107.9				
		Cl. 300	26.7	123.8				
	ANSI SCHED 80	Cl. 150	24.3	107.9				
		Cl. 300	24.3	123.8				
	JIS SCHED 40	Cl. 20K	27.2	125.0				
	JIS SCHED 80	Cl. 20K	24.3	125.0				
40 / 1½"	DIN	PN 40	43.1	150	263	200	21	10
	ANSI SCHED 40	Cl. 150	40.9	127				
		Cl. 300	40.9	155.6				
	ANSI SCHED 80	Cl. 150	38.1	127				
		Cl. 300	38.1	155.6				
	JIS SCHED 40	Cl. 20K	41.2	140				
	JIS SCHED 80	Cl. 20K	38.1	140				

Continued next page

DN	Standard	Pressure rating	d [mm]	D [mm]	H [mm]	L [mm]	X [mm]	Weight [kg]
50 / 2"	DIN	PN 40	54.5	165	270	200	24	12
	ANSI SCHED 40	Cl. 150	52.6	152.4				
		Cl. 300	52.6	165				
	ANSI SCHED 80	Cl. 150	49.2	152.4				
		Cl. 300	49.2	165				
	JIS SCHED 40	Cl. 10K	52.7	155				
		Cl. 20K	52.7	155				
	JIS SCHED 80	Cl. 10K	49.2	155				
		Cl. 20K	49.2	155				
80 / 3"	DIN	PN 40	82.5	200	283	200	30	20
	ANSI SCHED 40	Cl. 150	78	190.5				
		Cl. 300	78	210				
	ANSI SCHED 80	Cl. 150	73.7	190.5				
		Cl. 300	73.7	210				
	JIS SCHED 40	Cl. 10K	78.1	185				
		Cl. 20K	78.1	200				
	JIS SCHED 80	Cl. 10K	73.7	185				
		Cl. 20K	73.7	200				
100 / 4"	DIN	PN 16	107.1	220	295	250	33	27
		PN 40	107.1	235				
	ANSI SCHED 40	Cl. 150	102.4	228.6				
		Cl. 300	102.4	254				
	ANSI SCHED 80	Cl. 150	97	228.6				
		Cl. 300	97	254				
	JIS SCHED 40	Cl. 10K	102.3	210				
		Cl. 20K	102.3	225				
	JIS SCHED 80	Cl. 10K	97	210				
		Cl. 20K	97	225				
150 / 6"	DIN	PN 16	159.3	285	319	300	38	51
		PN 40	159.3	300				
	ANSI SCHED 40	Cl. 150	154.2	279.4				
		Cl. 300	154.2	317.5				
	ANSI SCHED 80	Cl. 150	146.3	279.4				
		Cl. 300	146.3	317.5				
	JIS SCHED 40	Cl. 10K	151	280				
		Cl. 20K	151	305				
	JIS SCHED 80	Cl. 10K	146.3	280				
		Cl. 20K	146.3	305				
200 / 8"	DIN	PN 10	207.3	340	348	300	43	63
		PN 16						62
		PN 25	206.5	360				68
		PN 40		375				72
	ANSI SCHED 40	Cl. 150	202.7	342.9				64
		Cl. 300		381				76
	JIS SCHED 40	Cl. 10K		330				58
		Cl. 20K		350				64
250 / 10"	DIN	PN 10	260.4	395	375	380	49	88
		PN 16		405				92
		PN 25	258.8	425				100
		PN 40		450				111
	ANSI SCHED 40	Cl. 150	254.5	406.4				92
		Cl. 300		444.5				109
	JIS SCHED 40	Cl. 10K		400				90
		Cl. 20K		430				104
300 / 12"	DIN	PN 10	309.7	445	398	450	53	121
		PN 16		460				129
		PN 25	307.9	485				140
		PN 40		515				158
	ANSI SCHED 40	Cl. 150	304.8	482.6				143
		Cl. 300		520.7				162
	JIS SCHED 40	Cl. 10K		445				119
		Cl. 20K		480				139

7.3 Dimensions Prowirl 77 H

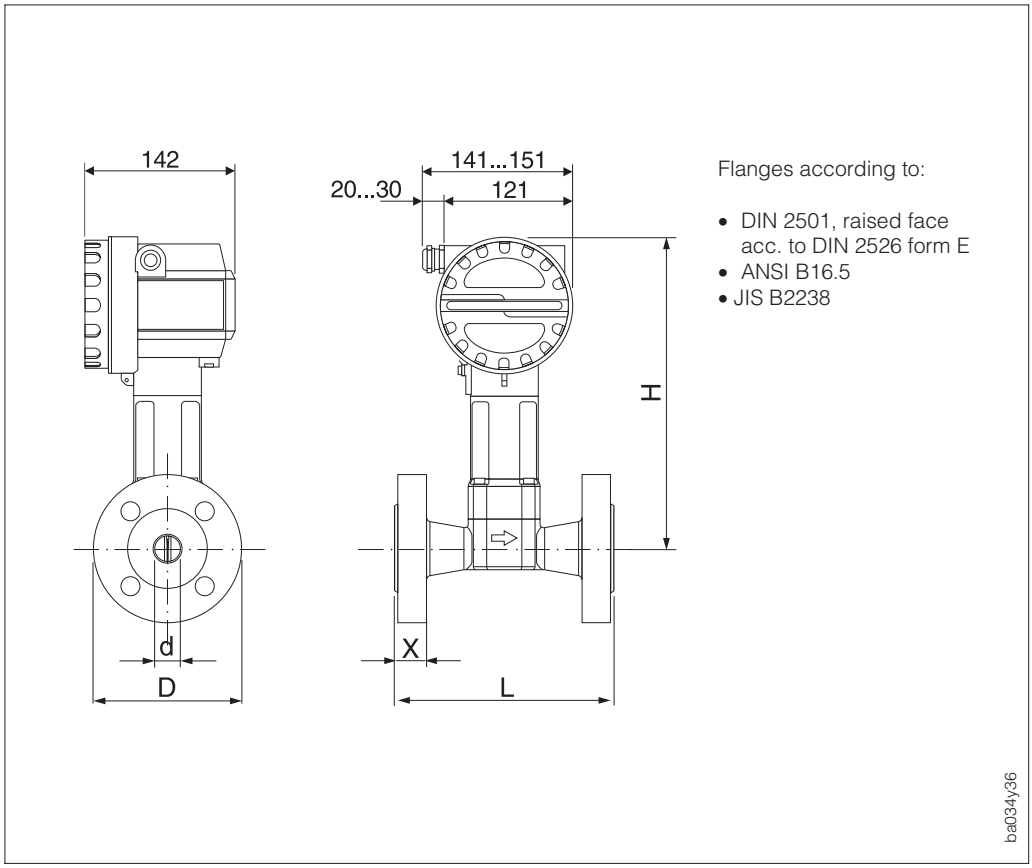


Fig. 15
Dimensions of Prowirl 77 H

DN	Standard	Pressure rating	d [mm]	D [mm]	H [mm]	L [mm]	X [mm]	Weight [kg]
15 / ½"	DIN	PN 160	17.3	105	288	200	22.4	7
	ANSI SCHED 80	Cl. 600	13.9	95.3				6
	JIS SCHED 80	Cl. 40K	13.9	115				8
25 / 1"	DIN	PN 100	28.5	140	295	200	26.4	11
		PN 160	27.9	140				11
	ANSI SCHED 80	Cl. 600	24.3	124				9
	JIS SCHED 80	Cl. 40K	24.3	130				10
40 / 1½"	DIN	PN 100	42.5	170	303	200	30.9	15
		PN 160	41.1	170				15
	ANSI SCHED 80	Cl. 600	38.1	155.4				13
	JIS SCHED 80	Cl. 40K	38.1	160				14
50 / 2"	DIN	PN 64	54.5	180	310	200	32.4	17
		PN 100	53.9	195				19
		PN 160	52.3	195				19
	ANSI SCHED 80	Cl. 600	49.2	165.1				14
	JIS SCHED 80	Cl. 40K	49.2	165				15
80 / 3"	DIN	PN 64	81.7	215	323	200	38.2	24
		PN 100	80.9	230				27
		PN 160	76.3	230				27
	ANSI SCHED 80	Cl. 600	73.7	209.6				22
	JIS SCHED 80	Cl. 40K	73.7	210				24
100 / 4"	DIN	PN 64	106.3	250	335	250	48.9	39
		PN 100	104.3	265				42
		PN 160	98.3	265				42
	ANSI SCHED 80	Cl. 600	97	273.1				43
	JIS SCHED 80	Cl. 40K	97	240				36
150 / 6"	DIN	PN 64	157.1	345	359	300	63.4	86
		PN 100	154.1	355				88
		PN 160	146.3	355				88
	ANSI SCHED 80	Cl. 600	146.3	355.6				87
	JIS SCHED 80	Cl.40K	146.6	325				77

7.4 Dimensions flow conditioner (DIN)

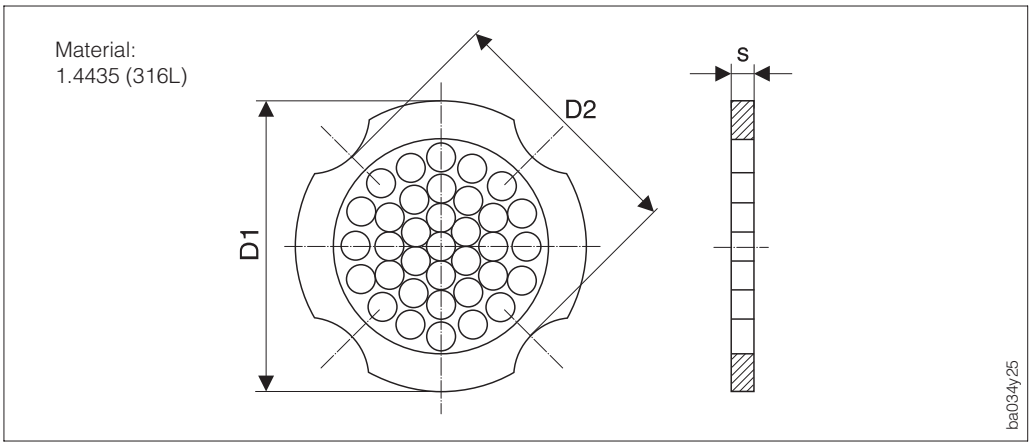


Fig. 16
Dimensions flow conditioner

Explanation of entries in column D1 / D2:

D1: The flow conditioner is clamped between bolts at its outer diameter.
D2: The flow conditioner is clamped between bolts at the indentures.

DIN					
DN	**Pressure rating**	**Centering diameter** [mm]	**D1 / D2**	**s**	**Weight** [kg]
15	PN 10...40 PN 64	54.3 64.3	D2 D1	2.0	0.04 0.05
25	PN 10...40 PN 64	74.3 85.3	D1 D1	3.5	0.12 0.15
40	PN 10...40 PN 64	95.3 106.3	D1 D1	5.3	0.3 0.4
50	PN 10...40 PN 64	110.0 116.3	D2 D1	6.8	0.5 0.6
80	PN 10...40 PN 64	145.3 151.3	D2 D1	10.1	1.4 1.4
100	PN 10/16 PN 25/40 PN 64	165.3 171.3 252.0	D2 D1 D1	13.3	2.4 2.4 2.4
150	PN 10/16 PN 25/40 PN 64	221.0 227.0 252.0	D2 D2 D1	20.0	6.3 7.8 7.8
200	PN 10 PN 16 PN 25 PN 40 PN 64	274.0 274.0 280.0 294.0 309.0	D1 D2 D1 D2 D1	26.3	11.5 12.3 12.3 15.9 15.9
250	PN 10/16 PN 25 PN 40 PN 64	330.0 340.0 355.0 363.0	D2 D1 D2 D1	33.0	25.7 25.7 27.5 27.5
300	PN 10/16 PN 25 PN 40/64	380.0 404.0 420.0	D2 D1 D1	39.6	36.4 36.4 44.7

7.5 Dimensions flow conditioner (ANSI)

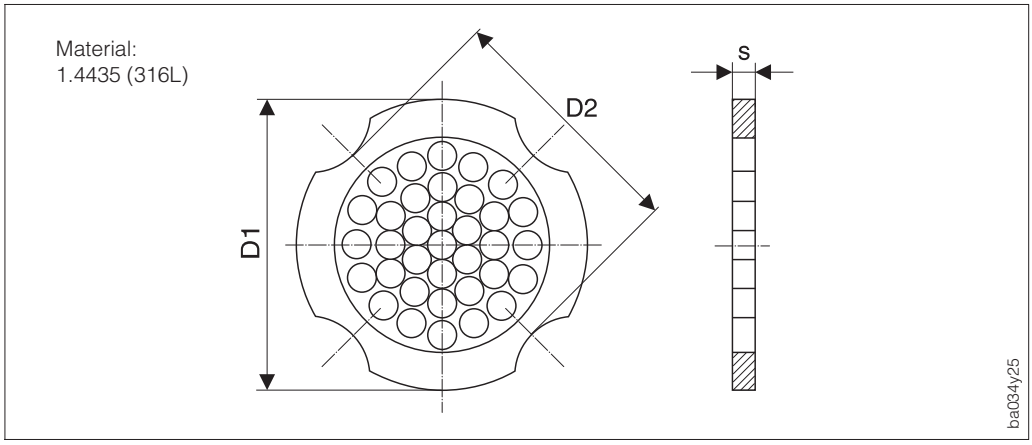


Fig. 17
Dimensions flow conditioner

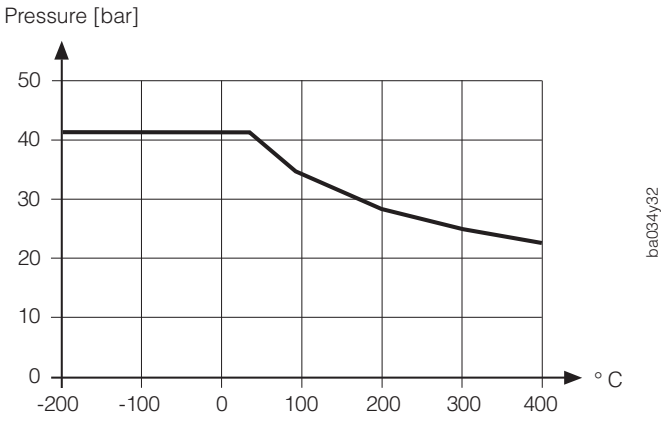
Explanation of entries in column D1 / D2:

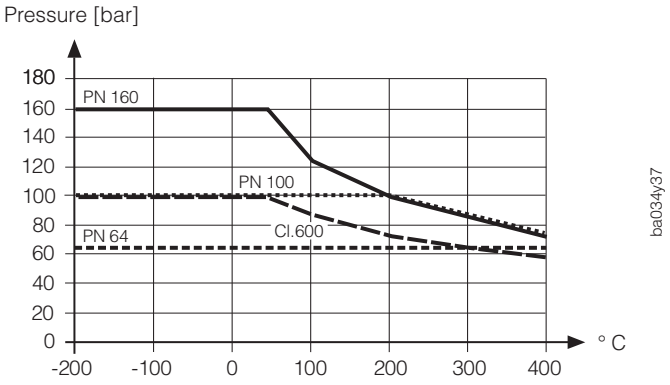
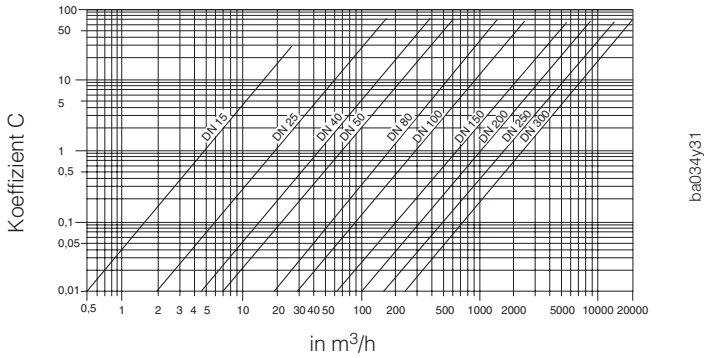
D1: The flow conditioner is clamped between bolts at its outer diameter.
D2: The flow conditioner is clamped between bolts at the indentures.

ANSI					
DN	**Pressure rating**	**Centering diameter** [mm]	**D1 / D2**	**s**	**Weight** [kg]
½"	Cl. 150 Cl. 300	51.1 56.5	D1 D1	2.0	0.03 0.04
1"	Cl. 150 Cl. 300	69.2 74.3	D2 D1	3.5	0.12 0.12
1½"	Cl. 150 Cl. 300	88.2 97.7	D2 D2	5.3	0.3 0.3
2"	Cl. 150 Cl. 300	106.6 113.0	D2 D1	6.8	0.5 0.5
3"	Cl. 150 Cl. 300	138.4 151.3	D1 D1	10.1	1.2 1.4
4"	Cl. 150 Cl. 300	176.5 182.6	D2 D1	13.3	2.7 2.7
6"	Cl. 150 Cl. 300	223.9 252.0	D1 D1	20.0	6.3 7.8
8"	Cl. 150 Cl. 300	274.0 309.0	D2 D1	26.3	12.3 15.8
10"	Cl. 150 Cl. 300	340.0 363.0	D1 D1	33.0	25.7 27.5
12"	Cl. 150 Cl. 300	404.0 420.0	D1 D1	39.6	36.4 44.6

8 Technical Data

Application ranges	
Designation	Flow measuring system Prowirl 77, “PFM” version
Function	Measurement of volumetric flow rate of saturated steam, superheated steam, gases and liquids.
Operation and system design	
Measurement principle	The Prowirl 77 vortex flowmeter operates on the physical principle of Karman vortex shedding.
Measurement system	The “Prowirl 77” instrument family consists of: • Transmitter: Prowirl 77 “PFM” Prowirl 77 “4...20 mA/HART” Prowirl 77 “PROFIBUS-PA” • Sensor: Prowirl 77 W wafer version, DN 15...150 Prowirl 77 F flanged version, DN 15...300, bigger nominal diameters on request Prowirl 77 H high pressure version, DN 15...150
Input variables	
Measured variables	The average flow velocity and volumetric flow rate are proportional to the frequency of vortex shedding behind the bluff body.
Measuring ranges	The measuring range is dependent on the fluid and the pipe diameter (see page 32). • Full scale value – Liquids: v_{max} = 9 m/s – Gas / steam: v_{max} = 75 m/s (DN 15 v_{max} = 46 m/s) • Lower range value – depends on the fluid density and the Reynolds number, Re_{min} = 4000, Re_{linear} = 20000 DN 15 / 25: $v_{min} = \frac{6}{\sqrt{\rho}}$ m/s, with ρ in $\frac{kg}{m^3}$ DN 40...300: $v_{min} = \frac{7}{\sqrt{\rho}}$ m/s, with ρ in $\frac{kg}{m^3}$
Output variables	
Output signal	PFM; two-wire current pulse output unscaled vortex frequency: 0.5...2850 Hz, pulse width: 0.18 ms
Galvanic isolation	The electrical connections are galvanicaly isolated from the sensor.
Measuring accuracy	
Reference conditions	Error limits based on ISO/DIN 11631: • 20...30 °C, 2...4 bar • Calibration rig traceable to national standards

Measuring accuracy (continued)	
Measured error	Liquids < 0.75% o.r. for Re >20000 < 0.75% o.f.s. for Re 4000...20000 Gas / steam < 1% o.r. for Re >20000 < 1% o.f.s. for Re 4000...20000 Current output temperature coefficient < 0.03% o.f.s./Kelvin
Repeatability	≤ ±0.25% o.r.
Operating conditions	
Installation instruction	Any position (vertical, horizontal) For limitations and other recommendations → see page 11
Inlet / outlet sections	Inlet section: minimum 10 x DN Outlet section: minimum 5 x DN For detailed information on the effect of pipe installation and flow disturbances → see page 10
Ambient temperature	–40...+60 °C When mounted outside, it is recommended that it is protected from direct sunlight by a sun shade, especially in warm climates with high process temperatures.
Ingress protection	IP 67 (NEMA 4X)
Shock and vibration resistance	At least 1 g in every axis over the whole frequency range up to 500 Hz
Electromagnetic compatibility (EMC)	To EN 50081 Part 1 and 2 / EN 50082 Part 1 and 2 and NAMUR industrial standard
Process conditions	
Process temperature	• Fluid: Standard sensor –40...+260 °C High/low temperature sensor –200...+400 °C Wafer type instruments of sizes DN 100 (4") and DN 150 (6") may not be mounted in orientation according to position B (see page 11) for fluid temperatures above 200 °C. • Seal: Graphite –200...+400 °C Viton – 15...+175 °C Kalrez – 20...+220 °C Gylon (PTFE) –200...+260 °C
Process pressure	DIN: PN 10...40 ANSI: Cl 150 / 300 JIS: 10K/20K Pressure-temperature curve of Prowirl 77 W and 77 F: 

Process conditions (continued)	
Process pressure (continued)	Pressure-temperature curve of Prowirl 77 H: 
Pressure loss	Dependent on nominal diameter and fluid: Δp [mbar] = coefficient C · density ρ [kg/m^3] 
Mechanical construction	
Construction / dimensions	See pages 21 ff.
Weight	See pages 21 ff.
Materials:	
Transmitter housing	Powder-coated die-cast aluminium
Sensor *– Wafer / flange*	Stainless steel, A351-CF3M (1.4404), complying to NACE MR0175
– Sensor	Stainless steel wetted parts: – standard and high/low temperature sensor: 316L (1.4435), complying to NACE MR0175 – high pressure sensor: A637 (2.4668) (Inconel 718), complying to NACE MR0175 non-wetted parts: – CF3 (1.4306)
– Pipe stand	Stainless steel, 304L (1.4308)
Gaskets	Graphite Viton Kalrez Gylon (PTFE)

Mechanical construction (continued)	
Cable entries	Power supply and signal cable (outputs): Cable entry PG 13.5 (for 5...11.5 mm cable) or Thread for cable entries: M20 x 1.5 (8...11.5 mm) ½" NPT G½"
Process connections	Wafer: Mounting set (see page 13) for flanges: – DIN 2501, PN 10...40 – ANSI B16.5, Class 150/300, Sch40 – JIS B2238, 10K/20K, Sch40 Flange: – DIN 2501, PN 10...40, raised face acc. to DIN 2526 form C – ANSI B16.5, Class 150/300, Sch40/80 (Sch80 DN 15...150) – JIS B2238, 10K/20K, Sch40/80 (Sch80 DN 15...150) High pressure: – DIN 2501, PN 64...160, raised face acc. to DIN 2526 form E – ANSI B16.5, Class 600, Sch80 – JIS B2238, 40K, Sch80
User interface	
Operation procedure / Display	8 DIP switches: for setting the nominal diameter and the application LED: for indicating power supply
Power supply	
Power supply	12...30 V DC (15...36 V DC for Ex d/XP version)
Power consumption	<1 W DC (incl. Sensor)
Power failure	LED → off
Certificates and approvals	
Ex-approval	*Ex i:* ATEX/CENELEC ⟨Ex⟩ II2G, EEx ib IIC T1...T6 ATEX ⟨Ex⟩ II3G, EEx nA IIC T1...T6 X FM Cl I/II/III Div 1, Groups A...G CSA Class I Div 1, Groups A...D Class II Div 1, Groups E...G Class III Div 1 *Ex d:* ATEX/CENELEC ⟨Ex⟩ II2G, EEx d [ib] IIC T1...T6 FM Cl I/II/III Div 1, Groups A...G CSA Class I Div 1, Groups A...D Class II Div 1, Groups E...G Class III Div 1
CE mark	By attaching the CE mark, Endress+Hauser confirms that the Prowirl 77 has been successfully tested and fulfills all legal requirements of the relevant EC directives.
Order information	
Accessories	• Mounting set for wafer • Replacement parts according to separate price list • Compart DXF 351 flow computer • Flow conditioner

Order information (continued)		
Supplementary documentation	• Technical Information Prowirl 77	TI 040D/06/en
	• Operating Manual Prowirl 77 “4...20 mA/HART”	BA 032D/06/en
	• Operating Manual Prowirl 77 “PROFIBUS-PA”	BA 037D/06/en
	• System Information Prowirl	SI 015D/06/en
	• System Information Prowirl 77	SI 021D/06/en
	• Additional Ex documentation:	
	ATEX II2G/CENELEC Zone 1	XA 017D/06/a3
	ATEX II3G/CENELEC Zone 2	XA 018D/06/a3
	FM	EX 016D/06/a2
	CSA	EX 017D/06/D2

External standards and guidelines

EN 60529	Degree of protection (IP ingress protection)
EN 61010	Protection Measures for Electrical Equipment for Measurement, Control, Regulation and Laboratory Procedures
EN 50081	Part 1 and 2 (interference emission)
EN 50082	Part 1 and 2 (interference immunity)
NAMUR	Normenarbeitsgemeinschaft für Meß- und Regeltechnik in der Chemischen Industrie
NACE	National Association of Corrosion Engineers

8.1 Measuring ranges (sensor)

The tables below show the relationship between measuring ranges and frequency ranges for a typical gas (air, at 0 °C and 1.013 bar) and a typical liquid (water, at 20 °C). The column “K-factor” shows a range of typical values for the K-factor of an instrument of the corresponding size and type (wafer or flange). Your E+H Sales Office will be pleased to provide information on flowmeters for your specific application with regard to the process characteristics of the fluid and operating conditions.

Prowirl 77 W (Wafer)							
DN DIN / ANSI	**Air** (at 0 °C, 1.013 bar) [m^3/h]			**Water** (at 20 °C) [m^3/h]			**K-factor** [pulses/dm^3]
	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range (Hz)	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range (Hz)	min./max.
DN 15 / ½"	4	35	330...2600	0.19	7	10.0...520	245...280
DN 25 / 1"	11	160	180...2300	0.41	19	5.7...300	48...55
DN 40 / 1½"	31	375	140...1650	1.1	45	4.6...200	14...17
DN 50 / 2"	50	610	100...1200	1.8	73	3.3...150	6...8
DN 80 / 3"	112	1370	75... 850	4.0	164	2.2...110	1.9...2.4
DN 100 / 4"	191	2330	70... 800	6.9	279	2.0...100	1.1...1.4
DN 150 / 6"	428	5210	38... 450	15.4	625	1.2... 55	0.27...0.32

Prowirl 77 F (Flange) Prowirl 77 H (High pressure to DN 150 / 6")							
DN DIN / ANSI	**Air** (at 0 °C, 1.013 bar) [m^3/h]			**Water** (at 20 °C) [m^3/h]			**K-factor** [pulses/dm^3]
	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range (Hz)	$\dot{V}_{min}$	$\dot{V}_{max}$	Frequency range (Hz)	min./max.
DN 15 / ½"	3	25	380...2850	0.16	5	14.0...600	390...450
DN 25 / 1"	9	125	200...2700	0.32	15	6.5...340	70...85
DN 40 / 1½"	25	310	150...1750	0.91	37	4.5...220	18...22
DN 50 / 2"	42	510	120...1350	1.5	62	3.7...170	8...11
DN 80 / 3"	95	1150	80... 900	3.4	140	2.5...115	2.5...3.2
DN 100 / 4"	164	2000	60... 700	5.9	240	1.9... 86	1.1...1.4
DN 150 / 6"	373	4540	40... 460	13.4	550	1.2... 57	0.3...0.4
DN 200 / 8"	715	8710	27... 322	25.7	1050	1.0... 39	0.1266...0.1400
DN 250 / 10"	1127	13740	23... 272	40.6	1650	0.8... 33	0.0677...0.0748
DN 300 / 12"	1617	19700	18... 209	58.2	2360	0.6... 25	0.0364...0.0402

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