

Orifice Plates, Orifice Flanges, Metering Runs and Venturi Tubes

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# ABB

## The Company

We are an established world force in the design and manufacture of instrumentation for industrial process control, flow measurement, gas and liquid analysis and environmental applications.

As a part of ABB, a world leader in process automation technology, we offer customers application expertise, service and support worldwide.

We are committed to teamwork, high quality manufacturing, advanced technology and unrivalled service and support.

The quality, accuracy and performance of the Company's products result from over 100 years experience, combined with a continuous program of innovative design and development to incorporate the latest technology.

The UKAS Calibration Laboratory No. 0255 is just one of the ten flow calibration plants operated by the Company and is indicative of our dedication to quality and accuracy.

EN ISO 9001:2000



Cert. No. Q 05907

EN 29001 (ISO 9001)



Lenno, Italy – Cert. No. 9/90A

Stonehouse, U.K.



## Electrical Safety

This equipment complies with the requirements of CEI/IEC 61010-1:2001-2 'Safety Requirements for Electrical Equipment for Measurement, Control and Laboratory Use'. If the equipment is used in a manner NOT specified by the Company, the protection provided by the equipment may be impaired.

## Symbols

One or more of the following symbols may appear on the equipment labelling:

	<b>Warning</b> – Refer to the manual for instructions		Direct current supply only
	<b>Caution</b> – Risk of electric shock		Alternating current supply only
	Protective earth (ground) terminal		Both direct and alternating current supply
	Earth (ground) terminal		The equipment is protected through double insulation

Information in this manual is intended only to assist our customers in the efficient operation of our equipment. Use of this manual for any other purpose is specifically prohibited and its contents are not to be reproduced in full or part without prior approval of the Technical Publications Department.

### Health and Safety

To ensure that our products are safe and without risk to health, the following points must be noted:

1. The relevant sections of these instructions must be read carefully before proceeding.
2. Warning labels on containers and packages must be observed.
3. Installation, operation, maintenance and servicing must only be carried out by suitably trained personnel and in accordance with the information given.
4. Normal safety precautions must be taken to avoid the possibility of an accident occurring when operating in conditions of high pressure and/or temperature.
5. Chemicals must be stored away from heat, protected from temperature extremes and powders kept dry. Normal safe handling procedures must be used.
6. When disposing of chemicals ensure that no two chemicals are mixed.

Safety advice concerning the use of the equipment described in this manual or any relevant hazard data sheets (where applicable) may be obtained from the Company address on the back cover, together with servicing and spares information.

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# 1 General Installation Requirements

**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 was originally 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.

## 1.1 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.
- Observing and following the associated documents (specification, diagrams, dimensions sheet).

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 on or soldering on parts.
- Repairs, modifications and 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.

## 1.2 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 will not be 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.

## 1.3 Technical Limit Values

The equipment is intended for use only within the technical limit values specified on the data plate, including those for:

- The maximum working pressure
- The maximum and minimum operating temperatures.

## 1.4 Pressure Measurement

Install the DP Transmitter above the pipe-run on gases, and below the pipe-run on liquids and steam applications.

Ensure the impulse pipes have minimum inside diameter of 7 mm (0.275 in.) with ½ in. NB schedule 80 pipe or ½ in. o.d. instrument tubing preferred. Run the impulse pipes close together to avoid temperature differences between the HP and LP legs.

Ensure that the tapping points for horizontal pipes are located below the horizontal for liquids and above the horizontal for gases. The bottom tapping point for vertical pipes must be brought to the same height as the top tapping point.

For steam or wet gas applications use condensate (catch) pots. The tapping points are located on the horizontal for horizontal pipes. The bottom tapping point for vertical pipes must be brought to the same height as the top tapping point.

Condensate (catch) pots of the 3-port type offer the advantage of a filling point to protect instruments from severe process temperatures.

General installation objectives are to ensure the impulse pipes are completely full on liquid and steam applications and completely empty on gas applications. On gas applications it is important that any condensate is able to run back into the main pipe-run or be trapped by condensate (catch) pots.

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.

## 2 Orifice Plates

### 2.1 Installation

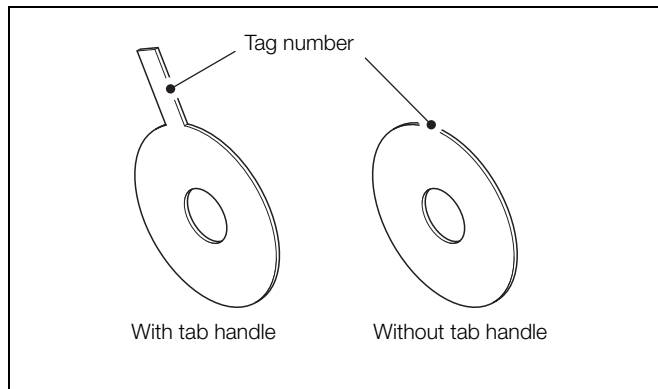


Fig. 2.1 Orifice Plates

1. Check the Tag Number of the orifice plate to ensure it is the correct unit for the location – see Fig 2.1.
2. Any weld outline must be even. Any protrusions inside the pipe must be ground-off and swept clean before installing the plate.
3. Ensure that the inside of the pipe is smooth and clean.
4. The tapplings and any associated impulse piping must be clear prior to putting into service. Check that there is no weld-spatter or any other blockages in the tapping holes and associated impulse piping. If necessary, these can be cleared by rodding out (for flange or D and D/2 type) or flushing (for corner or annular types and impulse piping) to remove any blockage. Observe any cleaning specification, for example, oxygen/pharmaceutical service.
5. Inspect the orifice plate and/or carrier and the flange faces by checking 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, that is, 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 any defective components if necessary.
6. Insert sufficient bolting to retain the orifice plate and/or the carrier in place.

7. Insert the correct gaskets between the orifice plate and the flange faces and/or carrier.

For full-face type orifice plates (that is, where the plate has holes through which the bolts pass) the gaskets must be placed on both sides of the plate and aligned prior to installation between the flanges.

For other plates, place the orifice plate between the bolts of the flanges, ensuring that the markings on the handle or the periphery of the orifice plate are facing upstream and that any drain or vent is correctly aligned. The orifice plate is designed so that it is centred automatically by the correct bolting. Loosen the jacking screw, if fitted.

8. Install the remaining bolting. Tighten the bolts on the flanges, observing the maximum torque according to the relevant specifications.

### 2.2 Maintenance

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

#### 2.2.1 Dismantling

To dismantle:

1. If the flanges have a jacking screw, take up the slack.
2. Loosen off the stud bolts/nuts and partially separate the flanges (using the jacking screw, if fitted).
3. Remove sufficient bolts, so that the orifice plate and/or the carrier can be lifted clear, together with the gaskets, ensuring that the orifice plate is not damaged.

#### 2.2.2 Inspection

Follow the instructions in Section 2.1, page 3, steps 3 to 5, with the following additional guidance:

- The frequency of the checks depends upon the abrasive or corrosive nature of the process fluid (that is, in the case of steam the plate must be checked yearly whereas for clean water the check may be every two or three years).
- In the case of a new process or plant, the checks must be made during each routine maintenance period until the wear of each installation, relative to others, can be assessed.

#### 2.2.3 Reassembly

Follow the instructions in Section 2.1, page 3, steps 6 to 8.

## 3 Orifice Flange Assemblies

### 3.1 Installation

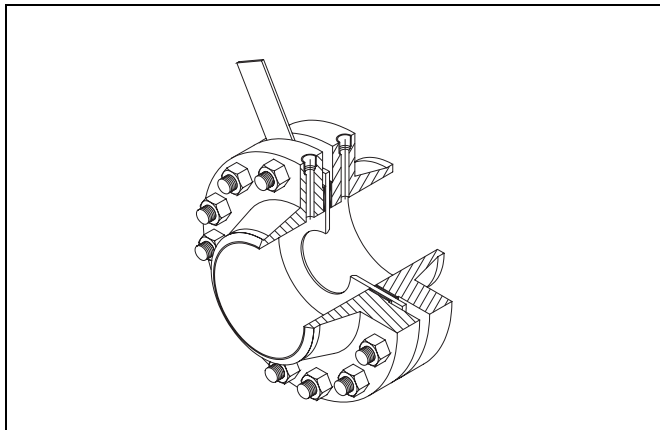


Fig. 3.1 Orifice Flange Assembly

Orifice flanges must be welded in accordance with the engineering standards for Weld-Neck end flanges. Take the following extra precautions:

1. Check the Tag Number of the flanges against the piping diagram to make sure they are the correct set for the location.
2. Ensure that the flanges are concentric to the inside of the pipeline and that the pressure tapping points are aligned as per the manufacturer's or the contractor's drawing.
3. Before welding the flanges into the line, disassemble the orifice flange assembly, because the welding process may damage the orifice plate and gaskets. Before installing, check for any defects on the flanges and ensure the gaskets are correct and suitable for the process. Assess any stresses or strains the flanges will be under once installed.
4. Ensure all weld outlines are even. Take care to ensure that any protrusion inside the pipe is ground off without undercut and swept clean.
5. Follow the instructions in Section 2.1 from Step 4, covering the Installation (in part) of Orifice Plates.

### 3.2 Maintenance

Always observe the plant safety regulations. Before beginning work ensure the pipework is depressurized and empty. Follow the instructions in Section 2.2, covering the Maintenance of Orifice Plates (Dismantling, Inspection and Reassembly), plus the following additional guidance:

- Check flanges and bolting for signs of damage at the same time as the orifice plates are checked.
- Inspect the assembly regularly to ensure that there are no defects or damage, such as material corrosion and wear, and/or cracking on a weld or flange.

## 4 Metering Runs

### 4.1 Introduction

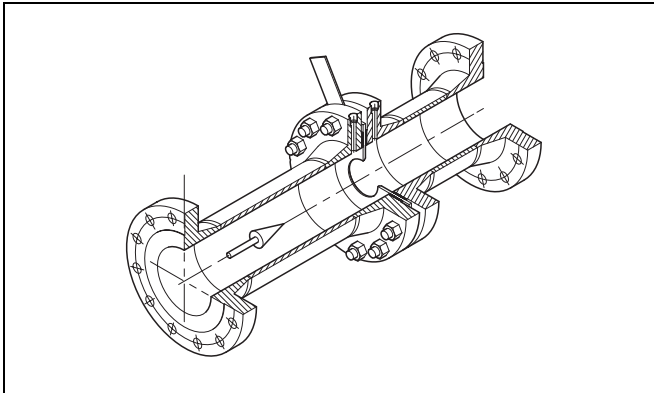


Fig. 4.1 Metering Run

Metering runs are sections of clean straight pipe upstream and downstream of an orifice plate or other assembly. The longer length of pipe is installed upstream of the primary element. All ends are flanged or have weld-prepared ends.

Metering runs are designed in accordance with the process conditions advised by the customer and, unless specified, no allowance will have been made for corrosion, erosion or any externally applied stresses. The metering run must therefore be installed in an operational situation protected from external stresses.

The pressure equipment must not be misused and must only be operated within the maximum and minimum pressure and temperature limits specified on the data plate. Where no minimums are stated these shall be taken as 0 barg and 0 °C.

### 4.2 Installation

1. Check the Tag Number of all components of the metering run against the piping diagram to ensure that they are the correct set of components for the location.
2. Ensure that the longer length of pipe is installed upstream of the primary element.
3. Before bolting or welding into the line, ensure that the pressure tapping and/or thermowell points are aligned as per the manufacturer's or the contractor's drawing.
4. For weld-in units ensure that the pipe sections are concentric to the inside of the pipeline.
5. Ensure that all weld outlines are even. Take care to ensure that any protrusion inside the pipe is kept to an absolute minimum.
6. For flanged units, observe the maximum torque of the bolting according to the relevant specifications.
7. Follow the instructions in Section 2.1, steps 5 to 8, covering the Installation (in part) of Orifice Plates.

### 4.3 Maintenance

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

Follow the instructions in Section 2.2 covering the Maintenance of Orifice Plates (Dismantling, Inspection and Reassembly), plus the following additional guidance:

- Inspect the assembly and metering run at regular maintenance intervals to ensure there are no defects or damage such as material corrosion and wear, cracking on a weld or flange, or thinning or cracking of pressure-retaining housing. If any such damage or defects are detected, to a degree where they are judged to have become dangerous, the assembly and/or run must be removed from service.
- Ensure that the bolts are tightened to the correct torque.

## 5 Flow Nozzles

### 5.1 Introduction

Flow nozzles can be:

- Flanged type, where the nozzle is part of a flange assembly to be welded in the line
- Weld-in type, where the nozzle is supplied within a pipe unit ready for welding in the line.

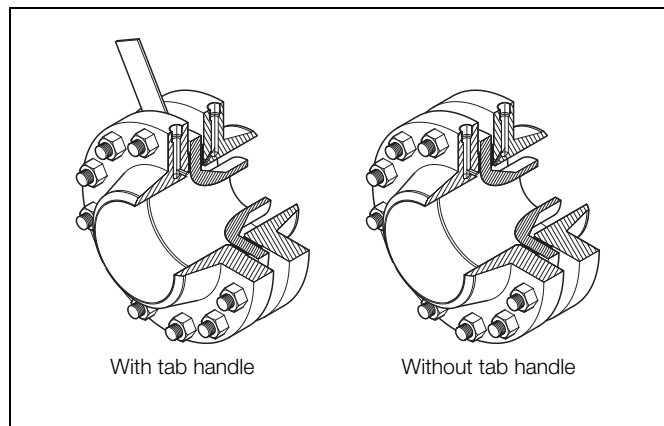


Fig. 5.1 Flow Nozzles

### 5.2 Installation

To install:

1. Check the Tag Number of the unit against the piping diagram to make sure that it is the correct unit for the location.
2. Ensure that the inside surfaces of the pipes are smooth and clean and that the edge preparations are in accordance with the welding procedure.
3. Ensure that the flanges or integral weld-in nozzle are concentric to the inside of the pipeline and that the pressure tapping points are aligned as per the manufacturer's or the contractor's drawing.
4. For a Flanged unit, before welding the unit into the line, disassemble the nozzle flange assembly, as the welding process may damage the nozzle and gaskets.
5. Ensure that all weld outlines are even and that any protrusion inside the pipe is kept to an absolute minimum. For a Flanged unit, any protrusion inside the pipe must be ground off and swept clean.
6. Ensure that the tappings and any associated impulse piping are clear before putting into service. Check that there is no weld spatter or any other blockage in the tapping holes and associated impulse piping. If necessary, these can be cleared by rodding out (for flange or D and D/2 type) or by flushing (for corner or annular types and impulse piping) to remove any blockage. Observe any cleaning specification, for example, oxygen/pharmaceutical service.

7. For flanged or carrier type nozzles:

- Inspect the nozzle and/or the carrier and the flange faces to ensure that the faces of the nozzle are free from scratches and that the nozzle inlet profile is clean and polished.
- Check that the gasket surfaces are clean. Replace if necessary.

8. Re-install the nozzle and gaskets between the flanges. Due to the long nozzle profile the nozzle must be inserted into the downstream pipe section or the carrier, before that section is lowered into position and bolted into the line.

9. Install sufficient bolting to retain the nozzle and/or the carrier.

Insert the correct gaskets between the nozzle and the flange faces and/or the carrier. Place the nozzle between the bolts of the flanges, ensuring that the polished nozzle inlet is facing upstream and that any drain or vent is correctly aligned. The nozzle is designed so that it is automatically centred by use of the correct bolting.

10. Install the remaining bolting. Loosen the jacking screw, if fitted.

11. Tighten the bolts on the flange as per the relevant engineering standards, observing the maximum torque of the bolting according to the relevant specifications.

### 5.3 Maintenance

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

#### 5.3.1 Dismantling

To dismantle:

1. If the flanges have a jacking screw, take up the slack.
2. Loosen the stud bolts/nuts and partially separate the flanges (using the jacking screws, if fitted).
3. Remove sufficient bolts, so that the nozzle and/or carrier can be lifted clear (together with gaskets), ensuring that the nozzle is not damaged.

#### 5.3.2 Inspection

Inspect the assembly regularly to ensure there are no defects or damage, such as material corrosion and wear, and/or cracking on a weld or flange. Check that the bolts are tightened to the correct tension.

The frequency of the checks depends upon the abrasiveness of the process fluid. In the case of steam, the nozzle must be checked yearly, whereas for clean water the check may be every two or three years.

In the case of a new process or plant, the checks must be made during each routine maintenance period until the wear of each installation, relative to others, can be assessed.

#### 5.3.3 Reassembly

Follow the instructions in Section 5.2 on page 6 from step 2.



## 6 Venturi (Including Dall and Lo-Loss Tubes)

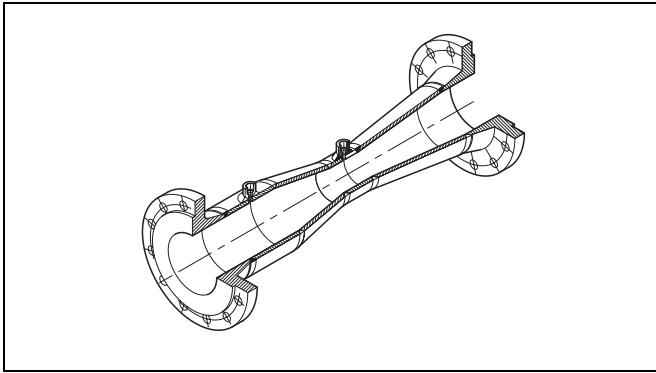


Fig. 6.1 Venturi

Venturi Tubes are sections of piping incorporating tapered inlet and outlet sections with a parallel throat section and integral pressure tapping points. The ends are flanged or weld-prepared.

Venturi are designed in accordance with the process conditions advised by the customer and, unless specified, no allowance is made for corrosion, erosion or any externally applied stresses. The Venturi must therefore be installed in an operational situation protected from external stresses.

The pressure equipment must not be misused and must be operated only within the maximum pressure and minimum temperature limits specified on the data plate. Where no minimum is stated these shall be taken as 0 barg and 0 °C.

Venturi Tubes are of the Flanged type or the Weld-in type and are supplied in one piece.

### 6.1 Installation

To install:

1. Check the Tag Number of the unit against the piping diagram to ensure that it is the correct unit for the location.
2. Install the unit with the arrow on the unit label pointing in the direction of flow.
3. Before bolting or welding in the line, ensure that the pressure tapping points are aligned as per the manufacturer's or the contractor's drawing.
4. Ensure that all weld outlines are even and that any protrusion inside the pipe is kept to an absolute minimum.
5. Ensure that the tappings and any associated impulse piping are clear before putting into service. Check that there is no weld-spatter or any other blockages in the tapping holes and associated impulse piping. If necessary these can be cleared by rodding out or flushing to remove any blockage. Observe any cleaning specification, for example, oxygen/pharmaceutical service.
6. For flanged units, tighten the bolts to the maximum torque given in the relevant specifications. For weld-in units ensure that the pipe sections are concentric to the inside of the pipeline.
7. For weld-in units ensure that the weld profile is even and that there is no excessive protrusion into the bore.

### 6.2 Maintenance

Always observe the plant safety regulations. Before beginning work ensure the pipe work is depressurized and empty.

#### 6.2.1 Dismantling and Inspection

Inspect the Venturi at regular maintenance intervals (that is, during plant shutdowns) for thinning or cracking of pressure-retaining housing. If such defects are detected, to a degree where they are judged to have become dangerous, the venturi must be removed from service.

For flanged types only, remove the unit from the line and check for any corrosion, erosion or any other mechanical damage. Also check that any bolted connections and impulse fittings are correctly tightened.

For units that are welded into the pipeline, it is essential to use suitable test equipment to check the pressure-retaining parts for wear, degradation or any other mechanical damage. If damage is apparent, the unit must be replaced to ensure accuracy of measurement.

#### 6.2.2 Reassembly

For reassembly all types of venturi except weld-in units, follow the instructions in Section 6.2 on page 7.

## Notes

# PRODUCTS & CUSTOMER SUPPORT

## Products

### Automation Systems

- for the following industries:
  - Chemical & Pharmaceutical
  - Food & Beverage
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- Positioners

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- Zirconia Oxygen Analyzers, Katharometers, Hydrogen Purity and Purge-gas Monitors, Thermal Conductivity

## Customer Support

We provide a comprehensive after sales service via a Worldwide Service Organization. Contact one of the following offices for details on your nearest Service and Repair Centre.

### United Kingdom

ABB Limited  
Tel: +44 (0)1946 830 611  
Fax: +44 (0)1946 832 661

### United States of America

ABB Inc.  
Tel: +1 215 674 6000  
Fax: +1 215 674 7183

### Client Warranty

Prior to installation, the equipment referred to in this manual must be stored in a clean, dry environment, in accordance with the Company's published specification.

Periodic checks must be made on the equipment's condition. In the event of a failure under warranty, the following documentation must be provided as substantiation:

1. A listing evidencing process operation and alarm logs at time of failure.
2. Copies of all storage, installation, operating and maintenance records relating to the alleged faulty unit.

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**ABB Limited**  
Salterbeck Trading Estate  
Workington, Cumbria  
CA14 5DS  
UK  
Tel: +44 (0)1946 830 611  
Fax: +44 (0)1946 832 661

**ABB Inc.**  
125 E. County Line Road  
Warminster  
PA 18974  
USA  
Tel: +1 215 674 6000  
Fax: +1 215 674 7183