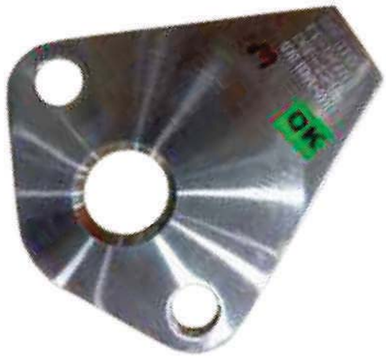
Orifice assemblies manufacturing std. as per ISO 5167, AGA-3, and as per SARP 3.2, B16.5, B16.47, B16.36, B16.20

Spraytech Systems manufactures orifice plate assemblies for various applications. Applications which go for conditions summarised as below, is applied with the most precise measurement of the application with manufacturing of the device with 3 axis vertical machining centre. The process of manufacture is completed with X, Y and Z axis serving the completion of the machining of the plate at the same time, leading to most linear hysterisis, and thus leading to most accurate flow measurements.

Orifice plate of Spraytech Systems Instruments cater to all high and differential node of pressure and temperature and offers an accurate reading of desired within its limits of performance and application



Spraytech Systems assemblies are rated with high precision of manufacture and design concepts. The orifice assemblies have the following design considerations

- Type tested for radiography level -1 with max upto 10ppm moistness content
- Type tested for helium leak test at $10^{(-6)}$ mbarltr/sec
- MTBF for assemblies at 10^{6}, before the first formation of rustiness
- Guaranteed full life cycles at 70,000, before the first formation of rustiness
- Complete forged assemblies
- When electrolysis test done at 25KV, the probe gives isolated test results and not conductive, which shows forgings with lowest possible moistness content

These when compared with plate versions of flanges which Spraytech Systems do not manufacture as per design policy standard

Type tested for radiography level -3 with min 1000ppm moistness content

Type tested for helium leak test at $10^{(-1.5)}$ mbarltr/sec

MTBF for assemblies at 10^{2}, before the first formation of rustiness

Guaranteed full life cycles at 7,000, before the first formation of rustiness

When electrolysis test done at 25KV, the probe gives conductive test results, which shows plate version with highest possible moistness content, leading to low MTBF

Table 7.1

Type of orifice plate	Reynolds	Application	Viscosity @ 30°C
Square edge concentric	7500 onwards	For all applications with clean of foreign particles	0.01cp to 10cp
Conical entrance	80 to 1500	High viscosity measuring capacity leading to ruling off application which requires accuracy at lowest reynolds, thus effectively rid off applications of magnetic and vortex	0.01cp to 150cp
Eccentric	3000 to 12000	For liquids containing solid particles that are likely to sediment or for vapors likely to deposit water condensate, also used for bottom flush application	0.01cp to 15cp
Quadrant edge	1500 to 9000	Viscous fluids and all and most for Fertilizer and petrochemicals	0.01cp to 40cp
Segmental	5000 to 20000	Sedimentation process application	0.01cp to 20cp

Spraytech Systems Orifice Performance

Principally, Spraytech Systems orifice plate is a precision instrument. In best circumstances, the inaccuracy of Orifice plates can possibly fall in the range of 0.75-1.5%. However, there are numerous error causing conditions which can terribly affect the accuracy of Spraytech Systems Orifice plate.

Following factors are used to judge the performance of Spraytech Systems Orifice plate:

1. Precision in the bore calculations
2. Quality of the installation
3. Condition of the plate itself
4. Orifice area ratio
5. Physical properties of the fluid flow under measurement, refer the free length table mentioned below

Further class of installation depends upon following factors

- Tap location and circumstance. Generally, there are three ways to position a pressure tap.
- Provision of the process pipe
- Competence of straight pipe runs
- Gasket intervention
- Misalignment of pipe and orifice bores
- Lead line design

Extra detrimental conditions consist of

- Dulling of the sharp edge or nicks caused due to corrosion or erossion
- Warpage of the plate because of waterhammer and dirt
- Grease or secondary phase deposits on any of the orifice surface

Any of the above said conditions has the tendency to affect the discharge coefficient of an orifice plate to a large extent.

Upstream and downstream free length required for Spraytech Systems orifice assembly performing accurate measurements, with beveling at the downstream end of the orifice. Without bevel the upstream and downstream length at 1.5 times the valve given to achieve same accuracy.

Table 7.2

Beta value based on the parameters of pressure, temp, flow, density	Upstream FREE LENGTH	Downstream FREE LENGTH
0.9	56D	9.5D
0.8	50D	8D
0.7	44D	7.25D
0.6	38D	5.5D
0.5	26D	4D
0.4	20D	3D
0.3	13.5D	2.5D
0.2	4.8D	1.75D
0.1	4.0D	1.5D
0.05	2.5D	1D

Information on physics of designing Spraytech Systems Orifice assembly

Spraytech Systems orifice plate is a device used for measuring flow rate. Either a volumetric or mass flow rate may be determined, depending on the calculation associated with the it. It uses the same principle, namely Bernoulli's principle which states that there is a relationship between the pressure of the fluid and the velocity of the fluid. When the velocity increases, the pressure decreases and vice versa.

Description

Spraytech Systems orifice plate is a thin plate with a hole in the middle or edge depending on design as per application. It is usually placed in a pipe in which fluid flows. When the fluid reaches the orifice plate, the fluid is forced to converge to go through the small hole; the point of maximum convergence actually occurs shortly downstream of the physical orifice, at the so-called vena contracta point. As it does so, the velocity and the pressure changes. Beyond the vena contracta, the fluid expands and the velocity and pressure change once again. By measuring the difference in fluid pressure between the normal pipe section and at the vena contracta, the volumetric and mass flow rates can be obtained from Bernoulli's equation.

Incompressible flow measurement through Spraytech Systems orifice

By assuming steady-state, incompressible (constant fluid density), inviscid, laminar flow in a horizontal pipe (no change in elevation) with negligible frictional losses, Bernoulli's equation reduces to an equation relating the conservation of energy between two points on the same streamline:

$$P_1 + \frac{1}{2} \cdot \rho \cdot V_1^2 = P_2 + \frac{1}{2} \cdot \rho \cdot V_2^2$$

OR

$$P_1 - P_2 = \frac{1}{2} \cdot \rho \cdot V_2^2 - \frac{1}{2} \cdot \rho \cdot V_1^2$$

By continuity equation:

$$Q = A_1 V_1 = A_2 \cdot V_2 \quad \textbf{or } V_1 = Q / A_1 \textbf{ and } V_2 = Q / A_2$$

$$P_1 - P_2 = \frac{1}{2} \cdot \rho \cdot \left(\frac{Q}{A_2}\right) - \frac{1}{2} \cdot \rho \cdot \left(\frac{Q}{A_1}\right)^2$$

Solving for Q :

$$Q = A_2 \sqrt{\frac{2\,(P_1 - P_2)/\rho}{1\,(A_1/A_2)^2}}$$

and:

$$Q = A_2 \sqrt{\frac{1}{1-(d_2/d_1)^4}} \sqrt{2\,(P_1/P_2)/\rho}$$

The above expression for Q gives the theoretical volume flow rate. Introducing the beta factor $ß = d_2/d_1$ as well as the coefficient of discharge C_d :

$$Q = C_d A_2 \sqrt{\frac{1}{1-\beta^4}} \sqrt{2\,(P_1/P_2)/\rho}$$

And finally introducing the meter coefficient C which is defined as $C = \frac{1}{\sqrt{1-\beta^4}}$ to obtain the final equation for the volumetric flow of the fluid through the orifice:

(1) $$Q = C\,A_2 \sqrt{2\,(P_1 - P_2)/\rho}$$

Multiplying by the density of the fluid to obtain the equation for the mass flow rate at any section in the pipe:

(2) $$\dot{m} = \rho Q = C A_2 \sqrt{2\,\rho\,(P_1 - P_2)}$$

where:

Q = volumetric flow rate (at any cross-section), m³/s

$\dot{m}$ = mass flow rate (at any cross-section), kg/s

C_d = coefficient of discharge, dimensionless

C = orifice flow coefficient, dimensionless

A_1 = cross-sectional area of the pipe, m²

A_2 = cross-sectional area of the orifice hole, m²

d_1 = diameter of the pipe, m

d_2 = diameter of the orifice hole, m

$ß$ = ratio of orifice hole diameter to pipe diameter, dimensionless

V_1 = upstream fluid velocity, m/s

V_2 = fluid velocity through the orifice hole, m/s

P_1 = fluid upstream pressure, Pa with dimensions of kg /(m·s²)

P_2 = fluid downstream pressure, Pa with dimensions of kg / **(m·s²)**

ρ = fluid density, kg/m

Deriving the above equations used the cross-section of the orifice opening and is not as realistic as using the minimum cross-section at the vena contracta. In addition, frictional losses may not be negligible and viscosity and turbulence effects may be present. For that reason, the coefficient of discharge C_d is introduced. Methods exist for determining the coefficient of discharge as a function of the Reynolds number.

The parameter $\sqrt{1-\beta^4}$ is often referred to as the velocity of approach factor and dividing the coefficient of discharge by that parameter (as was done above) produces the flow coefficient C. Methods also exist for determining the flow coefficient as a function of the beta function $ß$ and the location of the downstream pressure sensing tap. For rough approximations, the flow coefficient may be assumed to be between 0.60 and 0.75. For a first approximation, a flow coefficient of 0.62 can be used as this approximates to fully developed flow.

Orifice only works well when supplied with a fully developed flow profile. This is achieved by a long upstream length (20 to 40 pipe diameters, depending on Reynolds number) or the use of a flow conditioner.

Flow of gases through Spraytech Systems orifice

In general, equation (2) is applicable only for incompressible flows. It can be modified by introducing the expansion factor Y to account for the compressibility of gases.

(3) $$\dot{m} = \rho_1 Q = C Y A_2 \sqrt{2\,\rho_1\,(P_1 - P_2)}$$

Y is 1.0 for incompressible fluids and it can be calculated for compressible gases.

Calculation of Expansion Factor

The expansion factor Y, which allows for the change in the density of an ideal gas as it expands isentropically, is given by:

where:

$$Y = 1 - \left(\frac{1-r}{k}\right)\left(0.41 + 0.35\beta^4\right)$$

where:

Y = Expansion factor, dimensionless

$r = P_2 / P_1$

k = specific heat ratio (c_p / c_v), dimensionless

Substituting equation (4) into the mass flow rate equation (3):

$$\dot{m} = C A_2 \sqrt{2\rho_1 \left(\frac{k}{k-1}\right) \left[\frac{(P_2/P_1)^{2/k} - (P_2/P_1)^{(k+1)/k}}{1 - P_2/P_1}\right] (P_1 - P_2)}$$

and:

$$\dot{m} = C A_2 \sqrt{2\rho_1 \left(\frac{k}{k-1}\right) \left[\frac{(P_2/P_1)^{2/k} - (P_2/P_1)^{(k+1)/k}}{(P_1 - P_2)/P_1}\right] (P_1 - P_2)}$$

and thus, the final equation for the non-choked (i.e., sub-sonic) flow of ideal gases through an orifice for values of β less than 0.25:

$$(5) \quad \dot{m} = C A_2 \sqrt{2\rho_1 P_1 \left(\frac{k}{k-1}\right) \left[(P_2/P_1)^{2/k} - (P_2/P_1)^{(k+1)/k}\right]}$$

Using the ideal gas law and the compressibility factor (which corrects for non-ideal gases), a practical equation is obtained for the non-choked flow of real gases through an orifice for values of β less than 0.25:

$$(6) \quad \dot{m} = C A_2 P_2 \sqrt{\frac{2M}{Z R T_1} \left(\frac{k}{k-1}\right) \left[(P_2/P_1)^{2/k} - (P_2/P_1)^{(k+1)/k}\right]}$$

Remembering that $Q_1 = \dfrac{\dot{m}}{\rho_1}$ and $\rho_1 = \dfrac{P_1}{Z R T_1}$ (ideal gas law and the compressibility factor)

$$(8) \quad Q_1 = C A_2 \sqrt{2\frac{Z R T_1}{M} \left(\frac{k}{k-1}\right) \left[(P_2/P_1)^{2/k} - (P_2/P_1)^{(k+1)/k}\right]}$$

where:

k = specific heat ratio (c_p / c_v), dimensionless

$\dot{m}$ = mass flow rate at any section, kg/s

Q_1 = upstream real gas flow rate, m³/s

C = orifice flow coefficient, dimensionless

A_2 = cross-sectional area of the orifice hole, m²

ρ_1 = upstream real gas density, kg/m³

P_1 = upstream gas pressure, Pa with dimensions of kg/(m·s²)

P_2 = downstream pressure, Pa with dimensions of kg/(m·s²)

M = the gas molar mass, kg/mol

R = the Universal Gas Law Constant = 8.3145 J/(mol·K)

T_1 = absolute upstream gas temperature, K

Z = the gas compressibility factor at P_1 and T_1, dimensionless

Orifice Plates

Specifications

Design: Conforms to ISA RP 3.2, DIN 1952, BS 1042, ISO-5167

Types: Square edge concentric, Quadrant edged, Conical entrance, Eccentric, Segmental

Plate material: SS304, SS316, SS316L as standard. Hastelloy-C, Monel, PP, PVC, PTFE coated, etc. can be given on request.

Orifice Bore: In accordance with ISO-5167, BS-1042, ASME MFC 3M, R.W.Miller, L.K.Spink, AGA-3

Tab Plate: In the same material as plate & is welded to orifice plate. Tab plate integral to the Orifice plate (i.e. without welding) can also be offered as a special case.

Vent / Drain: Vent or Drain holes are provided as per customer's requirement. The diameter of the vent or drain holes are as per ISA RP 3.2

Flange Union: Weld neck, Slip on, Threaded, Socket welded with RF or RTJ facing Orifice flanges are in accordance with ANSI B16.36 with minimum flange rating of 300# for sizes up to 8" or male - female flanges in accordance with ANSI B16.5.

Pressure Tappings: Corner tappings are recommended for sizes upto 1 ½"; Flange taps from 2" to 16" ; D – D/2 taps for higher sizes.

Gasket: CAF as per IS: 2712 Gr 0/1 , SS spiral wound + CAF, SS spiral wound + Grafoil, SS spiral wound + PTFE are normally supplied as per process requirement. Other materials available on request.

For RTJ flanges , the plate is fixed on the plate holder. The plate holder is in Soft Iron material & acts as a gasket .

Studs / Nuts: ASTM A193 Gr.B7/A-194 Gr.2H as standard, Other material on request.

Jack Screw: ASTM A193 Gr.B7/A-194 Gr.2H as standard, Other material on request.

Permanent pressure drop for incompressible fluids

Permanent pressure loss is a term every system engineer, designer, or technician should be aware of. Whenever a piece of equipment or pipe is added to a flow system, pressure is lost. This pressure loss makes the pump or compressor work harder to generate the same flows in the system. If too much pressure loss exists, the system will simply stop flowing. This may be of concern if you are working with both low and high pressure systems. Every bit of pressure loss is equal to extra energy used (electricity, steam, or natural gas) to pump or compress the fluid, i.e. more money to operate.

In the case of flow meters, a loss is incurred because a piece of straight pipe would not have as much loss as the flow meter. The loss is also permanent. Permanent pressure loss should not be confused with pressure drop. Meters such as differential pressure-types have a pressure drop inside the meter section. The pressure measured upstream of the meter will be greater than the pressure just downstream of the meter. As you move further downstream of the meter, the pressure recovers to a level not quite as high as the upstream pressure. The difference between the upstream pressure and the downstream recovered pressure equals the permanent pressure loss.

Fluid velocity also plays an important role in permanent pressure loss. The faster the fluid is moving, the greater the pressure loss. Therefore, a permanent pressure loss value must always be associated with a certain flow rate. Meter manufacturers often state the permanent pressure loss at the maximum stated velocity of the meter.

There are many different meter types and all have different characteristics of permanent pressure loss. Some meters have no restriction in the pipe, so therefore no permanent pressure loss. In other words, they incur the same loss as a straight piece of pipe. For example, magnetic meters and ultrasonic meters generally have no permanent pressure loss.

Other meters have a very high loss. These meters have physical restrictions due to the nature of the meter. Examples of high loss meters include curved-tube type coriolis flowmeters and positive displacement meters.

Permanent pressure loss is just one of the characteristics to consider when evaluating a flowmeter. A meter with a low loss is not necessarily better than a meter with a high loss. Every characteristic of the meter technology must be weighed according to the needs of the application.

For a square-edge orifice plate with flange taps:

$$\frac{\Delta P_p}{\Delta P_i} = 1 - 0.24\beta - 0.52\beta^2 - 0.52\beta^3$$

where:

ΔP_p = permanent pressure drop

ΔP_i = indicated pressure drop at the flange taps

$\beta = d_2 / d_1$

And rearranging the formula

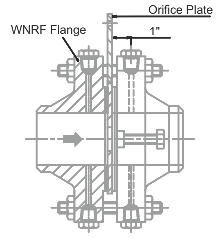
$$\Delta P_i = P_1 - P_1 = \frac{Q^2 p (1-\beta^4)}{2 C_d^2 A_2^2} = \frac{Q^2 p (1-\beta^4)}{2 C_d^2 A_2^2 \beta^4}$$

Uncertainty in measuring flow elements

Uncertainty factor is indicated to give an idea of how the orifice plate behaves on changes of the flow due to turbulances. The free length table as indicated above the orifice assembly will behave based on turbulances created and thus the uncertainty will differ, alongwith the choice of the beta value of the plate.

Various types of orifice assemblies

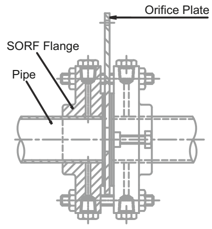
- The weld neck flange assembly is designed to transfer stresses to the pipe, thereby reducing high stress concentrations at the base of the flange. The pressure tappings are provided through the flange which are at a distance of approximately 20mm to 26mm from the face of the plate.



Orifice Assembly with WNRF Flange & Flange Taps

Fig 7.1

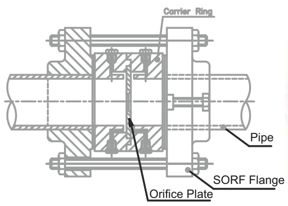
- The slip on flange has a low hub because the pipe slips into the flange prior to the welding. It is welded both from inside and out to provide sufficient strength and prevent leakage. The slip on flanges are bored slightly larger than the OD of the matching flange.



Orifice Assembly with SORF Flange & Flange Taps

Fig 7.2

- Orifice assembly with carrier raing and flange union is provided to facilitate pressure tapping, by means of corner tappings. This construction is generally used for lower sizes. refer the table below, a detail comparison with RTJ assemblies and it usage. Carrier ring by principle is applicable for ratings upto 300# and till 600# only under few conditions. The principle says atmost Carrier ring assembly is used upto 2" or may be still higher but only till 300# and if it is used for 600# the size should be reduced and be restricted till 2".



CARRIER RING

Orifice Plate with Carrier Ring & Flange Union

Fig 7.3

The reason is due the principle of operation of carrying the vena Contracta in the assembly without affecting the accuracy of the assembly. This means more flow, i.e more size, the carrier allows the vena contracta move further away attracting bigger free length s for accuracy and lesser scramped means forcing for leakage if pressure is more. Here more flow attracts more pressure and thus It is better to restrict carrier ring within 2" and upto 300-600#.

- RTJ assembly for high temperature and pressure: The plate holder assembly is a combination of plate holder and an orifice plate designed for ring tongue joint flanges. The plate holder has a function of holding the orifice plate and also the function as a gasket to prevent leakage of the process fluid. The plate holder has a oval or octagonal ring for mounting between ring tongue joint flanges. This metallic sealing system is applicable to a fluid of high temperature and high pressure. The pressure tapping system normally is of the flange tap type. Orifice plate is screwed to the plate holder. Generally the plate holder is of the softer material. The orifice plate is available in standard material such as SS316, 304, 304L, SS316L, PP, Hastealloy, Monel, PTFE, etc depending on applications .

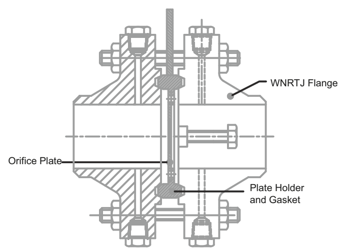
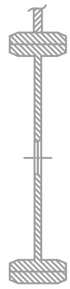


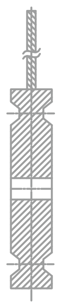
Plate with Plate Holder mounted in between RTJ Flanges

Fig 7.4



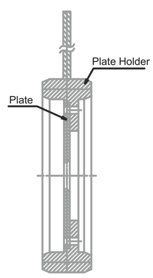
Integral RTJ

Fig 7.5



Integral RTJ with Female Groove

Fig 7.6



Orifice Plate with RTJ Holder

Fig 7.7

Table 7.3

Description	Application for RTJ assemblies	Application for carrier ring
Limit of pressure	Between 66 bar g till 400 bar g	Between 7 to 50, max till 80 bar g
Limit of temperature	Between plus 220 till 700 deg cent	Between 20 till 150 deg cent
Limit of flow rate	U can have it for ½" to 64", it depends on pressure and temp	Max recommended till 2", but may go till 6" but till 300#
Vena contracta design	Best usage is for having it next to the bore of the orifice plate	By concept the carrier shifts the vena contracta away from the orifice bore
Gasket	Metal version in form of plate holder	Rubber gaskets only and is dependent thus on both pressure and temp
Sealing tightness	RTJ in principle of the design has sealing tightness of 10^{-6} mbarltr/sec at 150 bar g test at 500 deg cent with metal plate holders and at higher flows beyond 10"	Not beyond 10^{-3} mbar ltr/sec at 80 bar and 130 deg cent at 6" flow, and 10^{-6} mbar ltr/sec at 40 bar and at 60 deg cent and at 2" plate holders and at flow rate thru it

Table 7.3 contd.

Description	Application for RTJ assemblies	Application for carrier ring
Accuracy	U can have the best accuracy at the normal recommended free space at higher flows and high temp	Accuracy is weakest, at all conditions as by concept the carrier rig shifts the vena contracta and the free length is thus increased
Repeatability	Not actually defined in orifice, but the hysteresis at high pressure and high temp is linear and hence the accuracy is line free length dependent	Not actually defined in orifice but hysteresis is not linear at all at any conditions as the vena contracts shifts and hence the accuracy is defined abruptly at conditions and free length has to be adjusted
For cryogenic application	Not recommended at all, normally for such application, the pressure does not exceed 75 bar g	Will be more effective only within 2" and within 150# arting

Spraytech Systems Restriction orifice plate and its assemblies

Restriction plate is a different operating principle developed by Spraytech Systems Wherein pressure gradient is developed across while the phenomenon is to keep a no loss flow. This is equally achieved by Restriction orifice by us wherein the design is effective for restriction of pressure. In this plate the bevel is not encrafted and the plate with relevant thickness is used for restriction parameters of pressure .

Multistage assemblies with Restriction plates are used. The concept is well explained at our Multistage assembly concept in the next few pages. Pl read on.

In the below table (7.4) the plate thickness versus pressure and temperature rating is indicated for both impact and differential to design both flow orifice plate and restriction orifice plate thickness. This is achieved at 100% flow consumption. At lesser or more, the ratio is divided at pressure column to have the resultant at that flow consumption

Table 7.4

Line size	Max DP and or inlet pressure impact in bar g	Max temp applicability with max DP or at that inlet pressure in deg cent	Plate thickness applicable at that stage based on data of column 2 and 3	Pressure and temp differ than those column 2 and 3 but upto the max limit of	Plate thickness applicable at the condition of column 5	Pressure and temp differ than those column 5 but upto the max limit of	Plate thickness applicable at the condition of column 7
½”	Upto 20	Upto 150	3.18mm	30 bar g and 250 deg cent	6.35mm	45 bar and 350 deg cent	9.52mm
1”	Upto 20	Upto 150	3.18mm	30 bar g and 250 deg cent	6.35mm	45 bar and 350 deg cent	9.52mm
11/2”	Upto 20	Upto 150	3.18mm	30 bar g and 250 deg cent	6.35mm	45 bar and 350 deg cent	9.52mm
2’	Upto 20	Upto 150	3.18mm	30 bar g and 250 deg cent	6.35mm	45 bar and 350 deg cent	9.52mm
3”	Upto 16	Upto 150	3.18mm	25 bar g and 250 deg cent	6.35mm	40 bar and 350 deg cent	9.52mm
4”	Upto 16	Upto 150	3.18mm	25 bar g and 250 deg cent	6.35mm	40 bar and 350 deg cent	9.52mm
6”	Upto 15	Upto 150	3.18mm	24 bar g and 250 deg cent	6.35mm	38bar and 350 deg cent	9.52mm
8”	XXXXX	XXXXX	XXXXX	24 bar g and 250 deg cent	6.35mm	38bar and 350 deg cent	9.52mm
10”	XXXX	XXXXX	XXXXX	24 bar g and 250 deg cent	6.35mm	38bar and 350 deg cent	9.52mm

Other temperature and pressure combinations and your solutions, please revert to Spraytech Systems Engineering and design team

Table 7.5

Orifice assembly size and rating	½” to 64”, and rating till 4000psi and till 700 deg cent from minus 196
Plate thickness defined	3.18mm till 350mm for various application, including blow down orifice assembly
Fastners	A193GrB7/ A194Gr2H and A193GrB8/ A194Gr8
Flanges MOC	SS316, A105, A182F11, A182F22, PP, PTFE, SS316L, SS304, SS304L, Hastealloy, Monel
Flanges type	WNRF, RTJ, SLIP ON, SWRF
Orifice plate MOC	SS316, PP, PTFE, SS316L, SS304, SS304L, Hastealloy, Monel





Calculation of Spraytech Systems plate thickness under pressurized conditions

Allowable stress in kg/mm^2= ((3 X Differential pressure in kg/mm^{2}X ((Orifice plate OD in mm , radius^2) - (Orifice bore radius in mm^2)) / (4 x (Orifice plate thickness in mm)^2))

Now allowable stress for example for SS316L plate is

Table 7.6

Temperature	Stress
100 < Temp in deg F <= 150	9.98383
150 < Temp in deg F <= 200	9.98383
200 < Temp in deg F <= 250	8.9292

Other information and calculation, kindly contact Spraytech Systems technical team

Weights for forged versus plate version for flanges

The below weights are for one flange only

Table 7.7

ANSI 150#	PLATE	FORGED	ANSI 300#	PLATE	FORGED	ANSI 600#	PLATE	FORGED
½"	0.3	0.8	½"	0.3	0.9	½"	1	1.4
1"	0.4	1.1	1"	0.5	1.8	1"	1.2	1.8
11/2"	0.6	1.8	11/2"	0.9	3.1	11/2"	1.8	3.6
2"	0.9	2.8	2"	1.2	3.7	2"	2.8	4.5
3"	1.6	5.2	3"	1.8	8.2	3"	4.7	8.2
4"	2.1	7.5	4"	2.7	11.8	4"	6.2	16.8
6"	4.1	11.3	6"	5.3	20	6"	11.8	38.1
8"	5.1	19.1	8"	7.5	32.2	8"	17.6	50.6
10"	8.8	25.4	10"	12.1	45.4	10"	23.7	85.8
12"	11.9	38.1	12"	15.6	64.4	12"	34.1	103
14"	20.2	51.3	14"	26.6	93.5	14"	52.1	158
16"	23.1	63.5	16"	33.6	113	16"	68.7	218
18"	30.7	74.9	18"	42.9	138	18"	90.8	252
20"	42.4	89.4	20"	55.5	168	20"	116	313
24"	60.2	122	24"	90.3	236	24"	163	444
28"	91	170	28"	140	325	28"	221	594
32"	133	230	32"	208	431	32"	285	770
36"	195	305	36"	276	500	36"	365	932
40"	254	380	40"	355	566	40"	418	1165

Other ratings and information available on request