Integral Assemblies

Integral assembly Std as per B16.5, B16.36, B16.20, B16.47 Series B, ISO5167, AGA-3, ASME, MFC 14M 2003

Spraytech Systems manufactured integral orifice assemblies are another type of measuring flow device, which caters to the principle of maintaining constant reynolds number through out the process of media entering and processed and finally out of the assembly.

This is possible with the precision manufactured device wherein the input flange, with pipe chamber, the orifice assembly and the outlet pipe chamber and the subsequent flange for the flange end connection, all shall be attributed to constant reynolds number.

The type of integral assemblies Spraytech Systems Manufactures:

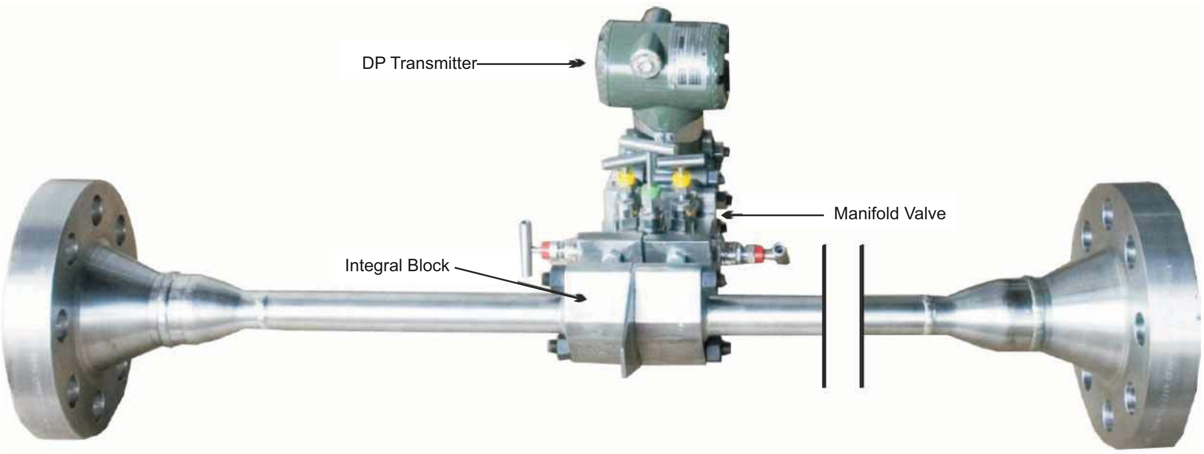
a) Integral meter run assembly upto 2"

b) Integral meter run with pressure and temperature compensation device for line sizes ½" till 40"

c) Integral assembly with line sizes above 2" till 40"

Fig 8.1

Fig 8.2



Integral Orifice Assembly, Manifold valve, DP transmitter & end flanges

Fig 8.3

Conceptually, integral assembly is designed with the following steps:

- Note the parameters of temp, pressure, density, line size
- Do the normal sizing and consider the up stream and downstream lengths of the pipe chamber based on schedule of the pipe connections accordingly
- For length of upstream and downstream use the table as below to decide the measurements
- For deciding the constant Reynolds number of the pipe chamber the Reynolds for pipe and plate is considered while doing the sizing
- For Reynolds number of the pipe chamber and plate the ISO formula of reynold number in deciding with help of parameters have to be considered, refer the mathematical formula as below
- The orifice assembly now including the accessories of 3 way or 5 way manifold valve with isolation valves of needle, globe or ball type and the DP gauge or DP transmitter is applicable for the orifice assembly
- Integrating versions of these assembly clears off the confirmed less hysteresis driven, linear hysteresis and more accuracy for the complete assembly
- Noise level and choking version in integral assembly is completed by selecting multistage assemblies in place of single stage and quoting accordingly
- End connection can be various rating of both flange or welded or screwed connection depending on application Spraytech Systems make can offer pressure rating till 4000psi and from minus 196 deg cent till plus 120 deg cent application
- Any application beyond plus 120 deg cent, i.e media temperature above 120 deg cent, the orifice assembly is given alongwith extension bonnet thus grading out temperature reaching the flow measuring metre whose normal and max ambient condition remain at 80 deg cent of media temp.
- The media temp fumes which eminate thru the pipe runs thru and reach the device whose thus rating at EExiaIICT6, rating ensures only upto 80 deg cent ambient conditions and at 120 deg cent at IIAIIBT3T4 condition .
- Thus more temp can still be sufficed with if the extension bonnet is manufactured and concluded and placed and mounted between the Orifice assembly with accessories leading to the orifice measuring meter
- The max allowable temperature in media is anyway restricted to 400 deg cent
- In temperature compensation technique, thru multi-variable transmitter the media temp is noted and the compressible media works out exact flow at the levels of changing temperature
- Similarly the pressure compensation, leading thru temperature changing is done and checked for exact flow with these constant reynold number technique
- All the pipe chambers offered are strictly honed and applied
- Constant pipe velocity thus lead to less stress on it increasing the life cycle of operation and lead to more of saving of excess energy in driving the media, thus the device is thoroughly used for energy conservation technique

In integral assembly, the temperature compensation and the pressure compensation is done at 0.3D and 0.6D downstream of the assembly respectively

The lengths are indicative and are min. Normally for higher line size 1", 2,"3" to 6" thermowel flange is required to hold the temperature sensor and the corresponding pressure sensor flange is placed to get the bellow, the bourdon sensor on the line for such measurements

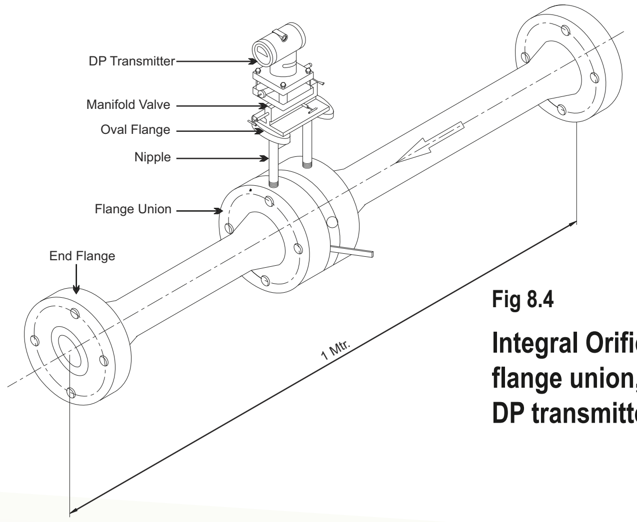


Fig 8.4

Integral Orifice Assembly with flange union, manifold valve, DP transmitter & end flanges

Table below to decide the pipe chamber length for integral assembly

Table 8.1

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

Reynold number of pipe chamber and that of the flange and orifice assembly remain constant when the pipe chamber selected with a scheduled gives the end flow rate with a specific bore to give a constant beta value.

Beta value changes if pipe chamber of different schedule and welding joints are different and being done with different techniques lead to a not constant value of Reynolds number

Welding techniques as applicable for integral assemblies

1.Arc welding

2.Tig welding

Welding joints being done at constant credibility of the welder maintain the so called practical Reynolds number. Here the techniques call for the pipe chamber placed with the assembly and welded at the same HEAT transfer ratio leading to same physical stress factor applicable for welding.

Such specialized application of the most constant integral values are well used along with temperature and pressure compensation at

1.Pharma industries

2.Power plants at desuperheaing section where long drawn applications can be easily solved with temperature and pressure compensation integral assembly

3.Desulpurisation technique at petrochemical and refinery application calling for temp and pressure compensation with constant reynold number application

Specification:

Table 8.2

Material of construction of pipe chamber	SS316, SS316L, A106, SS304, SS304L, Monel, Hastalloy, PP, PTFE
Material of orifice plate	SS316, SS316L, SS304, SS304L, Monel, Hastalloy, PP, PTFE
Material of construction of the end connection	SS316, SS316L, A106, SS304, SS304L, Monel, Hastalloy, PP, PTFE
End connections	Flanged, screwed, welded, other type on request
Line size assemblies	½” to 2” for integral metre run assemblies and till 40” for integral
Manifold block	3 way or 5 way in SS316 or SS316L or in A105
Isolation valve	Ball, needle, globe, ½” NPT F in A105, SS316, SS316L, SS304, SS304L, monel, PP, PTFE
Pressure	500mmwc till 4000psi
Temperature rating	Minus 100 till plus 400 deg cent
Application	For all conditions from Reynolds number 1250 onwards till 10^7
Orifice plates	Square edge, concentric, segmental, eccentric, quadrant edge
Media	Steam, steam water, water, acids, mixed phase, air, gasses, liquids all forms, liquids not less than Reynolds 1250

Reynolds number can be defined for a number of different situations where a fluid is in relative motion to a surface. These definitions generally include the fluid properties of density and viscosity, plus a velocity and a characteristic length or characteristic dimension. This dimension is a matter of convention - for example a radius or diameter are equally valid for spheres or circles, but one is chosen by convention. For aircraft or ships, the length or width can be used. For flow in a pipe or a sphere moving in a fluid the internal diameter is generally used today. Other shapes such as rectangular pipes or non-spherical objects have an equivalent diameter defined. For fluids of variable density such as compressible gases or fluids of variable viscosity such as non-Newtonian fluids, special rules apply. The velocity may also be a matter of convention in some circumstances, notably stirred vessels. With these conventions, the Reynolds number is defined as

$$\mathrm{Re} = \frac{\rho \mathbf{v} L}{\mu} = \frac{\mathbf{v} L}{\nu}$$

where:

v is the mean velocity of the object relative to the fluid (SI units: m/s)

L is a characteristic linear dimension, (travelled length of the fluid; hydraulic diameter when dealing with river systems) (m)

μ is the dynamic viscosity of the fluid (Pa·s or N·s/m² or kg/(m·s))

ν is the kinematic viscosity ($v = \mu / p$) (m²/s)

ρ is the density of the fluid (kg/m³)

Note that multiplying the Reynolds number by $\frac{L\mathrm{v}}{L\mathrm{v}}$ yields, $\frac{p\mathrm{v}^2 L^2}{\mu \mathrm{v} L}$ which is the ratio of the inertial forces to the viscous forces. It could also be considered the ratio of the total momentum transfer to the molecular momentum transfer.

are in contact with the flow.[9] This means the length of the channel exposed to air is not included in the wetted perimeter.

Flow in pipe

For flow in a pipe or tube, the Reynolds number is generally defined as:

$$\mathrm{Re} = \frac{\rho \mathrm{v} D_H}{\mu} = \frac{\mathrm{v} D_H}{\nu} = \frac{Q D_H}{\nu A}$$

where:

D_H is the hydraulic diameter of the pipe; its characteristic travelled length, L, (m).

Q is the volumetric flow rate (m³/s).

A is the pipe cross-sectional area (m²).

V is the mean velocity of the fluid (SI units: m/s).

μ is the dynamic viscosity of the fluid (Pa·s or N·s/m² or kg/(m·s)).

ν is the kinematic viscosity (v = μ /p) (m²/s).

ρ is the density of the fluid (kg/m³).

For shapes such as squares, rectangular or annular ducts where the height and width are comparable, the characteristical dimension for internal flow situations is taken to be the hydraulic diameter, D_H, defined as:

$$D_H = \frac{4A}{P}$$

where **A** is the cross-sectional area and **P** is the wetted perimeter. The wetted perimeter for a channel is the total perimeter of all channel walls that are in contact with the flow. [9] This means the length of the channel exposed to air is not included in the wetted perimeter.

For a circular pipe, the hydraulic diameter is exactly equal to the inside pipe diameter, as can be shown mathematically.

For an annular duct, such as the outer channel in a tube-in-tube heat exchanger, the hydraulic diameter can be shown algebraically to reduce to

D_H, annulus = $D_o - D_i$

where

D_o is the outside diameter of the outside pipe, and

D_i is the inside diameter of the inside pipe.

For calculations involving flow in non-circular ducts, the hydraulic diameter can be substituted for the diameter of a circular duct, with reasonable accuracy.

Flow in a wide duct

For a fluid moving between two plane parallel surfaces where the width is much greater than the space between the plates then the characteristic dimension is twice the distance between the plates.

Flow in an open channel

For flow of liquid with a free surface, the hydraulic radius must be determined. This is the cross-sectional area of the channel divided by the wetted perimeter. For a semi-circular channel, it is half the radius. For a rectangular channel, the hydraulic radius is the cross-sectional area divided by the wetted perimeter. Some texts then use a characteristic dimension that is four times the hydraulic radius, chosen because it gives the same value of Re for the onset of turbulence as in pipe flow, while others use the hydraulic radius as the characteristic length-scale with consequently different values of Re for transition and turbulent flow.