Special Documentation
Proline Prowirl 200

Inlet Run Correction feature

Endress+Hauser
People for Process Automation

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1 Document information

1.1 Document function

The document is part of the Operating Instructions and serves as a reference for application-specific parameters, providing a detailed explanation of each individual parameter of the operating menu.

1.2 Using this document

1.2.1 Information on the document structure

For the alignment of parameters with short descriptions according to the **Display/ Operation**, **Setup**, **Diagnostics** menu structure, Operating Instructions manual for the device.

For information about the operating philosophy, see the "Operating philosophy" chapter in the device's Operating Instructions

1.3 Symbols used

1.3.1 Symbols for certain types of information

Symbol	Meaning
 A0011193	**Tip** Indicates additional information.
 A0011194	**Reference to documentation** Refers to the corresponding device documentation.
 A0011195	**Reference to page** Refers to the corresponding page number.
 A0011196	**Reference to graphic** Refers to the corresponding graphic number and page number.
 A0013140	**Operation via local display** Indicates navigation to the parameter via the local display.
 A0013143	**Operation via operating tool** Indicates navigation to the parameter via the operating tool.
 A0013144	**Write-protected parameter** Indicates a parameter that can be locked against changes by entering a user-specific code.

1.3.2 Symbols in graphics

Symbol	Meaning
1, 2, 3 ...	Item numbers
A, B, C, ...	Views
A-A, B-B, C-C, ...	Sections

1.4 Documentation

This manual is Special Documentation and is not a substitute for the Operating Instructions supplied with the device.

For detailed information, refer to the Operating Instructions and other documentation on the CD-ROM provided or visit "www.endress.com/deviceviewer".

The Special Documentation is an integral part of the following Operating Instructions:

Sensor	HART	FOUNDATION Fieldbus	PROFIBUS PA
F	BA01154D	BA01217D	BA01222D

This Special Documentation is available:
- On the CD-ROM supplied with the device (depending on the device version ordered)
- In the Download Area of the Endress+Hauser Internet site: www.endress.com → Download

1.4.1 Content and scope

This Special Documentation contains a description of the additional parameters and technical data that are provided with the **Inlet Run Correction** function. All the parameters that are not relevant for inlet run correction are described in the Operating Instructions.

General information about inlet run correction can be found in the "General principles" section (→ 9).

2 Product features and availability

2.1 Product features

2.1.1 Inlet Run Correction feature

The **Inlet Run Correction** feature makes it possible to shorten the necessary inlet run upstream from the measuring device. If the inlet run available is too short, the measuring device can correct the measured error depending on the preceding disruption in the flow profile.

2.2 Availability

The **Inlet Run Correction** feature is a standard feature and can be used exclusively in the Prowirl F 200 with the specified accuracy (→ 10). It does not need to be ordered for the flowmeter ex works as is available as standard when the measuring device is delivered to the customer. The feature is accessed via the operating interfaces of the measuring device or via Endress+Hauser's FieldCare asset management software. No particular measures are required to put the feature into operation.

3 Commissioning

Please perform the following to commission the **Inlet Run Correction** feature.

1. Configure the measuring device (→ 🖹 7).
2. Make additional settings to correct the inlet conditions (→ 🖹 7).

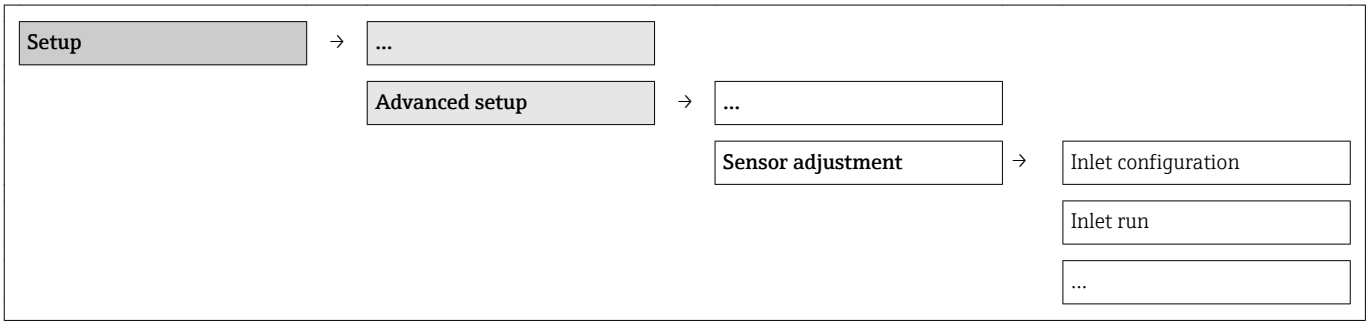
3.1 4-20 mA HART and PROFIBUS PA

3.1.1 Configuring the measuring device

The following steps are required to configure the device:

1. Select the inlet configuration (→ 🖹 7).
   ↳ One of the possible options is selected in the **Inlet configuration** parameter.
2. Define the length of the straight inlet run (→ 🖹 7).
   ↳ The length of the straight inlet run is selected in the **Inlet run** parameter.

Navigation
"Setup" menu → Advanced setup → Sensor adjustment



Parameter overview with brief description

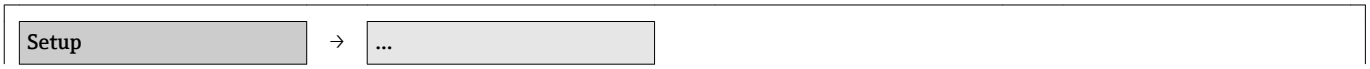
Parameter	Description	Selection / User entry	Factory setting
Inlet configuration	Select inlet configuration.	▪ Off ▪ Single elbow ▪ Double elbow ▪ Double elbow 3D ▪ Reduction	Off
Inlet run	Define length of the straight inlet run.	10 × DN to 20 m	Minimum: 10 × DN

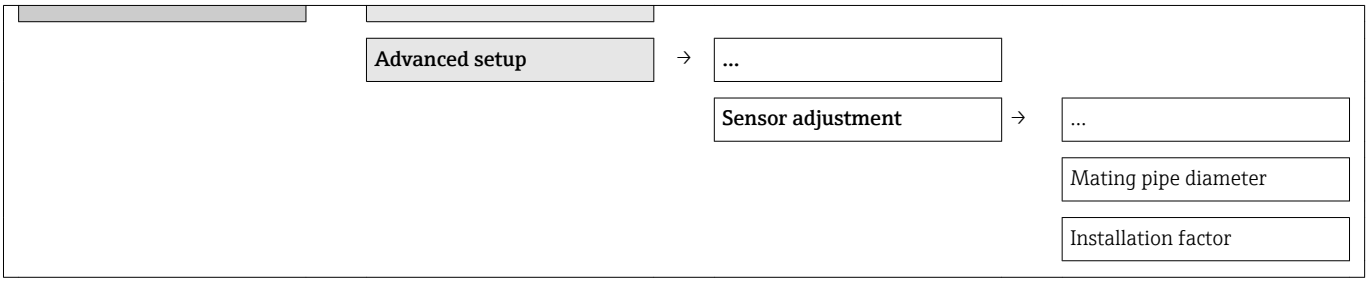
3.1.2 Additional settings

The following additional settings are required to correct the inlet conditions:

1. Enter the value of the mating pipe (→ 🖹 8).
   ↳ The value of the mating pipe is entered in the **Mating pipe diameter** parameter.
2. Enter the factor to adjust the installation conditions (→ 🖹 8).
   ↳ The factor to adjust the installation conditions is entered in the **Installation factor** parameter.

Navigation
"Setup" menu → Advanced setup → Sensor adjustment





Parameter overview with brief description

Parameter	Description	User entry	Factory setting
Mating pipe diameter	Enter actual value of the mating pipe to activate the diameter mismatch correction. *Note* The unit displayed depends on the **Length unit** parameter.	Flange connection: ▪ DN 15 (½"): ±20 % of the internal diameter ▪ DN 25 (1"): ±15 % of the internal diameter ▪ DN 40 (1½"): ±12 % of the internal diameter ▪ DN ≥ 50 (2"): ±10 % of the internal diameter Disc (wafer version): ▪ DN 15 (½"): ±15 % of the internal diameter ▪ DN 25 (1"): ±12 % of the internal diameter ▪ DN 40 (1½"): ±9 % of the internal diameter ▪ DN ≥ 50 (2"): ±8 % of the internal diameter	Country-specific: ▪ 0 m ▪ 0 ft
Installation factor	Enter factor to adjust for installation conditions.	Positive floating-point number	1.0

4 General principles

4.1 Definitions

4.1.1 General

Vortex flowmeters for volumetric flow measurement in a pipe are mainly calibrated in turbulent flow conditions. However, the calibration conditions are only seldom achieved in the field with the result that the inlet and outlet runs at the customer's place of operation often differ from those in the calibration rig.

Therefore in practice many measuring devices are exposed to a non-symmetrical flow profile that is not fully developed, resulting in a higher measured error.

The following flow obstructions cause deviations compared to a fully developed flow state:
- Single elbow (90° elbow)
- Double elbow (2 × 90° elbows, opposite)
- Double elbow 3D (2 × 90° elbows, opposite, not on one plane)
- Reduction by one nominal diameter size

Downstream from a non-ideal arrangement, the velocity distribution is disrupted compared with the known fully developed flow profile.

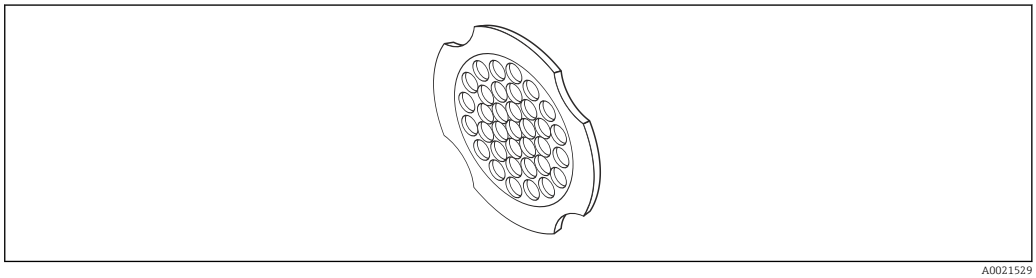
In a (straight) pipe, downstream from the flow obstruction, these irregularities in the flow profile disappear according to the specific decay law until the fully developed flow profile is restored.

Depending on the distance between the measuring device and the flow obstruction upstream, the disrupted flow profile can cause significant measured errors in the flow measurement.

4.1.2 Flow conditioner

The user is interested in maintaining the required length of straight pipe upstream from the measuring device in order to attain the level of accuracy specified by the manufacturer. At the same time, the user will try to keep this run as short as possible. If the required inlet runs cannot be observed, it is possible to install a specially designed flow conditioner. However given the high costs of installation coupled with the higher pressure loss caused by the flow conditioner this solution is often not economically viable.

For detailed information on the flow conditioner, see the "Special mounting instructions" section in the "Technical Information" document.



1 Example of a flow conditioner

Flow conditioners disrupt a non-symmetrical flow profile by intentionally mixing the flow. However the resulting turbulence causes an additional pressure loss.

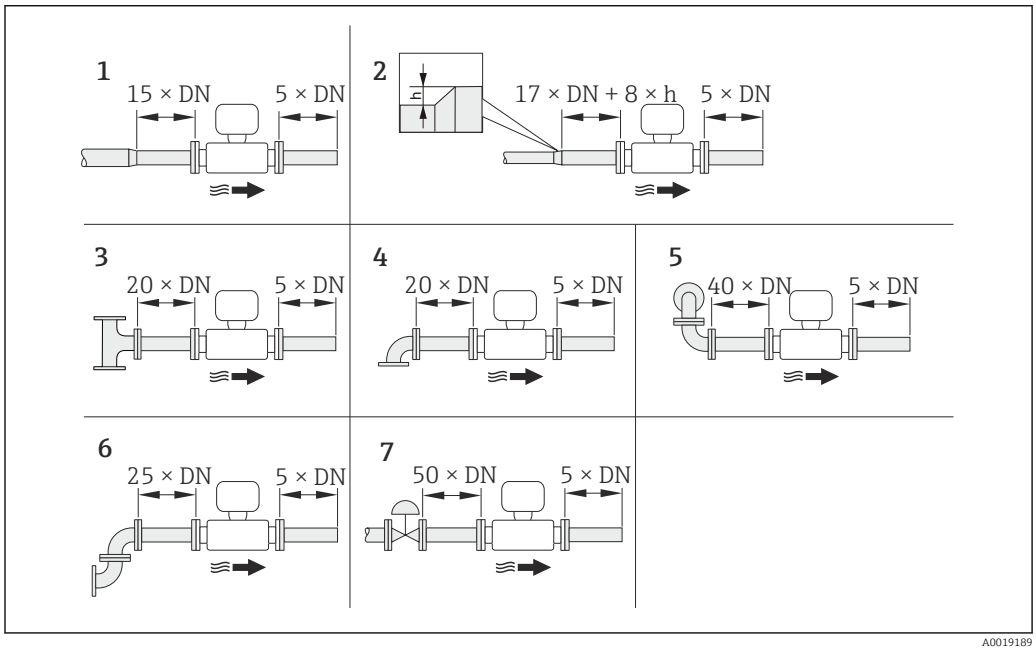
4.1.3 Inlet run correction by Endress+Hauser

An alternative and far less expensive approach is to find or establish a dependency between the measured error and the altered flow profile. On the basis of this dependency and with knowledge of the flow obstruction in the pipe (with information on the distance to the installed measuring device), the measured error caused by the disturbed flow profile can be corrected in part.

The **Inlet Run Correction** feature of Endress+Hauser's Prowirl F 200 presents an economic method for shortening the inlet run and does not generate any additional pressure loss.

Different flow obstructions can change the velocity distribution of the flow. Depending on the plant element, the fully developed flow profile will be a non-symmetrical or rotating flow profile. Such effects have a large negative impact on the measuring uncertainty of a wide range of flowmeters.

These typical pipe configurations disturb the flow profile and require the specified inlet runs (... × DN) to guarantee a fully developed flow profile:



2 Minimum inlet and outlet runs with different upstream pipe sections (without using inlet run correction)

h Difference in expansion
1 Reduction by one nominal diameter size
2 Expansion
3 T-piece
4 Single elbow (90° elbow)
5 Double elbow 3D (2 × 90° elbows, opposite, not on one plane)
6 Double elbow (2 × 90° elbows, opposite)
7 Control valve

Application

The **Inlet Run Correction** function can be used for the following pressure ratings and nominal diameters:
DN 15 to 150 (1 to 6")
– EN (DIN)
– ASME B16.5, Sch. 40/80

Inlet run correction is possible for the following flow obstructions:
- Single elbow (90° elbow)
- Double elbow (2 × 90° elbows, opposite)
- Double elbow 3D (2 × 90° elbows, opposite, not on one plane)
- Reduction by one nominal diameter size

The **inlet run correction** function:
- Makes it possible to shorten the inlet run to a minimum length of 10 × DN in the event of flow obstructions 1, 4, 5 and 6. An additional measuring uncertainty of ±0.5 % o.r. occurs.
- Cannot be combined with the **Wet Steam Detection/Measurement** application package. If wet steam detection/measurement is used, the corresponding inlet runs must be taken into consideration. It is also not possible to use a flow conditioner.

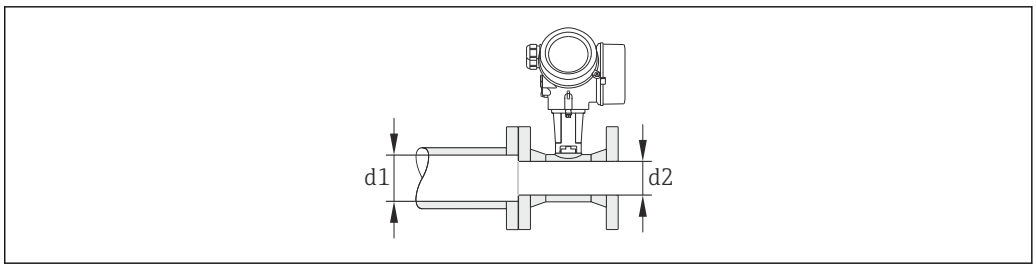
4.1.4 Diameter mismatch correction

The device also has diameter mismatch correction. This can be activated by entering the actual value of the mating pipe (d1) in this function.

If the mating pipe (d1) and the measuring pipe (d2) have different diameters, this alters the flow profile (→ 11).

A diameter mismatch can occur if:
- The mating pipe has a different pressure rating to that of the measuring device.
- The mating pipe has another schedule to that of the measuring device (e.g. 80 instead of 40), in the case of ASME.

To correct any resulting shift in the calibration factor, enter the actual value of the mating pipe (d1) in this function.



d1 Mating pipe
d2 Measuring pipe

- Inlet correction is switched off if 0 is entered in the function.
- The associated unit is taken from the **Inlet run** parameter.
- If the internal diameter of the mating pipe is larger than the mating diameter of the measuring device, an additional measuring uncertainty of typically 0.1 % (o.r.) per 1 mm diameter deviation must be expected.
- If the internal diameter of the mating pipe is smaller than the mating diameter of the Prowirl flange, an additional measuring uncertainty of typically 0.2 % (o.r.) per 1 mm diameter deviation must be expected.
- The diameter mismatch should only be corrected within the following limit values (listed below) for which test measurements have also been performed.

Flange connection:
- DN 15 (½"): ±20 % of the internal diameter
- DN 25 (1"): ±15 % of the internal diameter
- DN 40 (1½"): ±12 % of the internal diameter
- DN ≥ 50 (2"): ±10 % of the internal diameter

Disc (wafer version):
- DN 15 (½"): ±15 % of the internal diameter
- DN 25 (1"): ±12 % of the internal diameter
- DN 40 (1½"): ±9 % of the internal diameter
- DN ≥ 50 (2"): ±8 % of the internal diameter

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