ABB MEASUREMENT & ANALYTICS | OPERATING INSTRUCTION

FPD175

Compact orifice carrier assembly

The smart solution for remote applications.

Measurement made easy

—
Installation, commissioning and operating / maintenance instructions

Introduction

This Operating Instruction provides end-user details for the FPD175 compact orifice carrier assembly.

FPD175 is an orifice-based flowmeter for clean liquids, gases and steam and incorporates a welded 3- or 5-valve isolating/equalizing manifold. It is suitable for direct-mounted or remote mounted transmitters to suit the application.

FPD175 has pipe sizes 25 to 300 mm (1 to 12 in.) for a range of ANSI/ASME and DIN flange specifications, with an extended range to cover smaller pipe sizes (1 in and 1½ in. [25 and 40 mm]).

FPD175 can be used with any manufacturer's transmitter (note that currently a direct-mounted transmitter must have conventional manifold-mounting dimensions). Also, a multi-hole conditioning plate option reduces a straight pipe requirement, increases accuracy and reduces head loss.

For more information

Further publications for the FPD175 compact orifice carrier assembly are available for free download from www.abb.com/measurement (links and reference numbers for the transmitter publications are shown below) or by scanning this code:

	Search for or click on:
FPD175 compact orifice carrier assembly – Data Sheet	DS/FPD175-EN

Contents

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1 General safety information

WARNING

- The Pressure Equipment described in this manual is supplied, where appropriate, in accordance with the European Directive 97/23/EC and is designed to work in pressurized systems. Take care when installing all equipment and follow the instructions given. Failure to do this could result in damage to equipment and create possible hazards to operators and other equipment. Only use the equipment on the process for which it is designed. Install the equipment into a system that has been designed to allow for venting or draining of the process. For the necessary safety requirements refer to the appropriate instructions in this manual.
- Do not exceed the pipe vibration levels stated in the Specification (see Section 5, page 11). Excessive vibration could result in damage to the equipment and create possible hazards to other equipment and operators.

User guidelines

Correct use includes the following:

- Operation within the technical limit values.
- Observing and following the information provided on permissible media (fluids).
- Observing and following the instructions provided in the operating manuals.
- The following uses are not permitted:
  - Operation as a flexible adaptor in piping; for example, to compensate for pipe offsets, pipe vibrations and/or pipe expansions.
  - Use as a climbing aid; for example, for assembly purposes.
  - Use as a support for external loads; for example, as a support for piping.
  - Material gain; for example, by painting over the type plate or welding or soldering on parts.
  - Repairs, modifications, supplements or the installation of spare parts. These are permitted only if performed as described in the operating manual. More extensive work must be approved by ABB – the Company accepts no liability for unauthorized work.

The operating, maintenance and repair conditions that are stated in this manual must be observed. The Company accepts no liability for damage caused by usage that is incorrect or unprofessional.

Permissible process media (fluids)

Process media may be used only if:

- It can be assured that the physical and chemical properties of the pressure-bearing materials that come into contact with the process medium are not reduced from that required for operational safety, during the expected lifetime of the equipment.
- Process media with unknown properties for erosion and/or corrosion may be used only if the operator can perform regular and suitable tests to assure the safe condition of the equipment.

Technical limit values

The equipment is intended for use only within the technical limit values specified on the data plate and in the Specification (see 5 Specification on page 13), including those for:

- The maximum working pressure.
- The maximum and minimum operating temperatures.
- The maximum vibration level stated in the Specification section (see 5 Specification on page 13).

In addition, all connected pipework must be installed as it was designed, to ensure that there is no possibility of leakage or any undue stresses or strain acting upon it.

Safety precautions

Instructions and procedures in this manual may require special precautions to ensure the safety of personnel performing the operations. Explosions could result in death or serious injury; therefore refer to the Warnings in the transmitter operating manual before performing any operation in this manual.

2 Installation

General

Upstream straight pipe requirements to ISO 5167-2:2003 orifice plate

Fitting	ß = 0.4	ß = 0.65
Conical reducer (2D – D)	5D	12D
Conical expander (0.5D – D)	12D	28D
Single 90 ° bend	16D	44D
2 off 90 ° bends in same plane	10D	44D
2 off 90 ° bends in different plane	50D	60D

Where D = pipe diameter

Balanced orifice plate (multi-hole)

Fitting	ß = 0.4	ß = 0.65
Conical reducer (2D – D)	2D*	2D**
Conical expander (0.5D – D)	2D*	2D**
Single 90 ° bend	2D*	2D**
2 off 90 ° bends in same plane	2D*	2D**
2 off 90 ° bends in different plane	2D*	2D**

** This value can be 0D without effecting uncertainty if minimum differential pressure is not below 60 mbar.

** This value may be reduced, non-recoverable pressure loss could be effected.

Weight

Size in mm (in.)	Weight in kg (lbs)
25 (1)	9.5 (21)
40 (1½)	10 (22)
50 (2)	10.5 (23)
80 (3)	11.5 (25.3)
100 (4)	12 (26.5)
150 (6)	14 (31)
200 (8)	16 (35.3)
250 (10)	19 (42)
300 (12)	21.5 (47.4)

Dimensions

Dimensions in mm (in.)

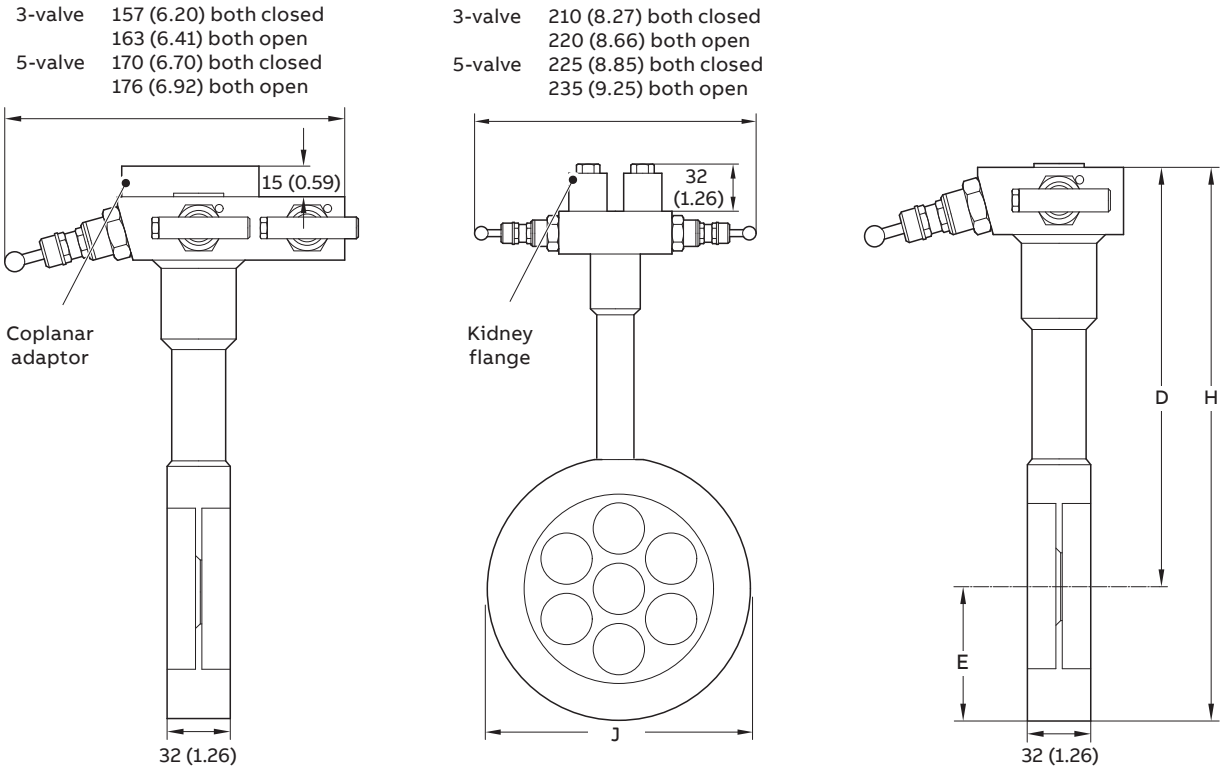

Figure 1 FPD175 3-valve (with remote mount adaptor) and 5-valve dimensions

Size	H	J	E (J/2)	D (H – E)
25 (1)	180 (7.10)	50.8 ±1 (2.00 ±0.04)	25.4 ±0.5 (1.00 ±0.02)	154.6 ±5 (6.10 ±0.20)
40 (1½)	203 (8.00)	73.2 ±1 (2.88 ±0.04)	36.6 ±0.5 (1.44 ±0.02)	166.4 ±5 (6.56 ±0.20)
50 (2)	221 (8.70)	92.1 ±1 (3.63 ±0.04)	46.05 ±0.5 (1.81 ±0.02)	174.95 ±5 (6.89 ±0.20)
80 (3)	257 (10.12)	127 ±1 (4.99 ±0.04)	63.5 ±0.5 (2.50 ±0.02)	193.5 ±5 (7.62 ±0.20)
100 (4)	314 (12.36)	157.2 ±1 (6.19 ±0.04)	78.6 ±0.5 (3.09 ±0.02)	235.4 ±5 (9.27 ±0.20)
150 (6)	372 (14.65)	215.9 ±1 (8.50 ±0.04)	107.95 ±0.5 (4.25 ±0.02)	264.05 ±5 (10.40 ±0.20)
200 (8)	426 (16.77)	269.9 ±1 (10.63 ±0.04)	134.95 ±0.5 (5.31 ±0.02)	291.05 ±5 (11.46 ±0.20)
250 (10)	502 (19.76)	323.8 ±1 (12.75 ±0.04)	161.9 ±0.5 (6.37 ±0.02)	340.1 ±5 (13.39 ±0.20)
300 (12)	560 (22.04)	381.0 ±1 (15.00 ±0.04)	190.5 ±0.5 (7.50 ±0.02)	369.5 ±5 (14.55 ±0.20)

Table 1 FPD175 3-valve and 5-valve sizing table – dimensions in mm (in.)

...2 Installation

Installations using direct-mount transmitters

Meter orientation

CAUTION
When fitting a transmitter to the manifold of the FPD175, ensure that the transmitter drain / vent valves are positioned to direct the process medium away from personnel and equipment when it is removed during drain and vent operations.

For all meter orientations, ensure the arrow on the meter body is aligned correctly with the direction of flow in the pipeline.

Horizontal pipe mounting – gas

To ensure that condensate drains back into the pipe, mount the meter above the pipe, at least 30 degrees above the horizontal – see Figure 2.

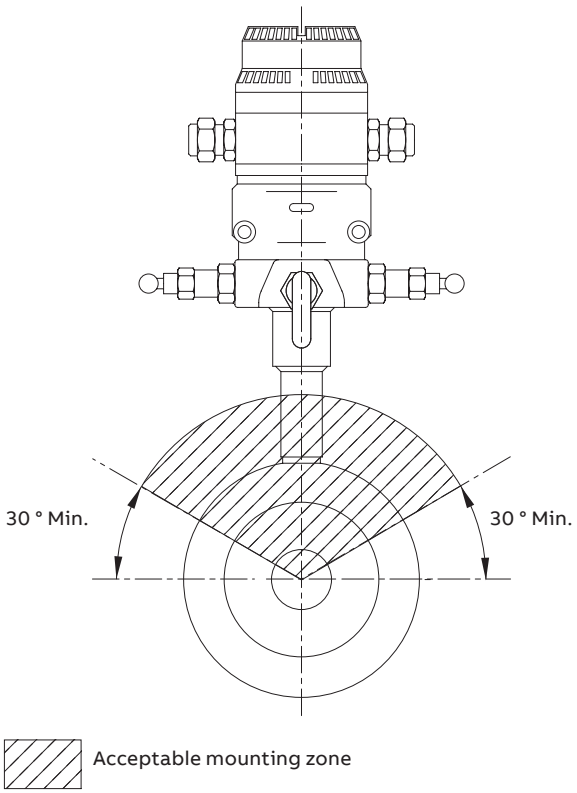

Figure 2 Horizontal pipe mounting – gas

Horizontal pipe mounting – liquids and steam

To ensure that gases vent back into the pipe, mount the meter below the pipe, at least 45 degrees below the horizontal – see Figure 3.

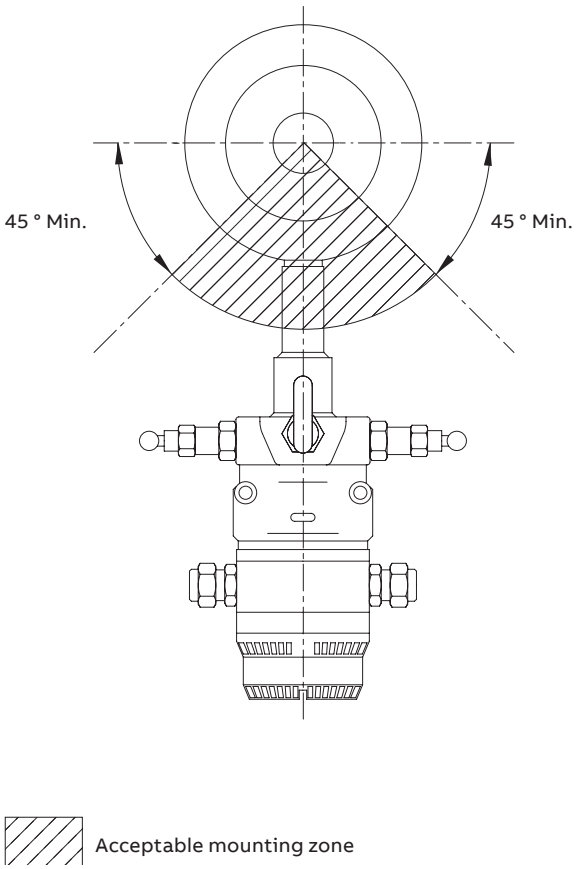

Figure 3 Horizontal pipe mounting – liquids and steam

Vertical pipe mounting – liquid and gas (upward flow)

If using ABB transmitter, the vent/drain screw valves on the electronics body must be located correctly depending on the medium being measured:

If pipeline contains:	Position vent/drain valves:	To:
Liquid	Higher than meter body	enable trapped gases to vent – see Figure 4
Gas	Lower than meter body	enable condensate to drain – see Figure 5

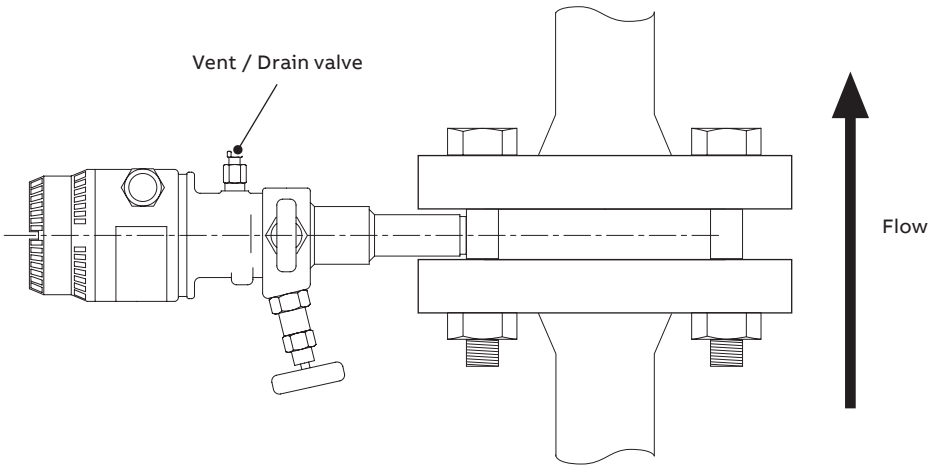

Figure 4 Vertical pipe mounting – liquid

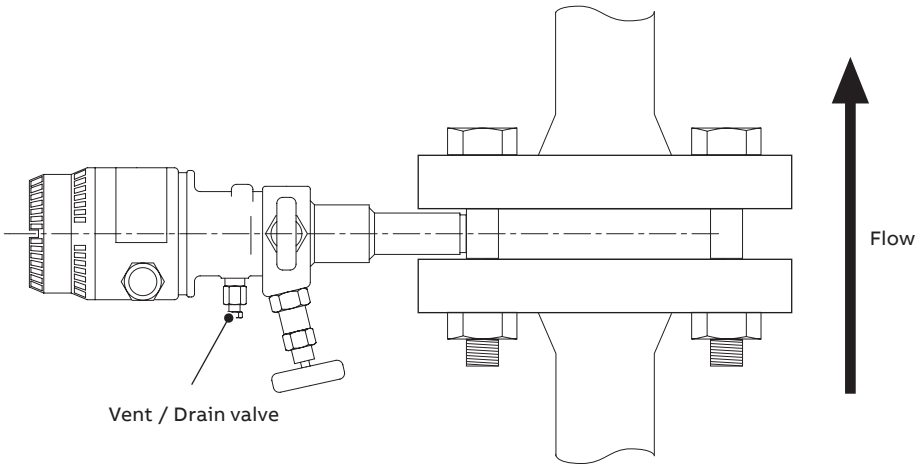

Figure 5 Vertical pipe mounting – gas

If using other than ABB transmitter, refer to relevant transmitter manual.

...2 Installation

Mechanical installation

IMPORTANT NOTE
Before installation, read: 1 General safety information on page 3.

CAUTION
Neither the transmitter nor the bore of the orifice plate is designed to withstand the weight of the meter. Do not lift the meter by either the orifice plate bore or the transmitter. Lift the meter only by the neck.

IMPORTANT NOTE
Accurate centralization in the pipeline is critical to FPD175 performance. For information on the effects of incorrect centralization, refer to standard ISO5167:2003.

To install:

1 Check the Tag Number of the meter to ensure it is the correct unit for the location.

2 Ensure all weld outlines in the pipeline where the meter is to be installed are even. Grind off any protrusions inside the pipe and ensure that the inside of the pipe is smooth and clean.

3 Ensure that any specialized cleaning requirements are performed (for example, those specifically for oxygen/ pharmaceutical applications).

4 Examine the meter and the flange faces and ensure that:

- **a** the faces of the orifice plate are free from scratches and are not buckled
- **b** the square edge of the orifice plate is not worn (no light is reflected from the square edge)
- **c** the orifice plate bore is not marked or distorted
- **d** the gasket surfaces are clean

Replace defective components as necessary.

5 Fit sufficient bolts in the lower part of the pipeline flanges to retain the meter in place.

6 If supplied, locate the centralizing tool on the meter body.

IMPORTANT NOTE
One of two types of centralizing tool is supplied with the meter – see Figure 6.

7 Place the correct gaskets on both sides of the meter body and align them correctly to the orifice plate, ensuring they do not protrude into the pipe bore.

8 Insert the meter and centralizing tool if required between the pipeline flanges ensuring that:

- **a** The manifold equalizing valve is pointing upstream, into the fluid flow.
- **b** The meter is oriented correctly depending on the type of installation – see Figure 2, 3, 4 and 5.

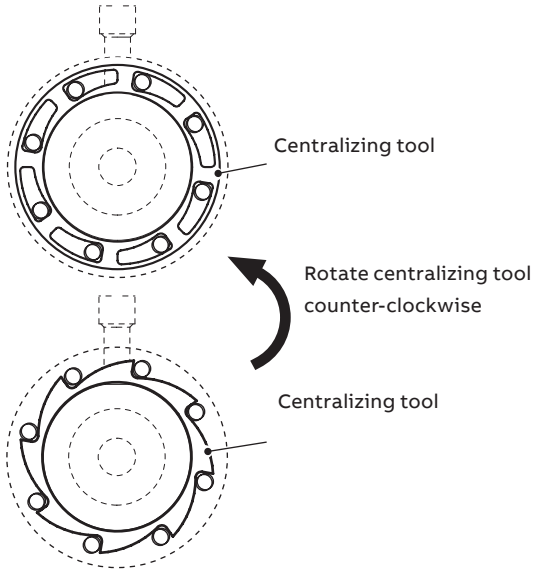

Figure 6 Optional centralizing tool
(meter orientation shown in gas metering installation)

9 Fit bolts diametrically opposite those fitted in step 5 and evenly tighten all bolts hand-tight.

10 Referring to Figure 6, rotate the centralizing tool to push the bolts against the outer edge of the bolt holes.

11 Ensuring the bolts remain held against the outer edge of their bolt holes, fit the remaining bolts and hand-tighten evenly.

12 Determine the maximum tightening torque per the relevant flange specifications.

13 Tighten each bolt to the correct torque in a diagonally opposing pattern; firstly to 30% of the maximum torque, then 60% and finally to the maximum torque.

If the optional centralizing tool is not used, follow steps 7 to 9 and 11 to 13, ensuring that the meter is installed co-axially with the pipe, as errors in alignment will impair meter performance

3 Commissioning

Gas and liquid service

CAUTION.
During the following procedure, wear Personal Protection Equipment appropriate for the process.

1 Install the meter as described in Mechanical installation, page 8:

- for horizontal pipe mounting – gas, refer to Figure 2, page 6.
- for horizontal pipe mounting – liquid, refer to Figure 3, page 6.
- for vertical pipe mounting – liquid, refer to Figure 4, page 7.
- for vertical pipe mounting – gas, refer to Figure 5, page 7.

2 Ensure the pipeline is full.

3 Gradually bring the pipeline up to normal operating pressure, checking for any leaks in the system. If leaks are detected, de-pressurize the pipeline and repair as necessary, observing all local health and safety and environmental requirements.

4 When the system is at normal operating pressure and flow established, bleed the impulse lines using the transmitter drain/vent valves. Collect and dispose of any bleed liquids in accordance with the local environmental regulations.

CAUTION.
Ensure the drain/vent valves are positioned so that process fluid is directed down and away from personnel when it is removed during the drain/vent operation.

To ensure correct operation, the transmitter (whether direct-mounted or remotely-mounted) must be zeroed at the normal operating pressure of the process. The following describes generically the process of zeroing the transmitter, but you must follow the specific instructions supplied by the manufacturer of the transmitter.

To zero the transmitter:

1 Ensure the pipeline is at the normal operating pressure and that the transmitter power supply is on.

2 Close the high pressure (HP) and low pressure (LP) isolation valves of the manifold.

3 Open the equalization valve of the manifold. The transmitter should now indicate a value close to zero.

4 Zero the differential pressure transmitter - following the transmitter operating manual

5 Open the HP and LP isolation valves.

6 Close the equalization valve. The transmitter should now indicate flow.

...3 Commissioning

Steam service

IMPORTANT NOTE
If a remote transmitter and condensate pots are not being used, fill the impulse lines with water or condensate to ensure correct operation and to protect the transmitter from excessive temperatures.

Referring to Figure 3, page 6:

1. Install the meter as described in Mechanical installation, pagepage 8.
2. Ensure the process pipeline is empty and de-pressurized.
3. If the transmitter is directly coupled to the meter manifold, connect a suitable water supply to the pipeline.
4. Open the drain / vent valves.

CAUTION
Ensure the drain / vent valves are positioned to direct process fluid down and away from personnel when they are opened during the drain/vent operation.

5. Open the HP and LP isolation valves and allow water to flow slowly into the impulse lines until an air-free flow is obtained from the drain / vent valves, indicating that the impulse lines are full.
6. Close the HP and LP isolation valves.
7. Close the drain/vent valves and disconnect the water supply.
8. Gradually bring the pipeline up to normal operating pressure, checking for any leaks in the system. If leaks are detected, de-pressurize the pipeline and repair as necessary observing all local health and safety and environmental requirements.

The differential pressure transmitter must be zeroed at the normal operating pressure of the process.

To zero the transmitter:

1. Ensure the pipeline is at the normal operating pressure and that the transmitter power supply is on.
2. Close the HP and LP isolation valves.
3. Open the manifold equalization valve. The transmitter should now indicate a value close to zero.
4. Zero the differential pressure transmitter referring to the relevant transmitter operating manual
5. Open the HP and LP isolation valves.
6. Close the equalization valve. The transmitter should now indicate flow. For information on fault diagnosis, refer to Troubleshooting, page 11.

4 Operation and maintenance

Troubleshooting

Refer to the differential pressure transmitter's Operating Instruction manual for procedures to be followed when error messages are shown on the transmitter's display.
For other suspected problems, complete the following checks to ensure correct installation:

Direction of flow	Ensure the flow direction is in accordance with the arrow on the meter. If not, remove and reinstall the meter correctly.
Mounting orientation	Ensure the meter is oriented correctly to the pipework with regard to flow direction, pipeline and nature of the fluid. Incorrect orientation can lead to metering errors and, in some cases, may damage the meter.
Zeroing of the transmitter	Zero the differential pressure transmitter during installation and commissioning – see Section 3, page 8 (Gas and liquid service) or page 10 (Steam service).
Manifold valves	The meter manifold is fitted with either three or five valves. The three-valve version has two on diametrically opposite sides of the meter (the HP and LP isolation valves) and one on the axis of the pipeline (the equalization valve) . The five valve version has four on diametrically opposite sides of the meter (the HP and LP isolation valves) and one on the axis of the pipeline (the equalization valve) . During measurement, ensure the equalization valve is fully closed and the HP and LP isolation valves are fully open.
Setup/ configuration of the transmitter	Ensure the 4 to 20 mA output of the meter is set correctly and that any receiving equipment is configured for the same flowrate range. Refer to the differential pressure transmitter's Operating Instructions for information on how to perform and check the configuration.

Table 2 Troubleshooting checks

Dismantling

CAUTION
Neither a directly-mounted transmitter nor the bore of the orifice plate is designed to withstand the weight of the meter. Do not lift the meter by either the orifice plate bore or the transmitter. Lift the meter only by the neck.

Always observe the plant safety regulations. Before beginning work, ensure pipework is depressurized and empty.
To dismantle:

1. If the flanges are fitted with a jacking screw, tighten the screw to remove any free play.
2. Loosen the flange securing bolts and/or nuts and (using the jacking screw, if fitted) partially separate the flanges.
3. Remove sufficient bolts to enable the meter, together with the gaskets, to be lifted clear, ensuring that no part of the meter is damaged.

Examination

IMPORTANT NOTE

- The frequency of examination depends upon the abrasive or corrosive nature of the process fluid, for example:
  Steam – annually
  Clean fluid – every 2 or 3 years.
- In the case of a new process or plant, examine the meter during each routine maintenance period until the wear of each installation, relative to others, can be assessed

Examine the meter in accordance with the instructions in Mechanical installation, page 8.

...4 Operation and maintenance

Replacement of removable orifice plate

1 Remove the FPD175 from the pipeline.

2 Check the removable plate (including the fixings) for damage (as per the criteria of Mechanical installation, page 8, step 4). If any damage or excess wear is found, replace the plate.

3 Loosen all 6 fixing screws and remove.

4 Lift the plate out of its location slot.

5 Examine the fixing threads in the FPD175 body checking for damage. If damaged the whole unit should be replaced.

6 Take the new plate out of its protective wrapping and check for damage (again as per the criteria on page 8, step 4).

7 Locate the new plate into the location slot and align the fixing holes with the fixing threads in the FPD175 body.

8 Insert each fixing screw in by hand and loosely tighten.

9 Using a suitably sized screwdriver tighten each fixing screw, working in a diagonally opposing pattern.

10 Check each screw again to ensure they are tight and secure.

11 Reinstall the device into the pipeline detailed in Mechanical installation, page 8.

Reassembly

Reassemble the meter in accordance with the instructions in Mechanical installation, page 8, steps 5 to 13.

5 Specification

Fluids

Liquids, gases and steam (vapor)

Line sizes

25, 40, 50, 80, 100, 150, 200, 250 and 300 mm
(1, 1½, 2, 3, 4, 6, 8, 10 and 12 in.)

Wetted materials

Orifice assembly, stem and manifold

316L stainless steel

Manifold seals

Graphite and PTFE

Process connections

Wafer body to fit between the following flange drillings:

- ASME B16.5 (ANSI) Class 150, 300 or 600
- DIN PN16, PN25, PN40, PN63 or PN100

Pipeline centralization can be assured using optional centralizing tool

Pressure limitations

100 bar (1450 psi) or as flange rating, whichever is the lower

Temperature limitations

Direct mount transmitter

–40 to 450 °F (–40 to 232 °C)
When mounted in steam service, mount at 180° and fill impulse lines with water.

Remote mount transmitter

–40 to 850 °F (–100 to 454 °C) – stainless steel

Assembly to a transmitter

- There is an option for the ABB 266 transmitter and FPD175 to be factory assembled. If the transmitter and FPD175 are not factory assembled, they may be shipped separately. Please notify your Local Sales Team of your requirements.
- A remote mount kit is available to enable remote location of transmitter. Please specify requirements to your Local Sales Team.

Integral RTD*

- 100 Ω platinum RTD temperature sensor assembly with mineral Insulated cable
- The RTD sensor complies with IEC-751 Class B accuracy and meets Intrinsic Safety certification.

***** Available only with direct mount transmitter models.

Orifice plate bore at 20 °C (68 °F)

For Beta = 0.4

25 mm (1 in.)	10.66 mm (0.42 in.)
40 mm (1½ in.)	16.36 mm (0.644 in.)
50 mm (2 in.)	20.99 mm (0.826 in.)
80 mm (3 in.)	31.17 mm (1.227 in.)
100 mm (4 in.)	40.90 mm (1.610 in.)
150 mm (6 in.)	61.63 mm (2.426 in.)
200 mm (8 in.)	81.10 mm (3.193 in.)
250 mm (10 in.)	101.8 mm (4.008 in.)
300 mm (12 in.)	121.29 mm (4.775 in.)

For Beta = 0.65

25 mm (1 in.)	17.32 mm (0.682 in.)
40 mm (1½ in.)	26.58 mm (1.047 in.)
50 mm (2 in.)	34.11 mm (1.343 in.)
80 mm (3 in.)	50.65 mm (1.994 in.)
100 mm (4 in.)	66.47 mm (2.617 in.)
150 mm (6 in.)	100.15 mm (3.942 in.)
200 mm (8 in.)	131.78mm (5.188 in.)
250 mm (10 in.)	165.43 mm (4.01 in.)
300 mm (12 in.)	197.1 mm (7.76 in.)

Weight (approximately)

Size	Typical weight in Kg (lb)
25 mm (1 in.)	8 (17.6)
40 mm (1½ in.)	10 (22)
50 mm (2 in.)	12.5 (27.5)
80 mm (3 in.)	15.5 (34.1)
100 mm (4 in.)	17 (37.4)
150 mm (6 in.)	20 (44)
200 mm (8 in.)	22 (48)
250 mm (10 in.)	26 (57.2)
300 mm (12 in.)	30.5 (67.1)

...5 Specification

Concentric orifice straight pipe requirements

As per ISO 5167:2003

	ß= 0.4	ß= 0.65
Conical reducer (2D – D)	5D	12D
Conical expander (0.5D – D)	12D	28D
Single 90 ° bend	16D	44D
2 off 90 ° bends in same plane	10D	44D
2 off 90 ° bends in different plane	50D	60D

Where D = pipe diameter

Conditioning orifice straight pipe requirements

Normal uncertainty

7D upstream and 2D downstream

Increased uncertainty

No straight pipe upstream and downstream

Performance

Concentric and conditioning plate coefficient uncertainties at reference conditions, excluding transmitter

Concentric plate (for Re >10^5)

Beta 0.4: 1 % uncertainty

Beta 0.65: 1 % uncertainty

* For a combination of Re <10^5 and Beta = 0.65, add 0.5 %

Conditioning plate (for Re >6000)

Beta 0.4: 0.5 % uncertainty

Beta 0.65: 0.5 % uncertainty

Repeatability

0.1 %

ABB recommends a minimum differential pressure of 25 in. wg (62 mbar) to ensure no increase in uncertainty if upstream straight pipe is less than 5 x pipe diameter.

Turndown

Up to 8:1

Notes

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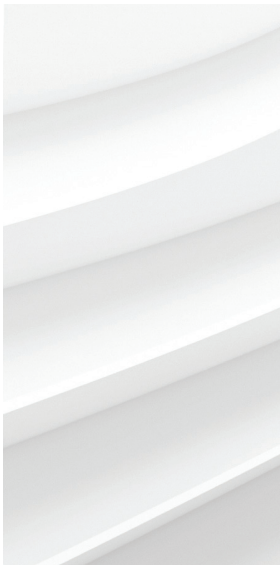

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