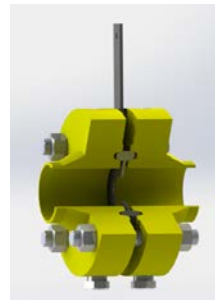
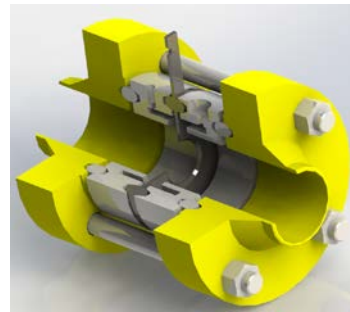


## Datasheet *Orifice plate - Overview*

Rev.6 Jan 2023

- ✓ Orifice plate design based on ISO5167, BS1042, ASME.MFC.3M and ISO TR15377 :2007 industry standards
- ✓ Accuracy, repeatability and reliability of the flow element
- ✓ Use for custody transfer metering
- ✓ Easy and quick installation and commissioning
- ✓ Very long life-time product
- ✓ Cost-effective and maintenance-free system
- ✓ Different types of orifice plates available depending on the application



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Orifice plates or diaphragms are the most commonly used primary elements for « differential pressure » flow measurement. Introduced in the pipes, they create a flow constriction, increase the fluid velocity and generate a differential pressure between the upstream and downstream of the constriction. Measuring the differential pressure  $\Delta P$  across the constriction gives the flow rate.

The differential pressure measurement of a fluid flow is the only **standardized measurement** principle (ISO NF 5167). Respecting sizing and installation conditions guarantees precision with regard to the standard requirements.

Orifice plate covers a wide range of applications, fluids and operating conditions. It gives a good level of accuracy at lowest cost and a long life time without specific maintenance and wear out failure. The reference to the standards enables quick and easy installation of the orifice plate on site without any need for calibration.



Deltafluid design office studies, designs and delivers drawings for any different type of orifice plates as well as complete flow and temperature measurement systems. Deltafluid manufacturing and testing facilities allow the delivery of elements with accuracy according the standards.

## Applications

	Type of fluid					
	Dry steam	Gas	Clean liquid	Viscous liquids	Fluid with solid particles	Gas with water condensate
Sharp-edge bore	●	●	●			
Conical entrance bore				●		
Quadrant edged bore				●		
Eccentric bore					●	●
Segmental bore					●	●
Multi orifice	●	●	●	●	●	●

Industries :

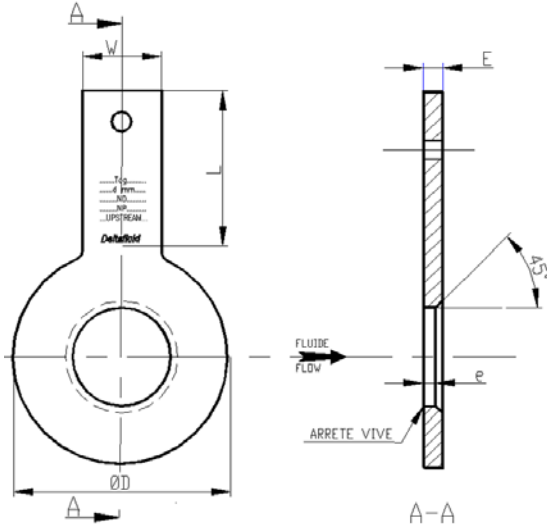
- Oil & Gas
- Chemical & Petrochemical
- Power
- Nuclear
- Food & Beverage
- Paper
- Iron & Steel
- Water
- Flue gas

The list of industries in which differential pressure flow products are applicable isn't exhaustive. Devices such as orifice plates are suitable for any kind of fluid whatever is the application.

## Concentric orifice plates

Concentric orifice plates represent the majority of plates used in all orifice-based devices. The orifice bore is positioned in the exact center of the plate.

## Sharp-edge orifice plates



### Conception :

Upstream edge of the orifice bore shall be square (sharp edge,  $r < 0,0004 d$ ) and angle of bevel  $45^\circ \pm 15^\circ$  on downstream side if necessary

### Type of fluid :

Low viscosity and clean liquid, gas or dry steam (monophasic fluids)  
Reynolds number not less than 5.000 (turbulent regime)

### Characteristics :

Simple, flexible, accurate, economic, easy installation and maintenance if necessary

### Tapping point configurations :

Flange, corner or radius taps



*The sharp-edge orifice plate is the most widely used for flow measurement thanks to its accuracy, easy installation and maintenance.*



## Conical entry orifice plates

### Conception :

45° conical inlet section and parallel exit section

### Type of fluid :

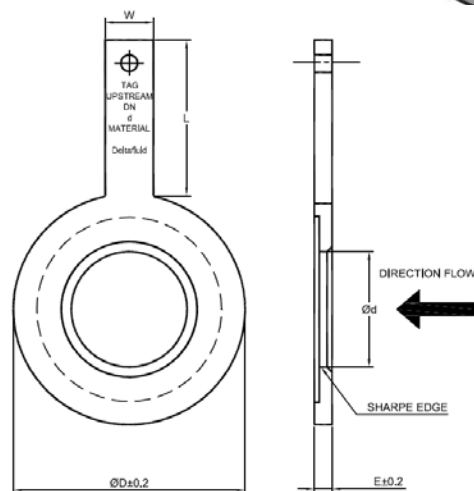
Very low Reynolds Number from 25 : high viscosity and/or low velocity clean fluids; low-density fluids

### Characteristics :

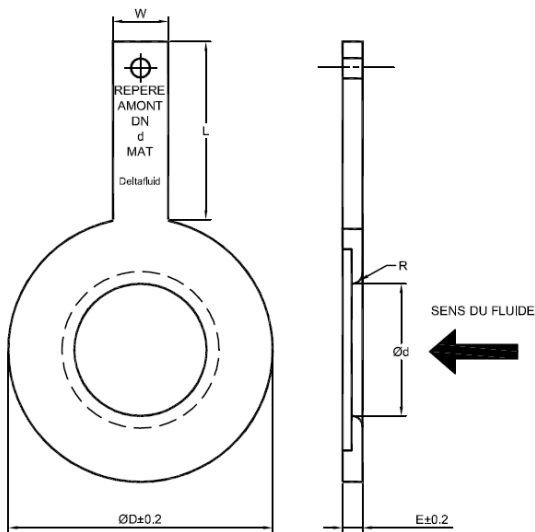
Measurement accuracy down to very low Reynolds Number.

### Tapping point configuration :

Corner taps



## Quarter circle orifice plates



### Conception :

Upstream edge of the orifice is a quarter of a circle (in form of a radius)

angle of bevel 45° on downstream side

### Type of fluid :

Low Reynolds Number from 250 ; clean and viscous fluids and/or at low velocity; low-density fluids

### Characteristics :

Measurement accuracy down to low Reynolds Numbers higher than those of the conical entry orifice plate.

### Tapping point configurations :

Flange taps recommended  
Corner and radius taps possible  
DN<40, corner taps required



## Non-concentric orifice plates

A concentric orifice plate is unsuitable for dirty fluids and two-phase flows as solid particles or water condensates could sediment in front of the plate causing deterioration in accuracy and possible blockage. Non-concentric orifice plates are designed so that such operating conditions are avoided and solids or condensation can pass through the bore.

## Eccentric orifice plates

### Conception :

Circular eccentric orifice : the center of the orifice is not on the axis of the pipe ; the most eccentric side of the orifice is flush with the inside wall of the pipe

### Type of fluid :

Liquids containing solid particles or vapors likely to deposit water condensates

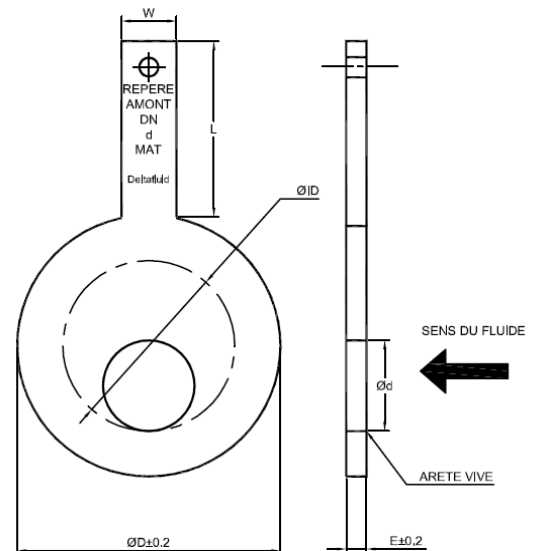
Orifice flush with the inside wall of the pipe so that particles or condensation can pass through freely

### Characteristics :

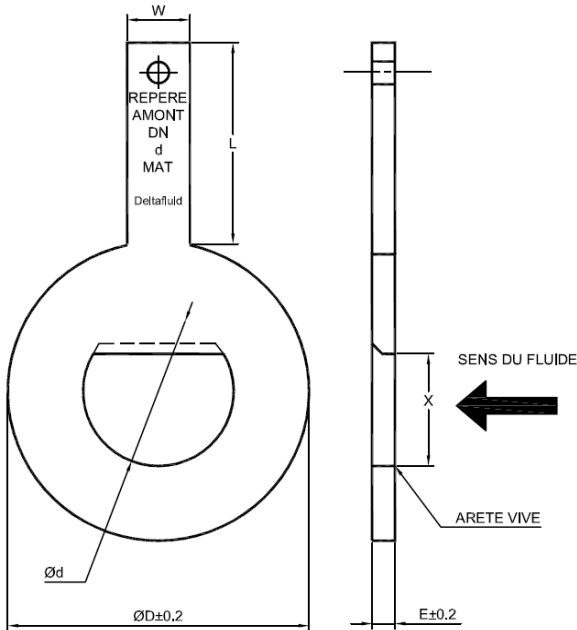
Eccentric bore top flush or bottom flush depending on the nature of the fluid

### Tapping point configuration :

Flange taps recommended



## Segmental orifice plates



### Conception :

Orifice has the shape of the segment of a circle of approximately the same diameter as the internal pipe ; curved edge of the orifice flush with the inside wall of the pipe

### Type of fluid :

Liquids containing solid particles or vapors likely to deposit water condensates

### Characteristics :

Eccentric bore top flush (avoid sedimentation of gases or vapors) or bottom flush (solid particles or condensates) depending on the nature of the fluid

### Tapping point configuration :

Flange taps recommended



## Multiholes orifice plates

This multihole orifice plate doesn't refer to any standard, design based on experience. It combines a flow conditioner with an orifice plate.

### Conception :

Placed in a symmetrical way in regard to the center of the plate.

### Type of fluid :

Gas, liquid and steam applications

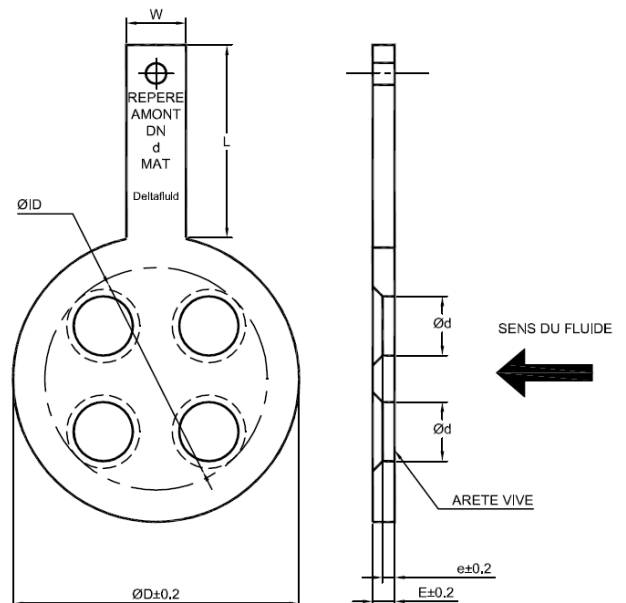
### Characteristics :

Used when available straight lengths are short

Requires only a length of 2D from a flow disturbance for upstream and downstream straight pipes

### Tapping point configuration :

Flange or radius taps





## RF and RTJ orifice plates types

The above mentioned orifice plates are RF type (raised face). Flat or spiral wound gaskets are needed to seal the flange assembly.

The RTJ (ring tongue joint) assembly is a metallic sealing system. The RTJ orifice plate is specifically designed to fit between RTJ flanges to prevent leakage of fluid. Female groove type or male type are available depending on the flange. The orifice flange can be machined from one piece or it can also be screwed to an RTJ plate holder; in this way, the RTJ holder material is softer than the flange's so that it can improve sealing.

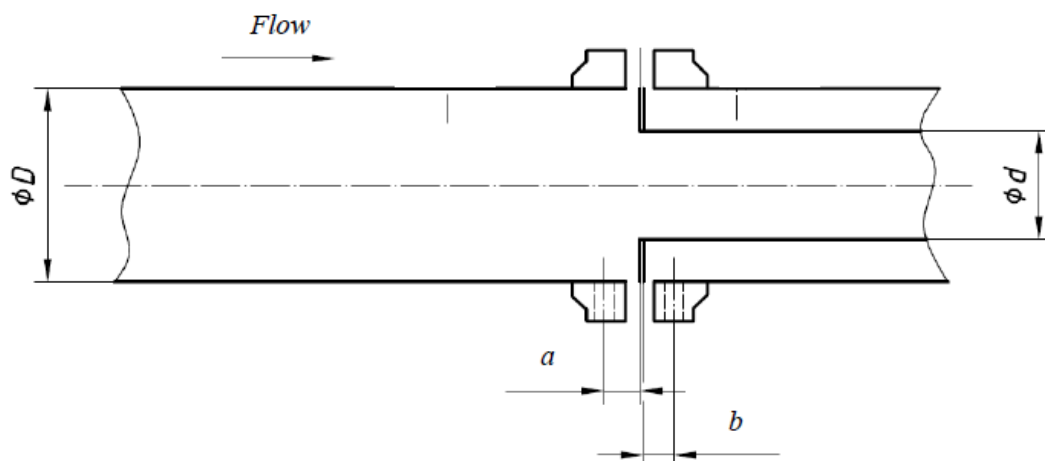
The RTJ orifice plate is suitable for a high pressure and high temperature fluid.



## *Pressure taps*

### **Flange taps**

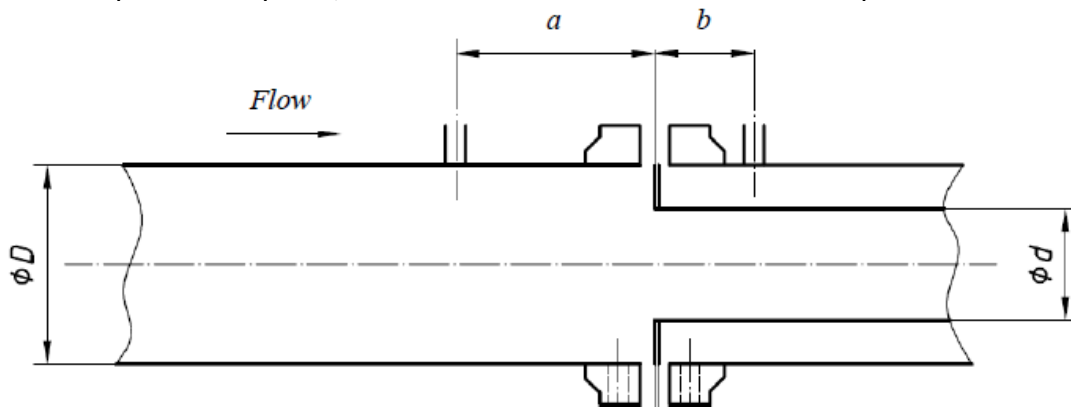
The taps are located in the flanges. The high pressure tap is 25,4 mm (1 inch) upstream of the inlet face and the low pressure tap is the same distance downstream of the outlet face of the orifice plate.



$$\begin{aligned}
 a = b &= (25,4 \pm 0,5) \text{ mm for } \beta > 0,6 \text{ and } D < 150 \text{ mm} \\
 &(25,4 \pm 1) \text{ mm for } \beta \leq 0,6 \\
 &(25,4 \pm 1) \text{ mm for } \beta > 0,6 \text{ and } 150 \text{ mm} \leq D \leq 1\,000 \text{ mm}
 \end{aligned}$$

## Radius taps

The taps are located in the pipe wall. The high pressure tap is 1 D upstream of the inlet face of the plate. The low pressure tap is 0,5D downstream of the outlet face of the plate.



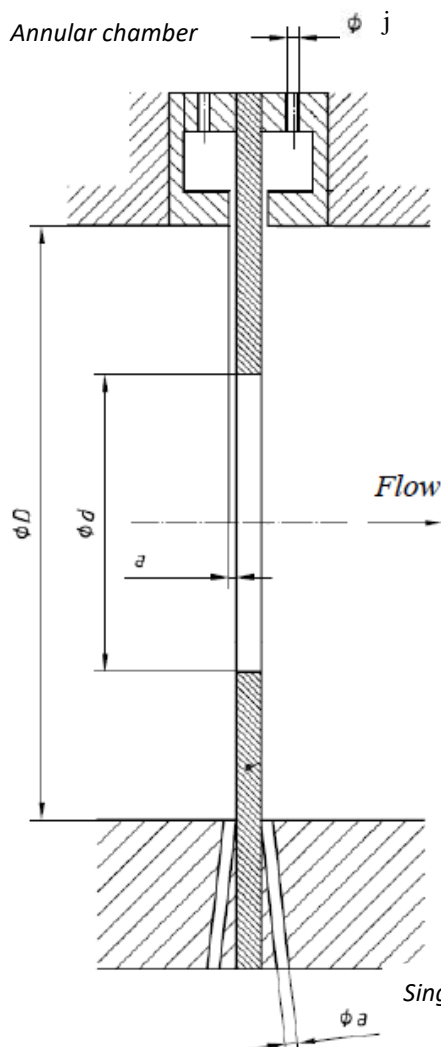
$$a = D \pm 0,1D$$

$$b = 0,5D \pm 0,02D \text{ for } \beta \leq 0,6$$

$$0,5D \pm 0,01D \text{ for } \beta > 0,6$$

## Corner taps

The pressure tap holes or slits open in the angle formed by the pipe wall and the orifice plate. They can be either a carrier ring with annular slots or single tappings in the flanges.



For clean fluids and vapors :  
 $\beta \leq 0,65 : 0,005D \leq a \leq 0,03D$   
 $\beta > 0,65 : 0,01D \leq a \leq 0,02D$

For any value of  $\beta$  :

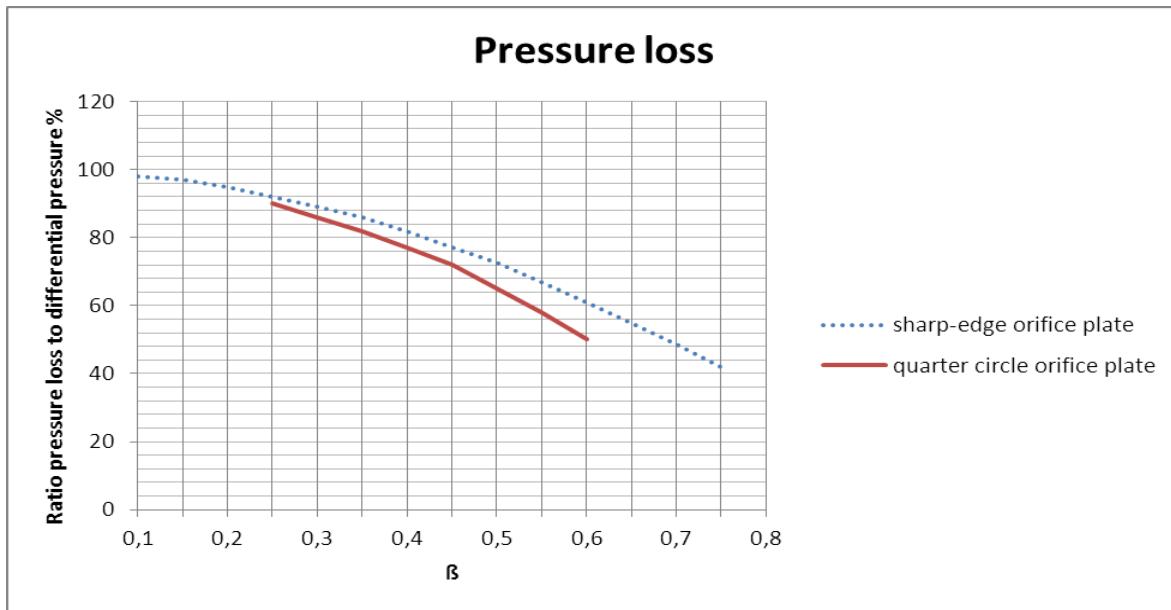
- Clean fluids :  $1 \text{ mm} \leq a \leq 10 \text{ mm}$
- Vapors, in case of annular chambers :  
 $1 \text{ mm} \leq a \leq 10 \text{ mm}$
- Vapor and liquefied gases, in case of single tappings :  $4 \text{ mm} \leq a \leq 10 \text{ mm}$

$$4 \text{ mm} \leq \phi j \leq 10 \text{ mm}$$

### Pressure losses when crossing the flow element

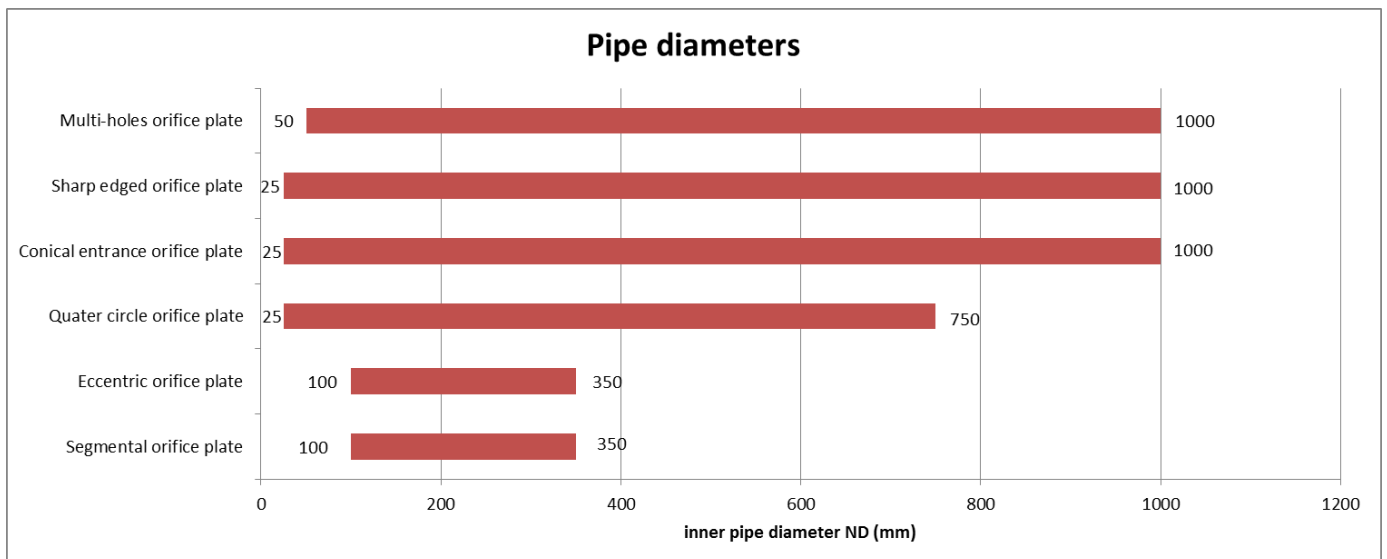
The differential pressure  $\Delta P$  generated across the flow element gives the flow rate. A great part of this  $\Delta P$  is recovered downstream but a residual pressure loss expressed as a percentage of  $\Delta P$  should be considered.

This residual pressure loss depends on the value of  $\beta$  and on the type of the differential pressure element :



### Pipe diameters

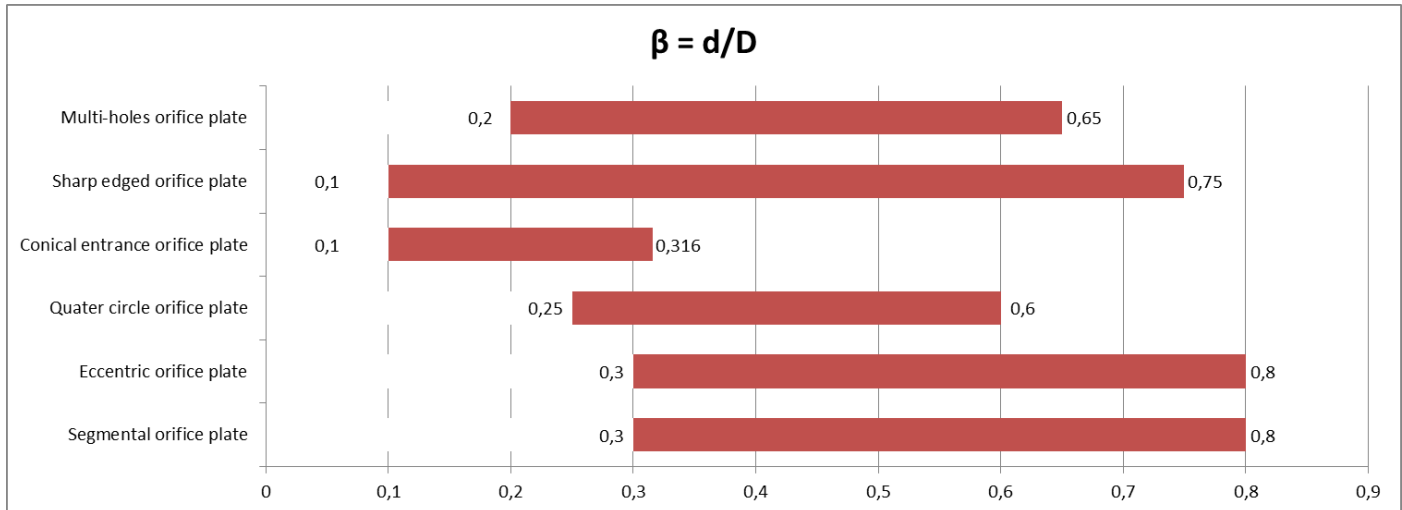
The inner diameter of the pipe has to respect a minimum and a maximum value depending on the differential pressure element :



**β values (ratio between the bore diameter and the inner pipe diameter  $\beta=d/D$ )**



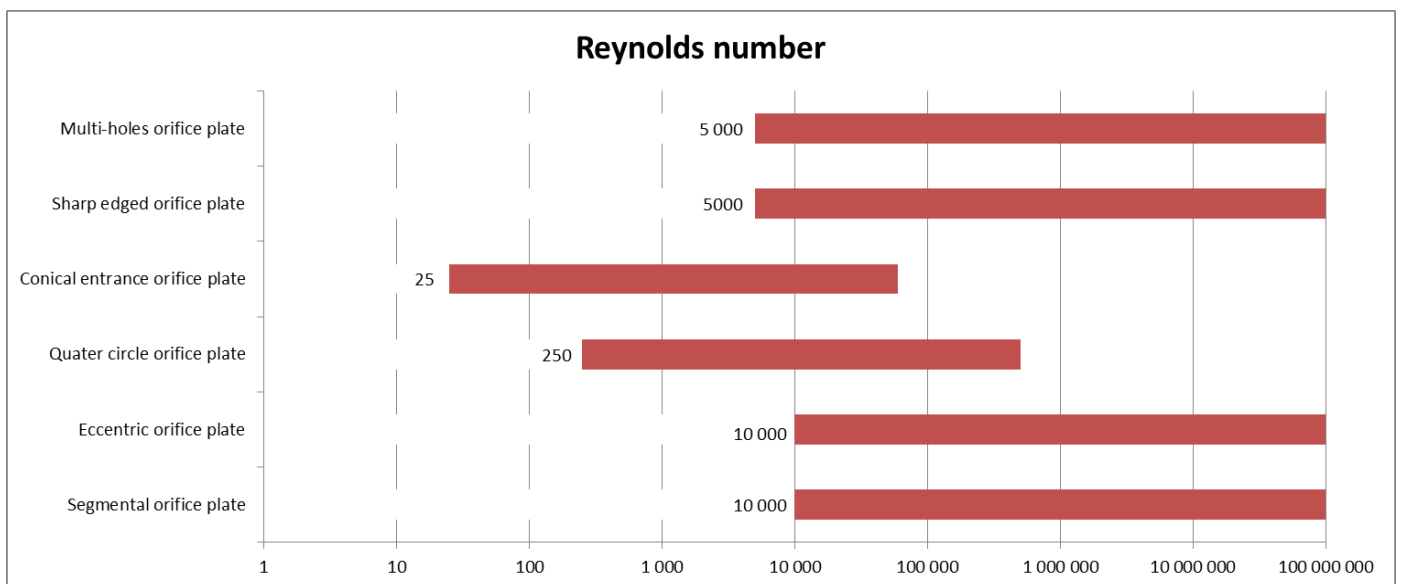
To ensure an accurate measure, the bore diameter should respect the following limits :



## Reynolds number

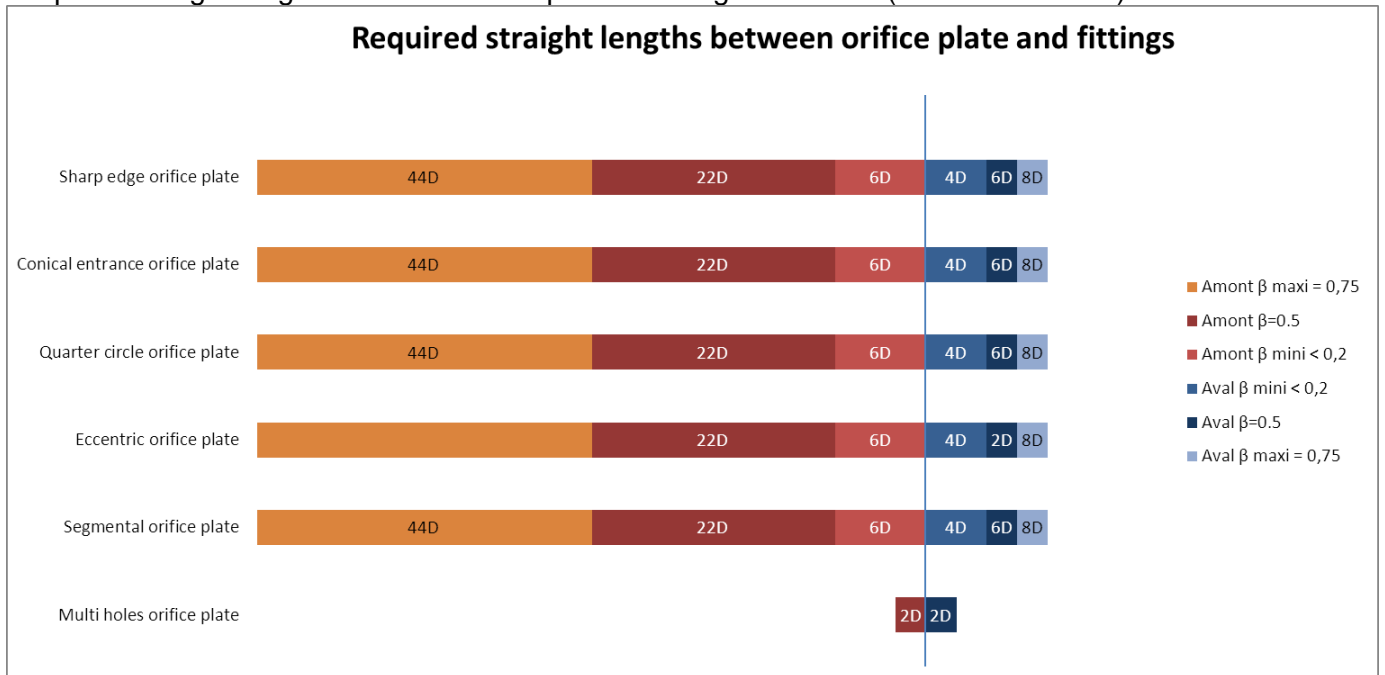
The Reynolds number is an important characteristic of the fluid and depends on its speed and its viscosity. It is as well a function of the pipe diameter.

The faster the speed of the fluid and the lower the viscosity, the higher the Reynolds number. Similarly, for a viscous and slow fluid circulating in the pipe, the Reynolds number is very low.



For  $\beta = 0,5$

## Required straight lengths between orifice plate and single 90° bend (or two 90° bends)



For more information concerning installation, please refer to the relevant datasheet.

To reduce upstream straight lengths, a flow conditioner can be used.

### Tag paddle

The orifice plates are delivered with a paddle welded to their edge. Plate orifice characteristics are laser-engraved on this paddle so that they can be seen without specific handling.

### Material

The material generally used is 304L or 306L stainless steel. However, the material may be different depending on the nature of the fluid, the operating temperature, etc... :

- Carbon steel,
- Monel,
- Hastelloy,
- Inconel,
- Titanium,
- Tantalum,
- PVC, etc...

## Ordering information – MAIN CODE

Delta OP-	MAIN CODE								
<b>Orifice Plate</b>	XX	XXX	X	XX	XX	XXX	XXXXX	XXX	XXX
<b>Type of upstream face</b>									
Sharp Edge	SE								
Conical Entrance	CO								
Quarter Circle	QC								
Eccentric	EC								
Segmental	SG								
Multi holes	MH								
<b>Type of face</b>									
Raising Face		RF*							
Ring Torque Joint		RTJ							
<b>for RTJ :</b>									
Male			M						
Female**			F						
<b>in 1 piece or in 2 pieces</b>									
Monobloc				MO					
Screwed - see plate support material				SC					
<b>Type of finishing</b>									
Polished 1 face				P					
Polished 2 faces				2P					
Others - SPECIFY				O					
<b>Nominal diameter</b>									
DN15 - 1/2"						1			
DN20 - 3/4"						0,75			
DN25 - 1"						1			
DN32 - 1"1/4						1,25			
DN40 - 1"1/2						1,5			
DN50 - 2"						2			
DN65 - 2"1/2						2,5			
DN80 - 3"						3			
DN100 - 4"						4			
DN125 - 5"						5			
DN150 - 6"						6			
DN200 - 8"						8			
DN250 - 10"						10			
DN300 - 12"						12			
DN350 - 14"						14			
DN400 - 16"						16			
DN450 - 18"						18			
DN500 - 20"						20			
DN600 - 24"						24			

	MAIN CODE								
	XX	XXX	X	XX	XX	XXX	XXXXX	XXX	XXX
<b>Rating</b>									
150#							A150		
300#							A300		
600#							A600		
900#							A900		
1500#							A1500		
2500#							A2500		
PN10							D10		
PN16							D16		
PN25							D25		
PN40							D40		
PN63							D63		
PN100							D100		
<b>Plate material</b>									
Stainless steel 304								SS4	
Stainless steel 316								SS6	
Inconel								INC	
Monel								MON	
Hastelloy								HLV	
PTFE								PTF	
Duplex								DPX	
Superduplex								SDX	
Others - SPECIFY								O	
<b>Plate support material</b>									
									<i>for OP RTJ screwed</i>
Stainless steel 304									SS4
Stainless steel 316									SS6
carbon steel									CS
Soft iron									SI
Others - SPECIFY									O
* OP-XX-RF can be assembled with simple or double & male or female facing depending on the flange									
** Pipe schedule or inner diameter ID to be specified									

## Ordering information – OPTIONS

OPTIONAL CODE	XX	XX	XXX	XXX	XXX	X	XX	XX	XX	X	X
<b>Mounting</b>											
pressure taps 0/0 - annular chamber	0										
pressure taps 25/25 - orifice flange	25										
pressure taps D - D/2	D										
<b>Flanges*<sup>(1)</sup></b>											
Welding neck		WN									
Orifice welding neck		WO									
Slip on		SO									
Others		O									
<b>Flanges material</b>											
ASTM A105			105								
A350LF2			350								
Carbon steel* <sup>(2)</sup>			CST								
Stainless steel 304			SS4								
Stainless steel 316			SS6								
Inconel			INC								
Monel			MON								
Hastelloy			HLV								
PTFE			PTF								
Duplex			DPX								
Superduplex			SDX								
Other			O								
<b>Pipe Schedule</b>											
5-5S				5							
10-10S				10							
20				20							
30				30							
40S-Std				STD							
40				40							
60				60							
XS-80S				XS							
80				80							
100				100							
120				120							
140				140							
160				160							
XXS				XXS							
<b>Annular chamber material</b>											
Carbon steel					CS						
Stainless steel 304					SS4						
Stainless steel 316					SS6						
Other					O						
<b>Gaskets</b>											
Flat						F					
Graphite						G					
Spiral wound						S					
PTFE						P					
Others						O					
<b>Boltings material</b>											
Carbon steel							CS				
Stainless steel							SS				
Others							O				

OPTIONAL CODE	XX	XX	XXX	XXX	XXX	X	XX	XX	XX	XX	X	X
<b>Manifold</b>												
3-way direct mounting									3D			
3-way remote mounting									3R			
5-way direct mounting									5D			
5-way remote mounting									5R			
<b>DP Transmitter</b>												
Standard										SD		
Multivariable										MV		
<b>Temperature sensor*<sup>(3)</sup></b>												
With temperature sensor											Y	
Without temperature sensor											N	
<b>Piping*<sup>(4)</sup></b>												
Upstream												U
Downstream												D
* <sup>(1)</sup> OP-SE-RF can be assembled with simple or double & male or female facing depending on the flange												
* <sup>(2)</sup> Type of carbon steel to be specified												
* <sup>(3)</sup> Type of temperature sensor to be specified												
* <sup>(4)</sup> Process connection to be specified												