

# Differential Pressure Flow Elements

DP Primary Elements – available with all the documentation, testing and certification that your industry needs



**Comprehensive range of DP primary elements**

– including orifice plates, carrier assemblies, metering runs, nozzles, Venturi tubes, Torbar averaging pitot tubes, Wedge meters and meters for subsea use

**Complete portfolio of secondary devices available**

– including DP transmitters, temperature and pressure elements, flow computers and recording/control instrumentation

**Designed to all the major standards**

– including the latest ISO 5167-1:2003, API, R W Miller, AGA and ASME

**Oil and Gas Industry standard designs available**

– for example, Shell, BP, Conoco, Esso, BOC designs and Industry/customer-specific paint finishes. Products designed to meet the demanding requirements of the Oil and Gas industries

**Extensive range of non-destructive examination methods**

– including hydrostatic pressure testing, dye-penetrant, radiography and magnetic particle inspections (ASME VIII) and hardness survey (for example, Rockwell)

**Comprehensive certification and documentation available**

– including PED 97/23/EC, material certificates (3.1B, 3.1C, NACE, etc.) and comprehensive welder and weld procedure qualifications (ASME IX and BS EN 288/287)

### Total Capability

Although it is over 100 years since the first DP devices were used, they still form the largest installed base of all flow measurement loops, especially in the Process and Chemical/Oil/Gas sectors.

ABB has been supplying DP devices from their very beginnings in the 19th century and have unrivalled experience in the field, incorporating the expertise of Kent, Taylor and Bush Beach. Kent engineers were involved in the design and manufacture of some of the first Venturi tubes to be used in the UK.

ABB can offer a complete range of DP Flowmeters – not only the primary elements but also the secondary transmitter and the recording/control/indication instrumentation that you need.

The ABB range of DP Primary Elements includes the following devices:

**Venturi Tubes**

**Wedge Meters**

**Averaging Pitot Tubes (Torbar)**

**Orifice Plates**

Square-edged, Conical-entry and Quarter Circle Concentric, Eccentric and Segmental

**Orifice Carrier Ring Assemblies**

Integral and Split-Ring

**Orifice Flange Assemblies**

**Compact Orifice Flow Meters (OriMaster)**

**Meter Runs**

Standard and Integral

**Flow Nozzles**

ISA, Long Radius and ASME Throat-tap

### Basic Principle of Operation

DP devices work on a principle based upon the Law of Conservation of Energy, where a restriction in the fluid path causes an acceleration in the fluid velocity and hence an increase in kinetic energy. The gain in kinetic energy is at the expense of pressure energy and this is manifested as a drop in fluid pressure across the narrowest part of the restriction.

The drop in pressure and the flow rate are linked by the following (albeit simplified) relationship:

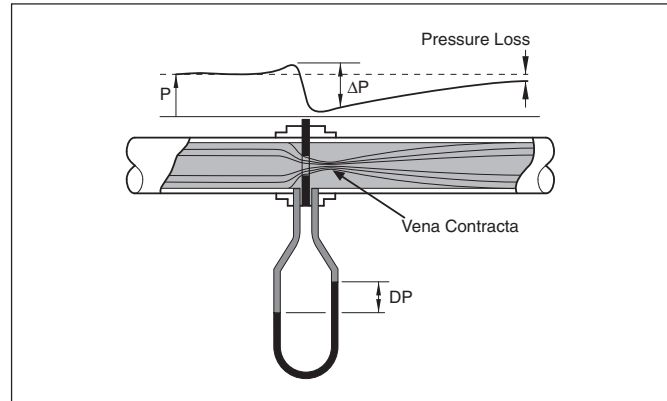
$$Q = k \sqrt{h}$$

where Q= fluid flow rate

k = a constant for that dp device

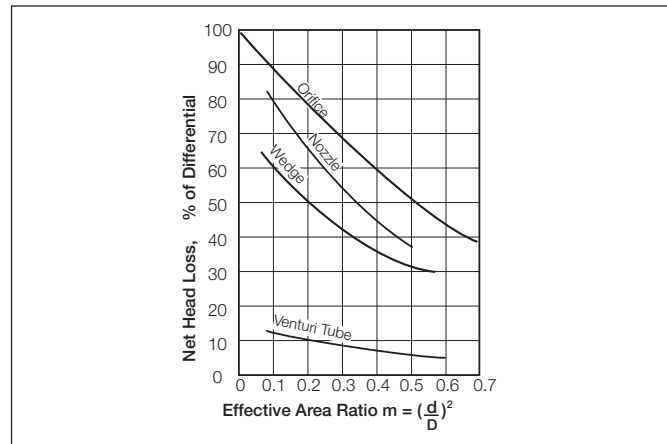
h = the pressure difference across the restriction

The DP generated for a given class of device depends on the bore of the restriction. Many calculation standards exist but in all cases the differential pressure produced by the restriction is larger than would normally be expected. This effect is due to the fluid stream being unable to follow the contours of the restriction perfectly and therefore having a flow stream whose narrowest diameter (known as the Vena Contracta) is less than the diameter of the restriction.



DP and Vena Contracta

The Vena Contracta increases the velocity and therefore the kinetic energy, that in turn gives a larger drop in pressure than would normally be expected. Some of the differential pressure generated is recovered downstream of the unit but all DP devices incur some loss – known as the 'irrecoverable pressure loss' – and this is usually expressed as a percentage of the differential pressure.



Comparative Pressure Losses

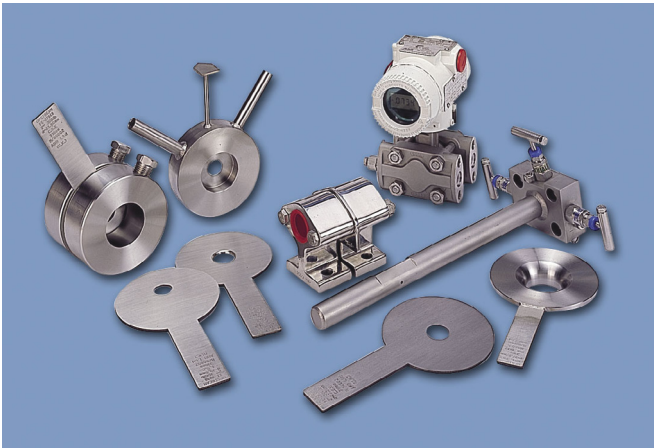
To correct for the Vena Contracta effect, each device has a Discharge Coefficient that is a multiplying factor of less than 1 and is part of the calculation. Typically the smaller the Vena Contracta compared with the bore of the device, the larger the deviation from expectations and hence the smaller the coefficient.

Units with a Vena Contracta diameter closer to that of the bore have a smaller deviation and hence a larger coefficient.

In general, devices that control and guide the fluid in its path into, through and out of the element have coefficients nearer to unity (e.g. 0.995 for a venturi tube). Those with little or no conditioning of the fluid path have lower coefficients (e.g. 0.6 to 0.65 for an orifice plate).

### Quality Products Backed-up With Comprehensive Documentation

ABB offers unsurpassed quality in its DP devices – and we also provide the full testing and documentation that your application needs. Whether the requirement is a single orifice plate with a simple Certificate of Conformity or a project requiring full material inspection, traceability, third-party verification, calibration and comprehensive data dossiers – ABB can satisfy all of the requirements.



Here are just some of the standards we follow and the services we can provide:

#### Quality Systems

BS EN ISO 9001:2000  
Q 05907

#### Environmental Impact

ISO 14001  
EMS 40882

#### EU Pressure Equipment Directive

97/23/EC

#### Design

BS EN ISO 5167-1:2003  
R W Miller  
API  
ASME  
L W Spink  
AGA

#### Materials and Traceability

BS EN 10204 3.1 B,C  
NACE MR-01-75

#### Product Testing Services

Hydrostatic Pressure testing  
Radiography – X-Ray/Gamma  
Magnetic Particle Inspection  
Dye-Penetrant Inspection  
Ultrasonic examination  
ASME VIII  
PMI (Texas Nuclear, Metascop)  
Flow Calibration  
Customer Inspection  
Independent Third Party Inspection

#### Base Metal Testing

Charpy Impact testing  
Hardness Survey  
HIC Testing  
Inter-crystalline Corrosion Testing etc.

#### Certification/Documentation to Your Requirements

Bore Calculations  
PED 97/23/EC  
CE Marking  
Material Certificates to 3.1B, 3.1C  
NACE MR-01-75 Conformity Certificate  
Welding Qualifications to ASME IX, EN BS 288/287  
GA Drawings  
Certificate of Conformity  
Weight Certificates  
NDT Certificates and Procedures  
Quality Plan  
Full Data Dossier  
Installation and Operating Manuals etc.

## Venturi Tube (VTC)



The classical Venturi tube is a robust, low pressure-loss device and is available for line sizes 25 to 1200mm (1 to 48 in.) as standard, with larger sizes available upon request. The meter can measure a wide range of clean liquids and gases. Smaller sized units are machined from barstock or forged bar; larger sizes are fabricated from rolled plate with forged flanges.

We can also offer full secondary systems with DP transmitters, pressure transmitters, temperature transmitters and flow computers (see page 15).

### Specification

#### Accuracy

Calibrated	within $\pm 0.5\%$ at design flowrate
Uncalibrated	typically within $\pm 1.5\%$ at design flowrate

#### Pressure loss

5 to 12% of differential head, dependent on the beta ratio (throat/pipe diameter ratio)

#### Maximum working pressure

Dependent on the material selection and application

#### Maximum working temperature

Dependent on the material selection and application

#### Pipeline size range (standard)

25 to 1200mm (1 to 48 in.)  
Fittings for larger pipelines are available to special order

#### Standard materials and finishes

##### Carbon steel

BS1501-151-430A; ASTM A105N/ASTM A106GRB

##### Stainless steel

BS 1502 316S31; ASTM A240 316;  
ASTM A182 F316; ASTM A312 TP 316

ABB can supply Venturi tubes in other materials and finishes to suit particular applications. Advice given on receipt of application details

All tubes are tested in accordance with the relevant code of practice or to customers' specific requirements

#### Flanges

Standard sizes to suit pressure rating and mating flanges

#### Tappings

$\frac{1}{2}$  in. NPT as standard. Also available as  $\frac{1}{2}$  in. BSPT,  $\frac{1}{2}$  in. socket weld connection,  $\frac{1}{2}$  in. NB Nipolet,  $\frac{1}{2}$  in. NB Nipoflanges, etc.

#### Testing/Documentation

A full range of applicable NDT, Documentation and Certification is available (see page 3)

## Wedge Flowmeter (WMR)



The simple design of ABB Wedge Flow Elements with their V-shaped flow restriction makes them extremely robust and, when coupled with ABB's leading range of electronic pressure transmitters, extremely accurate.

The ABB Wedge flowmeter is bi-directional and is particularly suitable for fluids with high solid content, erosive/abrasive fluids and high viscosity fluids. The smooth flow path has good self-cleaning characteristics and performance is not dependent on maintaining sharp edge profiles. The element design also allows solids to pass through the restriction without accumulating. The meter discharge coefficient remains constant down to low Reynolds Numbers (unequalled stability for Rd as low as 500), making it suitable for high-viscosity liquids.

To handle a range of flow rates within each nominal size of Wedge meter, up to 6 fixed ratios of free height below the restriction (H) to diameter (D) are available.

For use with high-viscosity fluids or with fluids which could block conventional small-bore impulse pipework, large bore tappings and remote-seal DP transmitter elements can be accommodated.

Typically the Wedge Flowmeter incurs a lower pressure loss than comparable orifice plates and nozzles.

ABB can also offer full secondary systems with DP transmitters, pressure transmitters, temperature transmitters and flow computers.

## Specification

### Accuracy

Calibrated	within $\pm 0.5\%$ ( $\pm 0.75\%$ for DN15 1/2 in.)
Uncalibrated	$\pm 5\%$

### Pressure loss

5 to 12% of differential head, dependent on the H/D ratio

### Maximum working pressure

Limited by process and tapping connection rating.  
Standard process designs up to ANSI 600 lb. rating  
Higher pressures available to special design

**Note:** Chemical Tee connections are limited to max 20.6 bar (300 psi)

### Maximum working temperature

Dependent on the material selection and application

### Pipeline size range (standard)

150 to 600mm (6 to 24 in.)  
Fittings for larger pipelines are available to special order

### H/D ratio

0.2 to 0.7, dependent upon size and design  
H/D ratio may be selected using the ABB Genie II sizing software ([www.abbgenie.com](http://www.abbgenie.com))

### Standard materials

Carbon Steel	ASTM A105 or A350 LF2
Stainless Steel	BS 1502 316S31 or ASTM A240 316

### Tappings

1/2 in. NPT female pipe taps or flanges (to ANSI B 16.5) or  
Chemical Tee, dependent on application requirements

### Testing/Documentation

A full range of applicable NDT, Documentation and Certification is available (see page 3)

## Torbar Averaging Pitot Tube



Torbar is a multi-port, averaging pitot flowmeter that utilizes the classical Pitot Tube principle and can be supplied as a primary element only or coupled with ABB's industry-leading 266 DP or multi-variable transmitters. A pitot tube measures flow by sensing the difference between the impact pressure of the flow and the static pressure. Unlike a conventional single-point pitot tube (which has the limitation of being a point-velocity device), Torbar has multiple impact-sensing ports across the pipe diameter and produces an averaged differential pressure signal proportional to the flow rate.

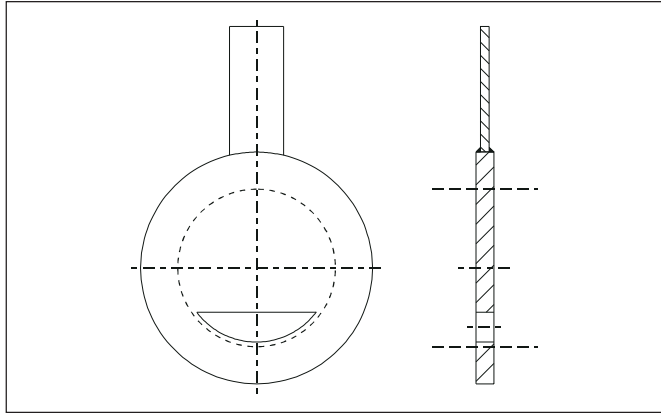
The outer impact tube has a number of pressure sensing holes facing upstream that are positioned at equal annular points in accordance with a log-linear distribution. The 'total pressures' developed at each upstream hole by the impact of the flowing medium are averaged in two stages: firstly, within the outer impact tube and secondly (and more accurately) within the internal averaging tube. This pressure is represented at the head as the high pressure component of the DP output.

Torbar is a versatile and cost-effective solution to difficult metering problems. It is type calibrated so that no further calibration is necessary once the meter is installed. It is simple to install and, prior to installation, ABB calculates the resonant frequency band, ensuring that the device is suitable for the purpose – a service that few companies provide.

Torbar is suited to the measurement of liquids, gases, saturated and super-heated steam. It offers low pressure drop, is available in a wide range of sizes and can be used in rectangular ducts. For further information refer to SS/TORBAR.

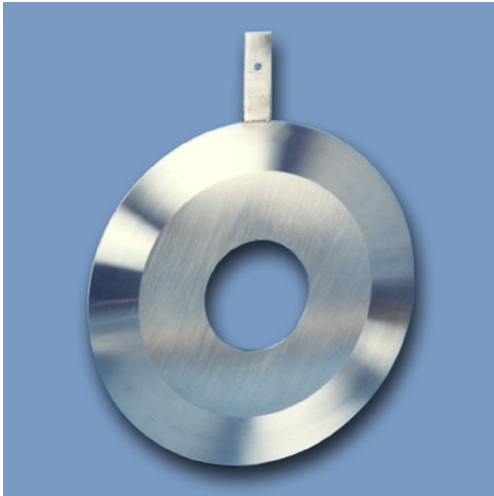
**Orifice Plates**

The ABB range extends from standard size orifice plates, some of which are available on a next day delivery if required, through orifice carrier assemblies to custom-engineered metering sections, such as those utilized in fiscal gas flow, incorporating temperature and pressure compensation elements. The plates are usually supplied with a data tab welded to the circumference. On this tab can be engraved the Tag Number plate bore, etc., which is visible without removing the plate from the line.



Typical Orifice Plate

**Concentric Orifice Plates**



Concentric orifice plates represent the majority of plates used in all orifice-based devices and, as the name suggests, the orifice bore is positioned in the exact centre of the plate. The user must arrange for the provision of tapping points in the pipework in the necessary positions so that the generated differential pressure can be measured and, if necessary, transmitted.

A variety of tapping point configurations are used:

**D and D/2 taps**

Here the tapings are located in the pipe wall. The centreline of the upstream tapping is one pipe diameter (D) from the upstream face of the plate and the downstream tapping is half the pipe diameter (D/2 or 1/2D) from the downstream face.

**Flange taps**

Here the tapings are located in the pipe flanges. The centreline of the upstream tapping is 25.4 mm (1 in.) from the upstream face of the plate and similarly the downstream tapping is 25.4 mm (1 in.) from the downstream face.

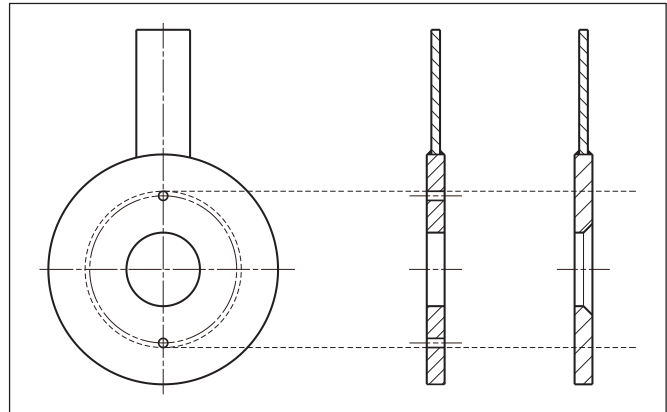
**Corner taps**

Corner Taps are also located in the pipe flanges but their centrelines break into the pipe exactly at the corners formed by the plate faces and the pipe walls.

ABB offers three types of concentric orifice plate to cover a wide range of applications designated CSE, CCL and CQC.

**Concentric Square Edge Type (CSE)**

Type CSE plates are used to measure the flowrate of clean, low-viscosity liquids, gases and dry steam at Reynolds Numbers in

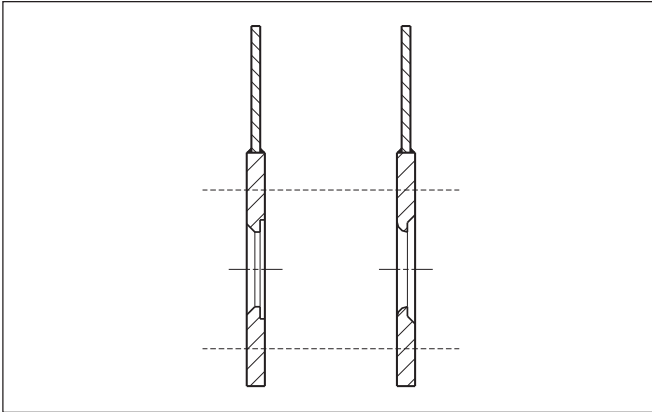


Concentric Square Edge Orifice Plate

the turbulent regime. The bore is sharp-edged on the inlet and usually parallel on the outlet, although, dependent on the d/D ratio and thickness, the outlet may be chamfered. The bore is calculated to produce the requested differential pressure at the design maximum flowrate and flowing conditions.

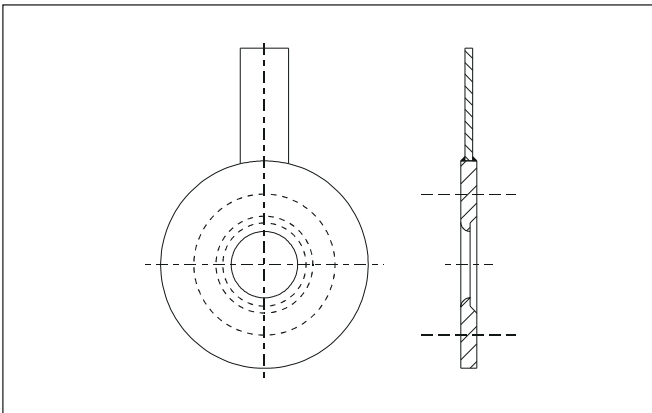
The typical accuracy of a CSE plate is ±0.5% but this is dependent upon the design conditions.



**Concentric Conical Entry Type (CCL)**

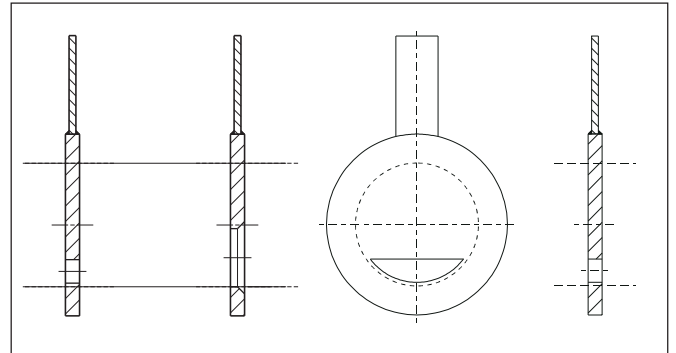
Type CCL Conical Entry plates have a bore with a chamfered (or conical) inlet section and a parallel throat/exit section. Their advantage is that they maintain their accuracy down to very low Reynolds Numbers and are therefore used to measure the flow of clean liquids at low velocity and/or at high viscosity. Additionally they are suited to the measurement of low-density gases.

Conical entry plates are available in sizes from 25 to 600 mm (1 to 24 in.). Their typical accuracy is  $\pm 2\%$  and they are used exclusively with Corner taps.

**Concentric Quarter-Circle Type (CQC)**

Type CQC Quarter-Circle plates differ from Conical Entry plates by having a bore with an inlet in the form of a radius. CQC plates maintain their accuracy down to relatively low Reynolds Numbers but not as low as those of CCL plates; hence they are used to measure the flow of clean liquids at low velocity and/or at elevated viscosity. They are also suited to the measurement of low-density gases.

Quarter-Circle plates are available in sizes from 25 to 600mm (1 to 24 in.). Their typical accuracy is between  $\pm 2$  and  $\pm 2.5\%$  and they are used with either Corner taps or Flange taps.

**Eccentric (ESE) and Segmental (SSE) Orifice Plates**

A concentric orifice plate is unsuitable for dirty liquids and gases as the solids can build up in front of the plate causing a deterioration in accuracy and possible blockage. These classes of orifice plate are designed such that solids can pass through the bore.

**Eccentric Square Edge Type (ESE)**

The bore of ESE plates is circular but is adjacent to the pipe wall so that solids can pass through freely. It is used to measure the flow of either low-viscosity liquids carrying suspended solids (or entrained gas) or for gases carrying entrained liquid.

Eccentric plates are available in sizes from 100mm (4 in.) upwards. The typical accuracy of ESE plates is 1 to 2% and they are used with corner taps.

**Segmental Square Edge (SSE)**

The bore of SSE plates is in the shape of a segment of a circle with its curved edge adjacent to the pipe wall so that solids can pass through freely. It is used to measure the flow of either low-viscosity liquids carrying suspended solids (or entrained gas) or for gases carrying entrained liquid. However, the Eccentric type (ESE) is preferred for such applications.

## Common Data

### Orifice Plate Materials

The standard material used by ABB for their orifice plates is stainless steel to ASTM A240 316/316L.

Other materials can be used if required and these include 304 SS; 321 SS; Alloy 400; Alloy 825; Alloy C276; Titanium; Alloy 625; 22Cr Duplex stainless steels; 25Cr Super Duplex st steels; 6 Mo stainless steel; 90/10 Cu/Ni, PTFE.

### Plate thickness

The thickness of the orifice plate does depend significantly upon the application and design conditions but, typically, a CSE plate will have the following minimum thicknesses:

3mm ( 0.12 in.) for pipe sizes from 25 to 250mm (1 to 10 in.)

6mm (0.24 in.) for pipe sizes from 300 to 600mm (12 to 24 in.)

10mm (0.4 in.) for pipe sizes from 600 to 1000mm (24 to 40 in.)

For high differential pressures, larger pipe sizes and for some Conical Entry, Quarter Circle and Restriction orifice plates, a greater thickness may be required. The actual plate thickness can be determined during calculations.

### Calculations

Calculations are performed in accordance with BS EN ISO 5167-1: 2003, unless otherwise requested.

Other calculation standards are available, including:

ASME

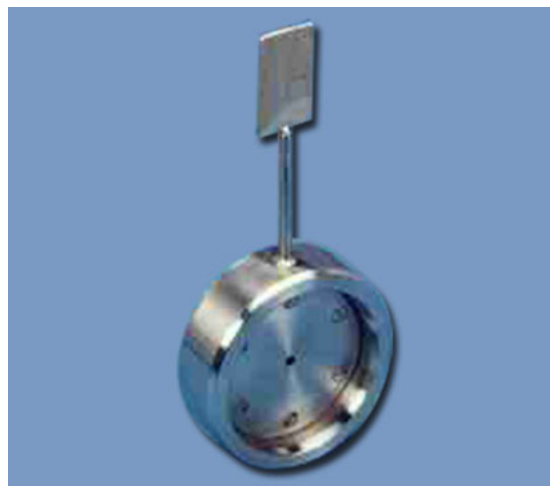
API

R W Miller

L W Spink

Pressure loss is typically between 40 and 95% of the generated differential pressure, dependent on the throat ratio ( $d/D$ ).

## Orifice Plate (RTJ)



The RTJ Orifice plate is designed specifically to fit between flanges that have ring-type joints. The carrier cross-section is designed to fit inside the recess of RTJ-type flanges and can have either an octagonal or oval profile. The carrier is usually in a softer material than the flange so that it deforms in the recess to improve flange sealing. The plate is retained by fixing screws and can be replaced once the carrier has been removed from the pipeline.

### Specification

#### Maximum working pressure

Limited by the application flange rating

#### Maximum working temperature

Dependent on the material selection and application

#### Pipeline size range (standard)

25 to 600 mm (1 in. to 24 in.)

Fittings for larger pipelines are available to special order

#### Materials

RTJ ring in either 316 stainless steel or soft iron with 316 stainless steel orifice plate. Can also be supplied in other materials

#### Thickness

Dependent on flange size, rating and plate thickness

#### Testing/Documentation

A full range of applicable NDT, Documentation and Certification is available (see page 3)



## Orifice Carrier Assemblies

Although simple orifice plates are a low-cost item, the need for the user to provide tapping points of a specific configuration and drilled into the pipework is often problematical and inconvenient.

A more-convenient alternative is an assembly comprising of an orifice plate mounted in a carrier that already has the correct tapping points fitted. ABB has a wide range of these carrier assemblies for different applications.

### Integral Orifice Carrier Assembly (IOCA)

The Integral Orifice Carrier Assembly is a one-piece orifice plate and carrier ring with integral 'corner' differential pressure tapings and is designed to fit between raised-face flanges. The orifice is generally of the square edge concentric-bore type and is suitable for clean low-viscosity liquids and gases, including dry steam.

### Specification

#### Maximum working pressure

Limited by the application flange rating

#### Maximum working temperature

Dependent on the material selection and application

#### Pipeline size range (standard)

25 to 600mm (1 to 24 in.) diameter  
Fittings for larger pipelines are available to special order

#### Materials

316 stainless steel as standard; other materials can be supplied

#### Thickness

Standard Carrier for clamping between pipe flanges  
32mm (1.26 in.) excluding jointing

#### Testing/Documentation

A full range of applicable NDT, Documentation and Certification is available (see page 3)

## Split Ring Orifice Carrier Assembly (SROCA)



The Split Ring Orifice Carrier Assembly is a dual-ring orifice carrier with differential pressure tapings and is designed to fit between raised face flanges. The carrier rings incorporate 'corner' differential pressure tapings (either into annular chambers or a chamfer) or 'flange' tapings. The orifice plate is specified separately but is generally of the concentric square edge type. The Split Ring carrier is suitable for similar applications to the Integral carrier. The main advantage of this type over the Integral carrier is that the orifice plate within the carrier can be replaced without having to replace the carrier.

### Specification

#### Maximum working pressure

Limited by the application flange rating

#### Maximum working temperature

Dependent on the material selection and application

#### Pipeline size range (standard)

25 to 600mm (1 to 24 in.) diameter  
Fittings for larger pipelines are available to special order

#### Materials

Carrier	carbon steel or 316 stainless steel
Orifice plate	stainless steel
Gasket	1.6 mm CAF

The unit can be supplied in other materials.

#### Thickness

Orifice plate	3mm (1/8 in.) or 6mm (1/4 in.)
Assembly	varies with tapings used and thickness of plate and jointing

#### Tapings

1/2 in. NPT as standard. Also available as 1/2 in. BSPT, 1/2 in. socket weld connection, 1/2 in. NB Nipolet, 1/2 in. NB Nipoflanges etc.

#### Testing/Documentation

A full range of applicable NDT, Documentation and Certification is available; see page 3

## Concentric Restriction Orifice Plates (CRN)



### Concentric Restriction Type

Type CRN plates are used where there is a requirement to reduce the line pressure or to restrict the flowrate to a certain value. The orifice bore (and plate thickness) is calculated to achieve the required restriction to the flow rate or pressure whilst maintaining plate integrity. Either standard RF or RTJ plates are available.

A multi-restriction assembly (see photograph above) consisting of several plates in series, can be engineered for use where the required pressure drop cannot be achieved (or where the noise level would be too high) across a single plate.

### Specification

Custom designed to meet application requirements

#### Calculation

To R W Miller

#### Plate thickness

The plate thickness of a restriction orifice plate depends significantly upon the required pressure drop and design conditions.

## Orifice Flange Assemblies (OFA)



An Orifice Flange Assembly is designed to be welded into the pipe and comprises:

- An orifice plate with data tab

- A pair of flanges with integral threaded taps, nuts, bolts, gaskets and jacking bolts (to assist in separating the flange in the line to remove the plate on sizes 76mm [3 in.] and above).

As standard, the assemblies are available with weld neck (for butt-welding to the pipe) orifice flanges, although a slip-on design is also available.

### Specification

#### Maximum working pressure

Limited by the application flange rating

#### Maximum working temperature

Dependent on the material selection and application

#### Pipeline size range (standard)

25 to 600 mm (1 in. to 24 in.)

Fittings for larger pipelines are available to special order

#### Tappings

1/2 in. NPT as standard. Also available as 1/2 in. BSPT, 1/2 in. socket weld connection, 1/2 in. NB Nipolet, 1/2 in. NB Nipoflanges, etc.

#### Materials

Flanges ASTM-A105N; ASTM-A350 LF2 ASTM-A182 F5, F9, F11 and F12; stainless steel ASTM-A182 F316(L), F304(L)

Bolts: ASTM – A193 GR B7 and L7

Nuts: ASTM-A194 GR 2H and H8

Gaskets 1.6mm (0.062 in.) asbestos-free or 4.5mm (0.177 in.) spiral-wound

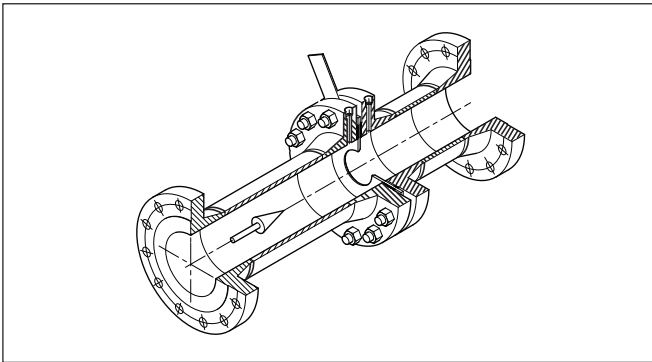
Orifice 316 stainless steel

Other materials are available

#### Testing/Documentation

A full range of applicable NDT, Documentation and Certification is available (see page 3)

### Meter Run Assembly (OMR)



When high accuracy flow measurement is demanded from the primary flow element, an orifice flange assembly can be incorporated into a fabricated orifice meter run, including upstream and downstream pipe sections.

ABB can also offer full secondary systems with DP transmitters, pressure transmitters, temperature transmitters and flow computers (see page 15).

The meter run is manufactured using specially selected pipe. The upstream section comprises a standard length of 16 diameters of straight pipe and the downstream section 8 diameters of straight pipe.

If required these assemblies can be water-calibrated for increased accuracy.

#### Specification

##### Maximum working pressure

Limited by the application and material selection

##### Maximum working temperature

Dependent on the material selection and application

##### Pipeline size range (standard)

25 to 600 mm (1 in. to 24 in.)

Fittings for larger pipelines are available to special order

##### Tappings

1/2 in. NPT as standard. Also available as 1/2 in. BSPT, 1/2 in. socket weld connection, 1/2 in. NB Nipolet, 1/2 in. NB Nipoflanges, etc.

##### Materials

Flanges ASTM-A105N, ASTM-A350 LF2  
ASTM-A182 F5, F9, F11 and F12,  
ASTM-A182 F316(L)

Bolts ASTM – A193 GR B7 and L7

Nuts ASTM-A194 GR 2H and H8

Gaskets 1.6mm (0.062 in.) asbestos-free or  
4.5mm (0.177 in.) spiral-wound

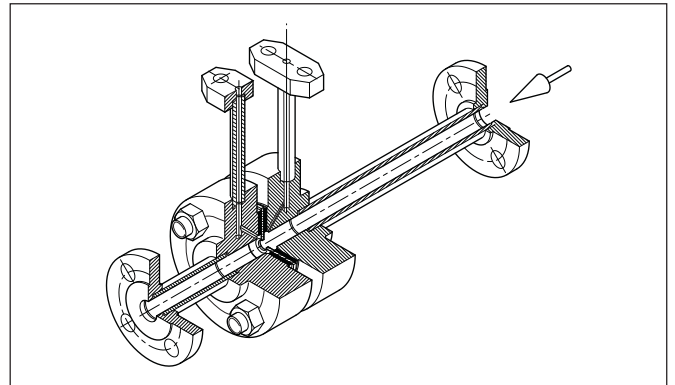
Orifice 316 stainless steel

Other materials are available

##### Testing/Documentation

A full range of applicable NDT, Documentation and Certification is available (see page 3)

### Integral Meter Run Assembly



This is a metering run for small pipes that has tapings designed to bolt directly to a differential pressure transmitter or manifold assembly.

#### Specification

##### Maximum working pressure

Limited by the application flange rating

##### Maximum working temperature

Dependent on the material selection and application

##### Pipeline size range (standard)

25 to 600 mm (1 in. to 24 in.)

Fittings for larger pipelines are available to special order

##### Tappings

1/2 in. Kidney flanges for manifold/transmitter connection with  
54mm centres

##### Materials

Flanges ASTM-A105N, ASTM-A350 LF2  
ASTM-A182 F5, F9, F11 and F12,  
ASTM-A182 F316(L)

Bolts ASTM – A193 GR B7 and L7

Nuts ASTM-A194 GR 2H and H8

Gaskets 1.6mm (0.062 in.) asbestos-free or  
4.5mm (0.177 in.) spiral-wound

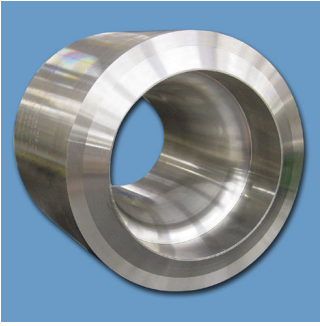
Orifice 316 stainless steel

Other materials are available

##### Testing/Documentation

A full range of applicable NDT, Documentation and Certification is available (see page 3)

## Flow Nozzles



The flow nozzle is used for high velocity flow measurement where erosion or cavitation would wear or damage an orifice plate. It does not rely on a sharp edge (which can degrade over time) for accuracy, therefore offering excellent long-term accuracy and it is often used for flow testing on steam-raising plant.

The discharge coefficient of a flow nozzle is such that a nozzle can measure approximately 55% higher flow rates than an orifice plate with a similar beta ratio and design differential pressure.

In the case of steam measurement, the pressure loss may not be significant as the effect is to beneficially heat the steam slightly.

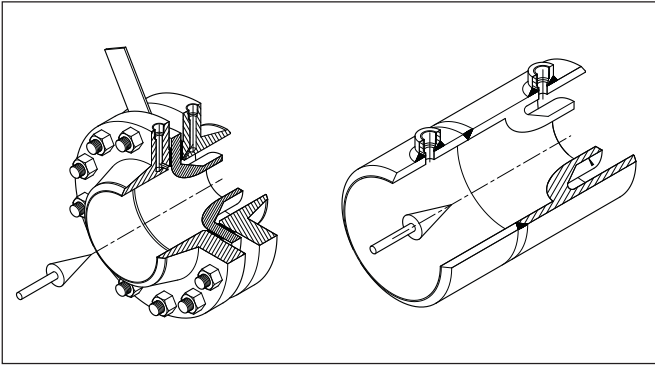


ABB supply Flow Nozzles to the following design standards:

- ISA (1932)
- Long Radius (High and Low Rates)
- ASME throat tap nozzles. PTC6

The flow nozzle is available in designs for clamping between flanges (within the bolt circle) or as a weld-in unit.

## Calculations

Calculations are performed in accordance with BS EN ISO 5167-1: 2003, unless otherwise requested.

Other calculation standards are available including:

- ASME
- AGA Report No. 3
- R W Miller
- L W Spink

Pressure loss is typically between 40 and 95% of the generated differential pressure, depending on the throat ratio ( $d/D$ ) – refer to page 2.

## Specification

### Maximum working pressure

Limited by the application and material selection

### Maximum working temperature

Dependent on the material selection and application

### Pipeline size range (standard)

25 to 600 mm (1 in. to 24 in.)  
Fittings for larger pipelines are available to special order

### Tappings

$\frac{1}{2}$  in. NPT as standard. Also available as  $\frac{1}{2}$  in. BSPT,  $\frac{1}{2}$  in. socket weld connection,  $\frac{1}{2}$  in. NB Nipolet,  $\frac{1}{2}$  in. NB Nipoflanges, etc.

### Materials

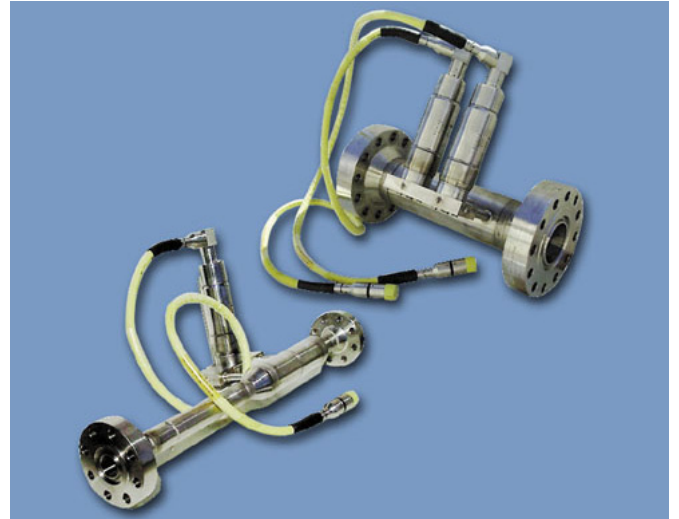
316 and 316L stainless steel  
Other materials (including high-temperature alloys) are available

### Testing/Documentation

A full range of applicable NDT, Documentation and Certification is available (see page 3)

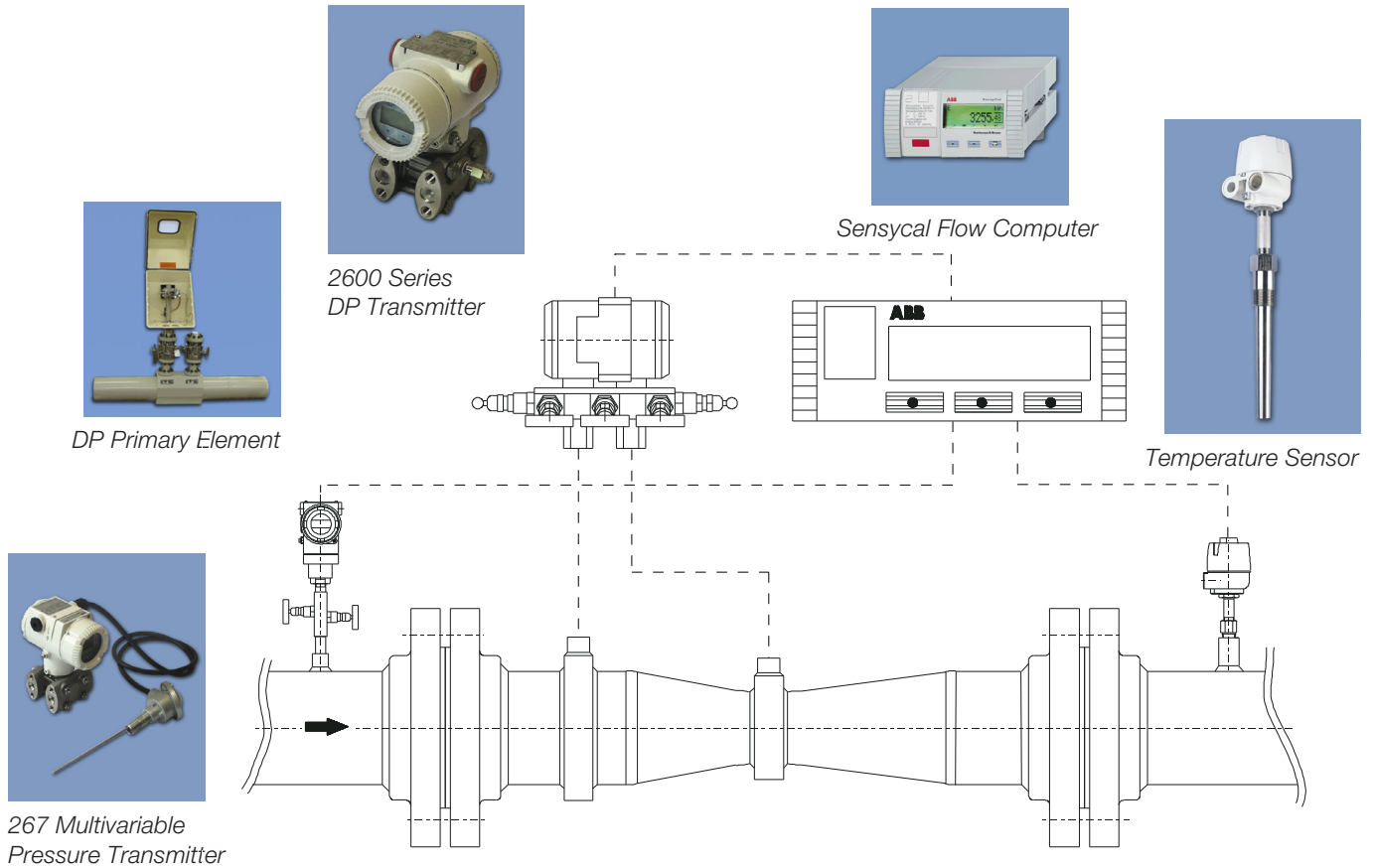
### Subsea Applications

ABB also design and manufacture Venturi Tubes and Orifice Assemblies for Subsea applications at high pressure, such as MEG Injection (Mono-Ethylene Glycol) and MEG CDU (Control Distribution Unit) meters.



### Typical Gas Flow Loop

Here is an example of how ABB can supply the secondary equipment required to offer a complete system – in this case a Gas Flow loop with Pressure and Temperature compensation.





**Notes**

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