

FPD150/160

Differential pressure – primary flow element orifice plates and orifice flange unions

Simple flow metering solutions for liquids, gases and steam, backed up by comprehensive documentation, certification and testing

Better Measurement
Better Outcomes



Simple orifice plate for low-cost measurement

- installs direct between flanges

Engineered and manufactured to latest standards

- to ISO5167:2003 as standard
- other design standards available

Orifice flange Unions ready for direct welding into pipeline

- manufactured in accordance with ASME B16.36
- tappings accurately positioned
- complete with gaskets, nuts and bolts

Range of flange drillings / ratings available

- raised, flat or RTJ-profile

Orifice plates

The differential pressure generated is sensed at a pair (or multiple pairs) of tapping points, each pair comprising a high pressure (inlet or upstream) and a low pressure (outlet or downstream) tapping. A variety of configurations are specified within ISO5167 and other standards, including the following:

D and D/2 taps

- the tappings are generally located in the pipe wall
- the upstream tapping is one pipe inside diameter (D) from the upstream face of the plate
- the downstream tapping is half the pipe inside diameter (D/2) from the downstream face of the plate

Flange taps

- the tappings are generally located in the pipe flanges
- the upstream tapping is 25.4 mm (1 in.) from the upstream face of the plate
- the downstream tapping is 25.4 mm (1 in.) from the downstream face of the plate

Corner taps

- the tappings are generally located in the pipe flanges
- the tappings break into the pipe at the corners formed by the upstream and downstream flange faces and the pipe wall

Orifice plate bore profiles

McMenon offers a variety of orifice plate bore profiles to cover a wide range of applications. These bore profiles can be classified as follows:

- circular bore, concentric with the pipe
- circular bore, adjacent to the pipe wall
- segmental profile bore, adjacent to the pipe wall

McMenon orifice plates are usually supplied with a data tab welded to the circumference. This tab can be engraved with orifice plate details (such as tag number and bore size) that are visible without removing the plate from the line.

Orifice plate types

Concentric square edge type plate

These plates are used to measure the flowrate of clean, low-viscosity liquids, gases and dry steam at Reynolds Numbers in the turbulent flow regime. The bore is sharp-edged on the inlet and usually parallel on the outlet, although, depending on the d/D ratio (Beta) and thickness, the outlet may be chamfered. The bore is calculated to produce the requested differential pressure at the design meter maximum flowrate and operating flowing conditions. Concentric orifice plates represent the majority of plates used across 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 sensed and transmitted. They are used with corner, flange or D & D/2 taps.

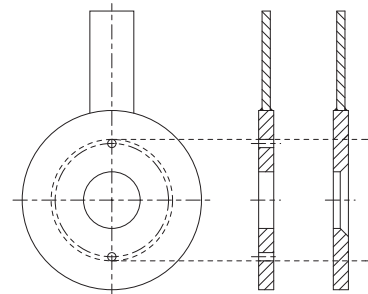


Fig. 1: Concentric square-edge type plate

Concentric conical entrance type plate

Conical Entrance 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 Entrance plates are used exclusively with corner taps.

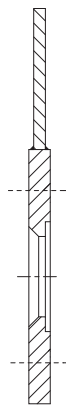


Fig. 2: Conical entrance type plate

Concentric quarter-circle type plate

Quarter-circle plates differ from conical entry plates by having a bore with an inlet in the form of a radius. They maintain their accuracy down to relatively low Reynolds Numbers (but not as low as those of conical entrance plates). Accordingly, 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 used with either corner taps or flange taps.

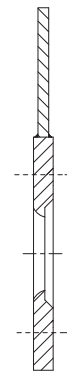


Fig. 3: Quarter circle type plate

Eccentric square edge type plate

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

Eccentric plates are used with either corner taps or flange taps.

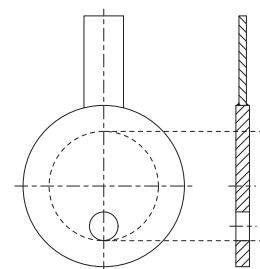


Fig. 4: Eccentric type plate

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Segmental square-edge type plate

The bore of segmental 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 is preferred for such applications.

Segmental plates are used with flange taps.

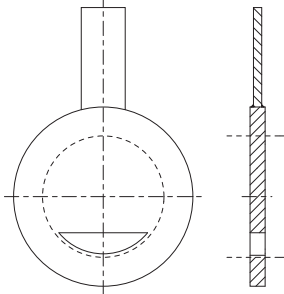


Fig. 5: Segmental type plate

Orifice flange unions

McMenon orifice flange unions combine the orifice plate with a pair of flanges, complete with nuts, bolts, washers and gaskets. To enable separation of the two flanges for removal and installation of the orifice plate, the assembly is supplied with jacking bolts. The resultant assembly is typically butt-welded into the pipework, although the flanges can be supplied for socket weld or screwed installation into the pipework. The orifice plates are usually supplied with a data tab welded to the circumference. This tab can be engraved with plate information (such as tag number and bore size), that is visible without removing the plate from the line. The differential pressure generated is sensed at a pair (or multiple pairs) of tapping points within the flange assembly, each pair comprising of a high pressure (inlet) and a low pressure (outlet) tapping.

As standard our orifice flange unions are supplied as welding-neck type. Other types, including socket weld and threaded, are available.



Fig. 6: Orifice flange union

Applications

Orifice plates are an incredibly versatile flow metering technology and can be used in a wide range of flow measurement applications, including:

- Clean liquids, gases and steam
- Fluids containing solids
- High viscosity fluids
- Fluids at low flowrates
- Flow monitoring
- Gas and utility flows to combustion plants
- Steam consumption
- Pilot plants

Comprehensive documentation

McMenon 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 and comprehensive data dossiers – the McMenon facility at Workington satisfies all of the requirements.

Standards and services

These 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
AGA
API
ASME

Materials and Traceability

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

Product testing services

Magnetic particle inspection
Dye-penetrant Inspection
PMI (Texas Nuclear)
Customer inspection
Independent third party Inspection

Base metal testing

Charpy impact testing
Hardness survey
HIC testing
Intercrystalline corrosion testing etc.

Certification / Documentation to your requirements

Bore calculations
PED 97/23/EC
Material certificates to BS EN 10204 3.1 B,C
NACE MR-01-75 conformity certificate
Welding qualifications to ASME IX, EN BS 288/287
GA drawings
Certificates of conformity
Weight certificates
NDT certificates and procedures
Quality plans
Full data dossiers
Installation and operating manuals etc.

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Specification

Materials

Plates:	Standard – 316/316L stainless steel
Flanges:	Standard – carbon steel; 316/316L stainless steel
Other flange & plate materials:	304 St Stl ; 310 St Stl; 317/317L St Stl ; 321 St Stl; Low temp carbon steel (ASTM A350 LF2 Class 1); CrMo steel (ASTM A182 F11, F5 and F22); 22Cr duplex St Stl ; 25Cr super duplex St Stl; Alloy 400; Alloy 625; Alloy 800; Alloy 825; Alloy C276; Titanium;
Nuts:	ASTM A194 2H; ASTM A194 8MA
Bolts:	ASTM A193 B7; ASTM A193 B8M
Gaskets:	RF and FF flanges, RTJ flanges* – Asbestos free; spiral wound (SS windings with CS or SS outer ring) 22 % Cr duplex (UNS S31803); 25 % Cr super duplex St Steel (S32750, S32760); Soft iron; 316 / 316L stainless steel; 304 / 304L stainless steel S32750, S32760); 6 % Mo SS (UNS S31254); Alloy 400 (UNS N04400); Alloy 625 (UNS N06625); Alloy 800 (UNS N08800); Alloy 825 (UNS N08825)

*For FPD150.P1 & FPD160.F1, the gasket material relates solely to the gasket.

For FPD150.P2 & FPD160.F2, the gasket material is the orifice plate holder material.

For FPD150.P3 & FPD160.F3, the plate and RTJ gasket are manufactured in a single piece and therefore the gasket must be specified to be the same material as the orifice plate.

Maximum working pressure

Limited by the application flange rating.

Maximum working temperature

Dependent on the material selection and application.

Pipeline size range (typical)

Concentric:	DN15 to 900 (½ to 36 in.)
Conical entrance:	DN15 to 500 (½ to 20 in.)
Quarter circle:	DN15 to 500 (½ to 20 in.)
Eccentric:	DN100 to 900 (4 to 36 in.)
Segmental:	DN25 to 600 (1 to 24 in.)

Plate thickness

McMenon	3; 6; 10 mm
Standard:	
Others available:	1.5; 2; 4; 8; 12; 15; 16 mm 1/2; 3/4 in.

The thickness of the orifice plate depends significantly on the application and design conditions.

Calculation standards

Preferred:	BS EN ISO 5167-1 & -2: 2003, unless otherwise requested
Others:	ASME; API; R W Miller; AGA

Design standards

Plate:	Preferred – McMenon
Others:	Saudi Aramco; Shell
Flange:	ASME B16.36

Pressure losses

Typical pressure loss: 40 to 95% of the generated differential pressure, dependent on the Beta ratio (d/D) and plate design

Pipeline installation

Mounting: Butt weld, socket weld or screwed flanges
Facing: Raised face; flat face; RTJ (octagonal or oval profile)
Facing standards: ASME 150; 300; 400; 600; 900; 1500; 2500 lb.

Plates to fit between other flange standards can be supplied.

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Ordering information

FPD150 orifice plates

Main code												Optional code							
Orifice plates		FPD150	XX	XX	XX	XXX	XX	XX	XX	XXX	XX	XX	XXX	XXX	XX	XXX	XX	XXX	XXX
Product design																			
Orifice plate only (for RF/FF flanges)		P1																	
Orifice plate screwed into RTJ male carrier		P2																	
Orifice RTJ male plate (integral, one piece)		P3																	
Customer-specific design																			
McMenon Standard		A1																	
Aamco Standard		A2																	
Shell Standard		S1																	
Orifice design																			
Concentric square edged – corner taps		C1																	
Concentric square edged – flange taps		C2																	
Concentric – D & D/2 taps		C3																	
Conical entrance – corner taps		L1																	
Eccentric – corner taps		E1																	
Eccentric – flange taps 90°		E2																	
Eccentric – flange taps 180°		E3																	
Quarter circle – corner taps		U1																	
Quarter circle – flange taps		U2																	
Segmental – flange taps		S2																	
Line nominal bore																			
DN 15 (1/2 in.)		015																	
DN 20 (3/4 in.)		020																	
DN 25 (1 in.)		025																	
DN 32 (1 1/4 in.)		032																	
DN 40 (1 1/2 in.)		040																	
DN 50 (2 in.)		050																	
DN 65 (2 1/2 in.)		065																	
DN 80 (3 in.)		080																	
DN 90 (3 1/2 in.)		090																	
DN 100 (4 in.)		100																	
DN 125 (5 in.)		125																	
DN 150 (6 in.)		150																	
DN 200 (8 in.)		200																	
DN 250 (10 in.)		250																	
DN 300 (12 in.)		300																	
DN 350 (14 in.)		350																	
DN 400 (16 in.)		400																	
DN 450 (18 in.)		450																	
DN 500 (20 in.)		500																	
DN 550 (22 in.)		550																	
DN 600 (24 in.)		600																	
DN 650 (26 in.)		650																	
DN 700 (28 in.)		700																	
DN 750 (30 in.)		750																	
DN 800 (32 in.)		800																	
DN 850 (34 in.)		850																	
DN 900 (36 in.)		900																	
DN 950 (38 in.)		950																	
DN 1000 (40 in.)		001																	
DN 1050 (42 in.)		051																	
Others		999																	

See pages 11, 12 and 13

Continued on next page ...

Main code											Optional code									
Orifice plates	FPD150	XX	XX	XX	XXX	XX	XX	XX	XXX	XX	XX	XXX	XXX	XX	XXX	XX	XXX	XX	XXX	XXX
	See page 8											See pages 11, 12 and 13								
Pipe schedule																				
Schedule 5S						S1														
Schedule 5						S2														
Schedule 10S						S3														
Schedule 10						S4														
Schedule 20						S5														
Schedule 30						S6														
Schedule 40S						S7														
Schedule 40						S8														
Schedule STD						S9														
Schedule 60						T1														
Schedule 80S						T2														
Schedule 80						T3														
Schedule XS						T4														
Schedule 100						T5														
Schedule 120						T6														
Schedule 140						T7														
Schedule 160						T8														
Schedule XXS						T9														
Others						Z9														
Pipe material																				
316 / 316L stainless steel						S6														
304 / 304L stainless steel						S4														
310 stainless steel						S3														
321 stainless steel						S2														
317 / 317L stainless steel						S8														
22 % Cr duplex (UNS S31803)						D1														
25 % Cr super duplex (UNS S32750)						D2														
25 % Cr super duplex (UNS S32760)						D3														
6 % Mo SS (UNS S31254)						M1														
Alloy 400 (UNS N04400)						M4														
Alloy 625 (UNS N06625)						N2														
Alloy 800 (UNS N08800)						U4														
Alloy 825 (UNS N08825)						U5														
Alloy C276 (UNS N10276)						U7														
Others						Z9														

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Orifice plates	Main code										Optional code											
	FPD150	XX	XX	XX	XXX	XX	XX	XX	XXX	XX	XX	XXX	XXX	XX	XXX	XX	XXX	XXX				
See page 8											page 9		See pages 11, 12 and 13									
Element material																						
316 / 316L stainless steel								S6														
304 / 304L stainless steel								S4														
310 stainless steel								S3														
321 stainless steel								S2														
317 / 317L stainless steel								S8														
22% Cr duplex (UNS S31803)								D1														
25% Cr super duplex (UNS S32750)								D2														
25% Cr super duplex (UNS S32760)								D3														
6% Mo SS (UNS S31254)								M1														
Alloy 400 (UNS N04400)								M4														
Alloy 625 (UNS N06625)								N2														
Alloy 800 (UNS N08800)								U4														
Alloy 825 (UNS N08825)								U5														
Alloy C276 (UNS N10276)								U7														
Others								Z9														
Orifice plate thickness																						
1.5 mm								S01														
2 mm								S02														
3 mm								S03														
4 mm								S04														
6 mm								S05														
8 mm								S06														
10 mm								S07														
12 mm								S08														
15 mm								S09														
16 mm								S10														
Others								Z99														
Flange type																						
Raised face flange								R1														
Oval RTJ								J1														
Octagonal RTJ								J3														
Flat face flange (within bolt circle)								F1														
Flat face flange (full face diameter plate with bolt holes)								F2														
Others								Z9														

Continued on next page ...

Main code											Optional code									
Orifice plates	FPD150	XX	XX	XX	XXX	XX	XX	XX	XXX	XX	XX	XXX	XXX	XX	XX	XX	XXX	XX	XXX	XXX
	See page 8					page 9		See page 10												
Flange rating																				
ASME Class 150											A1									
ASME Class 300											A3									
ASME Class 400											A4									
ASME Class 600											A6									
ASME Class 900											A7									
ASME Class 1500											A8									
ASME Class 2500											A9									
DIN PN 6											D0									
DIN PN 10											D1									
DIN PN 16											D2									
DIN PN 25											D3									
DIN PN 40											D4									
DIN PN 63											D5									
DIN PN 100											D6									
DIN PN 160											D7									
Others											Z9									
Gasket material																				
Soft iron											GP3									
316 / 316L stainless steel											GS6									
304 / 304L stainless steel											GS4									
22 % Cr duplex (UNS S31803)											GD1									
25 % Cr super duplex (UNS S32750)											GD2									
25 % Cr super duplex (UNS S32760)											GD3									
6 % Mo SS (UNS S31254)											GM1									
Alloy 20 (UNS N08020)											GU1									
Alloy 400 (UNS N04400)											GM4									
Alloy 600 (UNS N06600)											GU3									
Alloy 625 (UNS N06625)											GN2									
Alloy 800 (UNS N08800)											GU4									
Alloy 825 (UNS N08825)											GU5									
Alloy C276 (UNS N10276)											GU7									
Others											GZ9									
Orifice sealing face																				
Scrolled (3.2 to 6.3 μm)											SF6									
Drain / Vent hole																				
Drain hole (gas applications)											HT1									
Vent hole (liquid applications)											HT2									

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Orifice plates	Main code										Optional code									
	FPD150	XX	XX	XX	XXX	XX	XX	XX	XXX	XX	XX	XXX	XXX	XX	XXX	XX	XXX	XX	XXX	XXX
		See page 8				page 9		See page 10												
Drain / vent hole size																				
1 mm																			HA1	
1.5 mm																			HA2	
2 mm																			HA3	
3 mm																			HA4	
4 mm																			HA5	
5 mm																			HA6	
5.5 mm																			HA7	
6 mm																			HA8	
6.5 mm																			HA9	
7.5 mm																			HB1	
8 mm																			HB2	
10 mm																			HB3	
3/32 in.																			HB4	
1/8 in.																			HB5	
5/32 in.																			HB6	
3/16 in.																			HB7	
7/32 in.																			HB8	
1/4 in.																			HB9	
9/32 in.																			HC1	
5/16 in.																			HC2	
11/32 in.																			HC3	
3/8 in.																			HC4	
13/32 in.																			HC5	
7/16 in.																			HC6	
15/32 in.																			HC7	
1/2 in.																			HC8	
Others																			HZ9	
Surface Treatment																				
Oxygen cleaning																			P1	
Others																			Z9	
Certification																				
Material certificates to BS EN 10204 3.1 B																			C2	
Material certificates to BS EN 10204 3.1 C																			C3	
Material NACE MR0175																			CN	
Material NACE MR0103																			CM	
Positive material identification (NITRON XRF)																			CA	
100% dimensional check																			C6	
Others																			Z9	

Continued on next page ...

Orifice plates	Main code											Optional code															
	FPD150	XX	XX	XX	XXX	XX	XX	XX	XXX	XX	XX	XXX	XXX	XX	XX	XX	XXX	XX	XXX	XXX							
See page 8												page 9		See page 10													
Testing																											
Impact testing @ -46 °C (-50.8 °F)																		CH1									
Impact testing @ -196 °C (-320.8 °F)																		CH2									
Hardness survey																		CH3									
Documentation language (default = English)																											
German																		M1									
Italian																		M2									
Spanish																		M3									
French																		M4									
Chinese																		M6									
Added requirements																											
Manufactured to customer drawing																		GD9									
Special device																		STZ									
Material source limitations apply																		MS1									
Others																		MZ9									
Tab handle																											
No tab handle																											
TH0																											

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Differential pressure – primary flow element orifice plates and orifice flange unions

Optional codes continued on next page ...

		Main code												Options											
Orifice flange unions	FPD160	XX	XX	XX	XX	XX	XX	XX	XXX	XX	XX	XX	XXX	XXX	XX	XX	XXX	XX	XXX	XXX	XX	XXX	XX	XXX	XXX
		See page 14				See page 15				See page 16															
Orifice sealing face																									
Scrolled (3.2 to 6.3 μm)														SF6											
Drain / Vent hole																									
Drain hole (gas applications)														HT1											
Vent hole (liquid applications)														HT2											
Drain / Vent hole size																									
1 mm														HA1											
1.5 mm														HA2											
2 mm														HA3											
3 mm														HA4											
4 mm														HA5											
5 mm														HA6											
5.5 mm														HA7											
6 mm														HA8											
6.5 mm														HA9											
7.5 mm														HB1											
8 mm														HB2											
10 mm														HB3											
3/32 in.														HB4											
1/8 in.														HB5											
5/32 in.														HB6											
3/16 in.														HB7											
7/32 in.														HB8											
1/4 in.														HB9											
9/32 in.														HC1											
5/16 in.														HC2											
11/32 in.														HC3											
3/8 in.														HC4											
13/32 in.														HC5											
7/16 in.														HC6											
15/32 in.														HC7											
1/2 in.														HC8											
Others														HZ9											
Surface treatment																									
Oxygen cleaning														P1											
Others														Z9											
Tapping type																									
Threaded (female)														CTT											
Nipolet														TT2											
Nipoflange (B16.5)														TT3											
Socket weld														TT4											
Thread (male) nipple														TT5											
Others														TZ9											

Optional codes continued on next page ...

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Orifice flange unions	FPD160	Main code												Options											
		XX	XX	XX	XX	XX	XX	XX	XXX	XX	XX	XX	XXX	XXX	XX	XXX	XX	XXX	XX	XXX	XX	XXX	XXX		
		See page 14				See page 15				See page 16				See page 17											
Tapping rating																									
BSP Tr (M)																		TRB							
NPT F																		TRC							
NPT M																		TRD							
As line rating																		TRE							
ASME Class 150 RF																		TR1							
ASME Class 300 RF																		TR2							
ASME Class 600 RF																		TR3							
ASME Class 900 RF																		TRV							
ASME Class 1500 RF																		TRW							
ASME Class 2500 RF																		TRX							
ASME Class 150 RTJ																		TRY							
ASME Class 300 RTJ																		TRZ							
ASME Class 600 RTJ																		TR6							
ASME Class 900 RTJ																		TR7							
ASME Class 1500 RTJ																		TR8							
ASME Class 2500 RTJ																		TR9							
Kidney Flange																		TRK							
Tapping size																									
1/2 in.																		TS2							
3/4 in.																		TS3							
Others																		TZ9							
Tapping sets																									
1 Set																		TN1							
2 Sets																		TN2							
3 Sets																		TN3							
4 Sets																		TN4							
Tapping orientation																									
Inclined up																		TG2							
Horizontal																		TG3							
Inclined down																		TG4							
Certification																									
Material certificates EN 10204 3.1																		C2							
Material certificates EN 10204 3.2																		C3							
Material NACE MR0175																		CN							
Material NACE MR0103																		CM							
Positive material identification (NITRON XRF)																		CA							
100% dimensional check																		C6							
Others																		Z9							
Testing																									
Impact testing @ -46 °C																		CH1							
Impact testing @ -196 °C																		CH2							
Hardness survey																		CH3							
Others																		CZ9							
Documentation language (default = English)																									
German																		M1							
Italian																		M2							
Spanish																		M3							
French																		M4							
Chinese																		M6							
Added requirements																									
Manufactured to customer drawing																		GD9							
Special device																		STZ							
Material source limitations apply																		MS1							
Others																		MZ9							
Tab handle																									
No tab handle																									

TH0

Notes

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