

FLOW

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Orifice Plates & Assemblies

Orifice plates are most commonly used primary elements for flow measurement in pipelines based on the principle of measurement of 'differential pressure' created when an obstruction is placed in the fluid flow, due to increase in fluid velocity.

Orifice Plates cover a wide range of applications of fluid and operating conditions. They give an acceptable level of uncertainties at lowest cost and long life without regular maintenance.

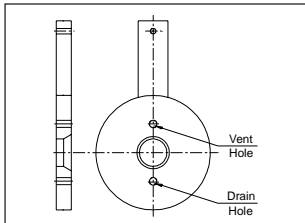
We manufacture orifice plates, restriction orifice plates, with or without carrier ring, meter run assemblies, integral orifice plates to suit customer's requirements.

We have fully equipped integrated designing, manufacturing and testing facilities which are among the best in country. Over the years we have manufactured and supplied orifice plate assemblies to many prestigious projects in the domestic as well as international market.



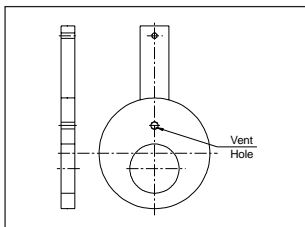
Orifice Plates

Types of orifice plates



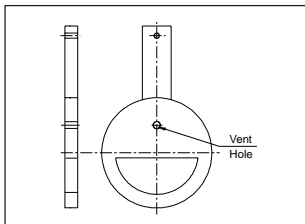
SQUARE EDGED CONCENTRIC

SQUARE EDGED CONCENTRIC : These are most commonly used for flow measurement . This has special features such as simple structures, high accuracy, and ease of installation & replacement. The orifice plates are correctly finished to the dimensions, surface roughness, and flatness to the applicable standard. These plates are recommended for clean liquids, gases & steam flow, when the Reynold number range from 10000 to 10^7 .



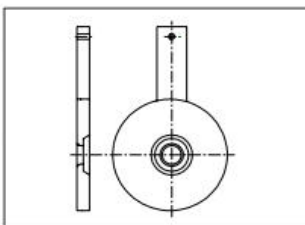
ECCENTRIC

ECCENTRIC : For liquids containing solid particles that are likely to sediment or for vapors likely to deposit water condensate, this orifice plate is used with its eccentric bore bottom flush with the bottom of the piping inside surface so that the sedimentation of such inclusions are avoided. Likewise, for gases or vapors, it may be installed with its eccentric bore top flush with the ID of the piping to avoid stay of gas or vapor in its vicinity.



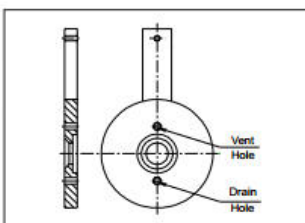
SEGMENTAL

SEGMENTAL : The bore of this orifice plate is a semicircle. These are used for measurements where solids are entrained in a gas or liquid flow stream.



QUADRANT EDGE

QUADRANT EDGE : The inlet edge of the bore of this orifice plate is rounded to a quarter circle. This orifice plate is principally used for measuring flow rates of low Reynolds number i.e. between 2000 to 10000



CONICAL ENTRANCE

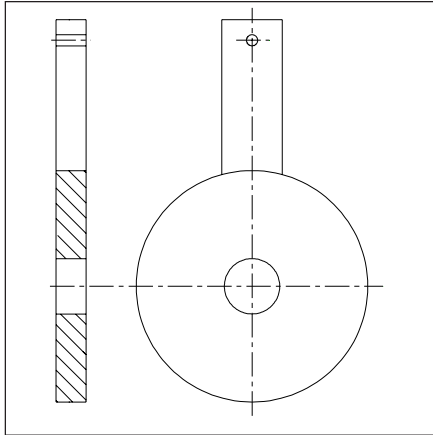
CONICAL ENTRANCE : This orifice plate is suitable for viscous fluids Reynolds number is very low i.e. between 80 to 2000.

Orifice Plates & Assemblies

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. Not drilled for orifice bores smaller than 25.4 mm
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 1/2"; 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	: Carbon Steel (C1038 heat treated)

Restriction Orifice



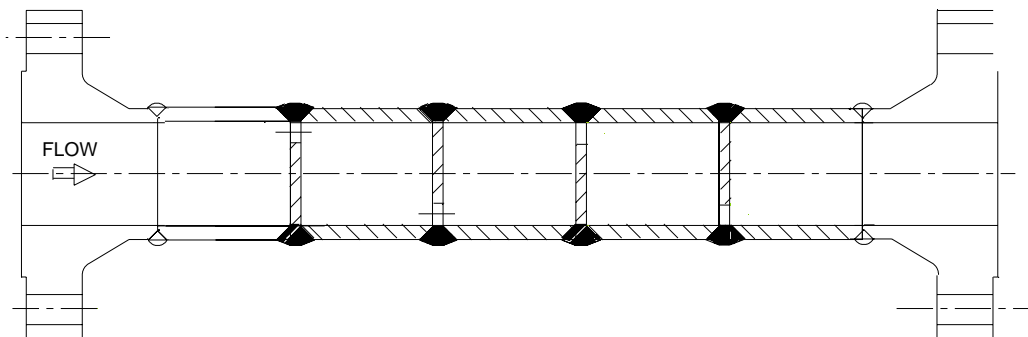
The restriction orifices are used for reducing fluid pressure and are designed somewhat different from the orifice plates that are used for measuring flow rates. They are designed to slip between the piping flanges.

While single restriction orifices are often sufficient to meet the requirements, there are situations where limitations arise due to process conditions making the single restriction orifices unacceptable. In such situations, use of multiple restriction in series is a better solution.

The foremost consideration for the case of multiple restriction is the pressure drop. This applies whether or not the fluid is liquid or vapor/gas. Higher pressure drop implies higher velocities resulting in vibration and noise problems.

The other consideration is not just about maximum permitted pressure drop & this is particularly for gas flow. If the process condition indicates that critical flow will occur with the use of single restriction plate, care should be exercised to avoid operating well beyond the critical pressure drop. Critical implies a pressure drop across the device exceeding 50 percent of the absolute upstream pressure at which point sonic velocity is reached.

Construction of Multistage Orifice Assembly comprises of multiple restriction orifice plates separated by a distance of one pipe diameter and welded with the pipes in between them. End connection is either suitable for butt welding or with end flanges.



Multiple Restriction Orifice Assembly

Orifice Plate Assemblies with RTJ Holder



Description

The Plate Holder Assembly is a combination of plate holder and an orifice plate designed for **ring tongue joint (RTJ)** flanges. The plate holder has a function of holding the orifice plate and also a function as a gasket to prevent leakage of the process fluid. The plate holder has an oval or octagonal ring for mounting between ring type 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 soft iron material. The Orifice plate is available in standard material such as SS316, SS304, SS316L, Monel, Hastelloy-C, etc. Other materials are available on request. The plate holder along with the orifice plate can be also machined from one piece.

CROSS SECTIONAL VIEW

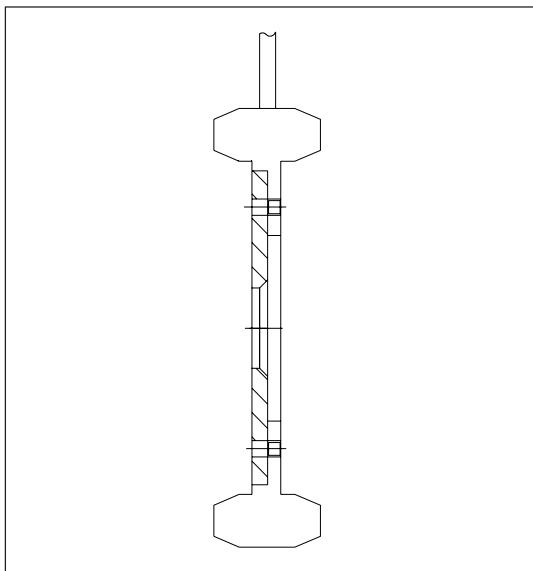


PLATE WITH PLATE HOLDER

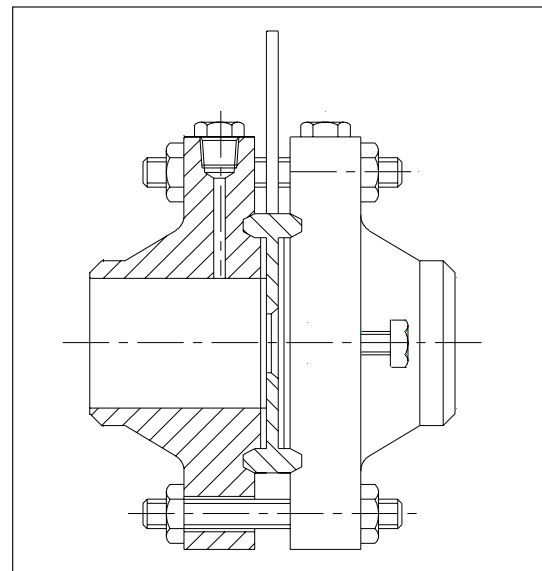
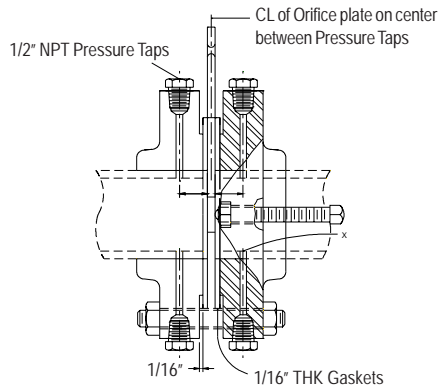


PLATE WITH PLATE HOLDER
MOUNTED IN BETWEEN RTJ FLANGES

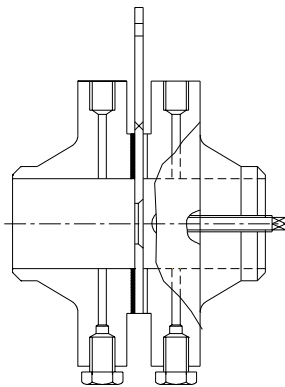
Orifice Plates & Assemblies

Typical assemblies



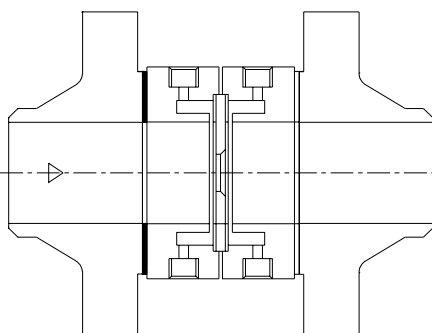
ORIFICE PLATE WITH SLIP ON FLANGE UNION

The slip on flange has a low hub because the pipe slips into the flange prior to 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 pipe



ORIFICE PLATE WITH WELD NECK FLANGE UNION

The weld neck flange is normally referred to as "high Hub" flange. It 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 1" from the face of the plate (shown in the drawing attached).



ORIFICE PLATE WITH MALE-FEMALE CARRIER RING AND WELD NECK FLANGED UNION

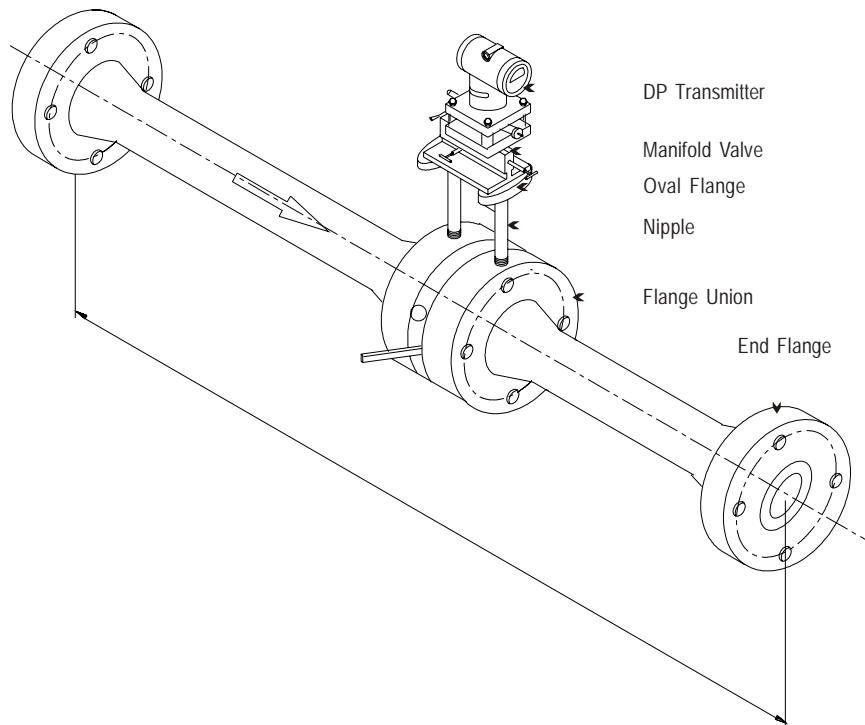
The construction is similar to the above except male-female carrier ring is provided to facilitate pressure tapping through it (corner tapping). This construction is generally used for lower line sizes (normally less than 2"). Carrier ring machined from single block is also offered in place of male-female carrier. For better accuracy, honed meter run assemblies are recommended which employ upstream and downstream straight lengths. The end connection in such case can be plain (suitable for welding) or flanged.

Integral Flow Orifice Assembly

Integral Flow Orifice Assembly is used when Differential Pressure Transmitter has to be directly mounted on the orifice assembly. This eliminates cost of installation of Differential Pressure Transmitter with impulse piping up to the orifice assembly. The transmitter is mounted on the orifice assembly through a 3-Valve H-type manifold. Available with line sizes of 2" & below. However due to process temperature limits of the transmitter, this assembly cannot be used for process temperatures above 120 Degrees Centigrade.

The assembly consists of a orifice plate between two integral blocks having corner taps. Generally meter run pipe is recommended with upstream length of 750mm and downstream length of 250mm.

The pipes are welded to the blocks with end flanges.



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

Flow Nozzles

Salient features & benefits

- Widely used for high pressure & high temperature steam flow
- Useful for flow measurement at high velocities
- Rounded inlet not subject to wear or damage, extending product life
- Better sweep-through effect for debris and liquids, eliminate damming effect
- Lower susceptibility to erosion
- Extended product life with no moving parts



GENERAL Flow Nozzle is used typically high-velocity , non-viscous , erosive flow. They are suitable for determining the flow rates of fluids at high temperature and high pressure. **GENERAL** Flow Nozzles are erosion-resistant, consistently accurate and virtually maintenance-free. They perform a wide variety of applications that include air, water, steam, gas, chemical substances and high temperature applications. The rounded design provides a more effective sweep-through of particles in the flow stream, which extends product life by reducing wear and potential damage. Flow Nozzles are manufactured in strict accordance with ASME MFC-3M , BS-1042 and ISO-5167 standards. For critical measurement applications, wet calibration at reputed flow laboratories can be offered.

Flow Nozzles have a smooth elliptical inlet leading to a throat section with a sharp outlet. Restriction in the fluid flow causes a pressure drop , which relates to the flow rate by applying Bernoulli's equation. The smooth inlet of the flow nozzle results in a higher coefficient of discharge than most other differential meters. This higher efficiency means greater flow capacity when compared to most other differential meters of the same size.

There are three types of Flow Nozzles

- ISA 1932, with corner taps
- ASME long radius, low beta ratio ($0.20 \leq \beta \leq 0.5$), with radius taps ($D \& D/2$)
- ASME long radius, high beta ratio ($0.45 \leq \beta \leq 0.8$), with radius taps ($D \& D/2$)

ASME long radius , low beta ratio Nozzle with throat taps is used in steam turbine performance test As per ASME PTC-6 code.

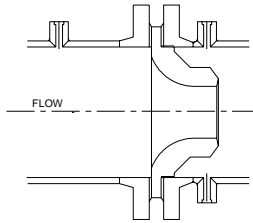
ISA-1932 nozzle can be mounted with carrier ring or in between flanges with corner taps.

Long radius nozzle are normally with weld-in branch pipe with radius taps.

Can be also mounted in between flanges.

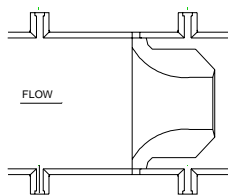
To avoid welding of dissimilar metals , nozzles are also installed in the pipe with holding ring.

Flow Nozzles



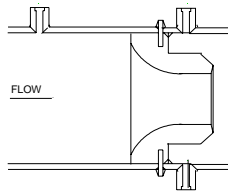
FLANGED TYPE FLOW NOZZLE

This type flow nozzle are the type most commonly used for insertion between pipe flanges. This type of nozzle is designed for pipe wall taps whose locations are determined by Beta ratio and pipe.



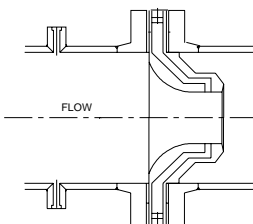
WELD-IN TYPE FLOW NOZZLE

This type of nozzle has a machined tongue around its greatest diameter designed to fit between beveled ends of both inlet and outlet pipe section. The pipe sections, with the nozzle in place are firmly clamped and welded. The weld-in flow nozzle is used where flanges are not applicable such as high temperature and pressure applications in power plant installations, feed water, etc.



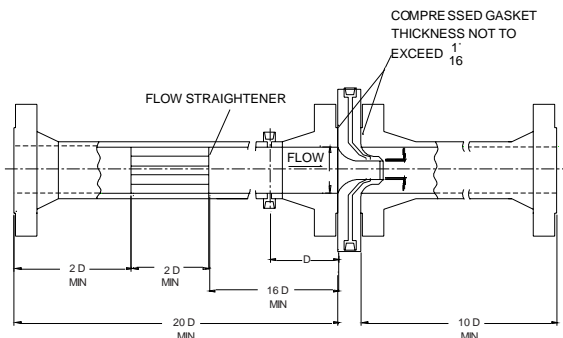
HOLDING RING TYPE FLOW NOZZLE

This type of nozzle is designed for installation in a pipe without flanges. The flow nozzle is installed with the help of holding ring and locating pins which are made of same material as that of pipe thereby eliminating welding of dissimilar materials.



FLANGED TYPE THROAT-TAP FLOW NOZZLE

Flange type throat-tap flow nozzle is used when extreme accuracy and repeatability required. In most cases this type of nozzle is purchased with a complete flow section and laboratory flow calibrated. This type of nozzles are manufactured in strict accordance with ASME performance test code PTC-6.



FLOW NOZZLE ASSEMBLY IN ACCORDANCE WITH ASME PTC-6

Venturi Tubes

Salient features & benefits

- Can be used on slurries and dirty fluids
- Short upstream piping required
- Low installation costs
- Lower susceptibility to erosion
- High pressure recovery
- Low permanent pressure loss
- Extended product life with no moving parts
- Vertical or horizontal installation



GENERAL Venturi Tubes serve users with accurate measurement of non-viscous fluids in clean & dirty streams. Venturi Tubes are virtually maintenance-free and corrosion-resistant. Venturi tubes are manufactured in strict accordance with ASME MFC-3M , BS-1042 and ISO-5167 standards. These measurement standards provide users with +/-1.0% uncertainty of discharge coefficient. For critical measurement applications, wet calibration at reputed flow laboratories can be offered.

Venturi Tube is a low pressure drop metering device . It offers constant accuracy, low susceptibility to erosion, high-pressure recovery, and installation at any angle from horizontal to vertical. Corrosion-resistant and virtually maintenance-free, this measurement product performs in a wide variety of applications that include air, water, vapor, steam, gas, chemical substances, sludge and slurry applications.

The classical Venturi Tube is made up of a entrance cylinder of the same diameter as the pipe connected to a conical convergent section , a cylindrical throat , and a conical divergent section. The convergent angle is 21 degrees and the divergent angle is between 7 and 15 degrees. The high pressure taps are located on the inlet convergent section and the low pressure taps are located at the middle of the throat section.

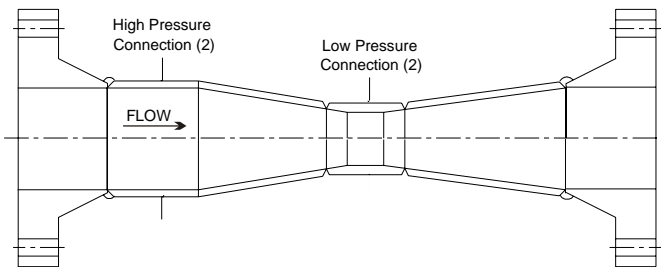
A piezometer ring is sometimes used for differential pressure measurement. This consists of several holes in the plane of the tap locations. Each set of holes is connected together in an annulus ring to give an average pressure.

Up to 8 inches , the entire venturi is machined from a single solid bar-stock . Above 8 inches the venturi is fabricated from sheet. Rectangular type venturi used in ductwork are also fabricated from sheet.

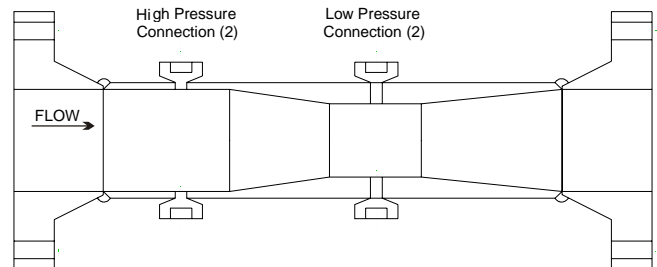
Many times the piping geometry does not allow full length of the Venturi Tube. In such case, 'Truncated' classical Venturi Tube can be offered wherein the divergent section can be truncated down by about 35% of its length without greatly modifying the pressure loss in the device. The outer diameter of the divergent section is less than the inside diameter D of the pipe.

The throat restricts the fluid flow resulting in a pressure drop. This differential pressure relates to the flow rate by applying Bernoulli's equation. The angled inlet and outlet cones help control the pressure recovery, making the Venturi the most efficient of all the differential meters available. This results in lower permanent pressure loss and greater capacity than other differential meters of the same size. Permanent pressure loss is generally 5% to 20% of the differential pressure, depending on the bore size selected.

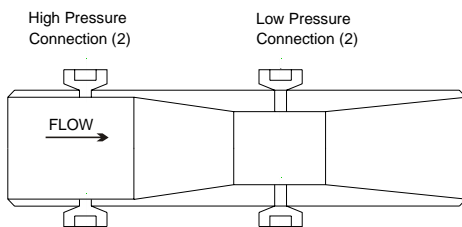
Venturi Tubes



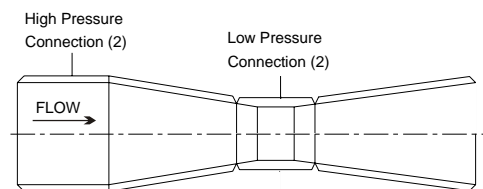
Fabricated with Flanged ends



Machined with Flanged ends



Machined with Weld ends



Fabricated with Weld ends

Averaging Pitot Tube

Averaging Pitot tube is a multiport self averaging flow meter. It is a primary element for flow measurement of gas, liquid, vapour in pipelines and ducts based on the principle of measurement of 'differential pressure'.

Features :

- Unique profile shape enables high flow rate turn down
- Dual averaging for better accuracy
- Suitable for Liquid ,gas and steam flow measurement
- Repeatability of measurement $\pm 0.1 \%$
- Short upstream and downstream straight pipe lengths
- Long term accuracy unaffected by wear.

Averaging pitot tubes are generally used for large line sizes or ducts where other primary devices become relatively expensive.

Averaging Pitot tube comprises of following components:

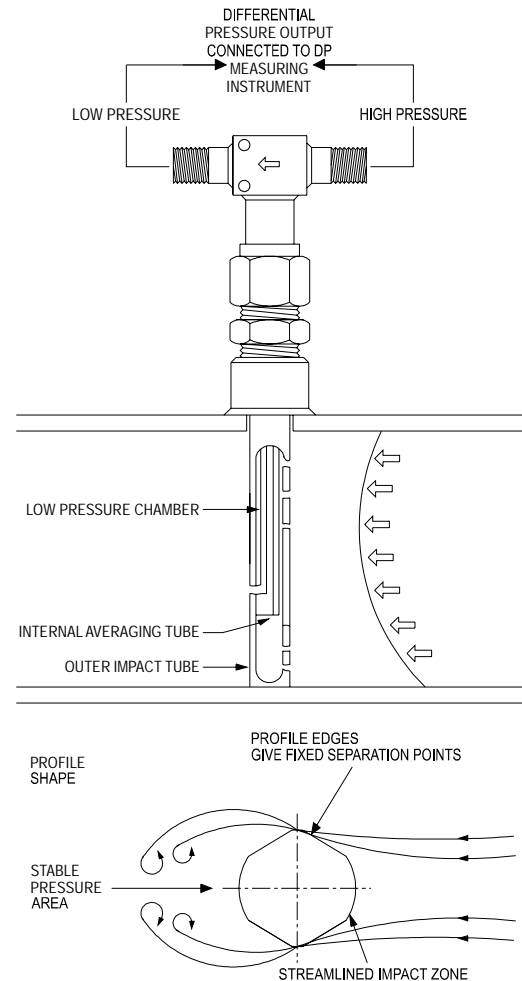
- **Outer impact tube** - one piece construction
- **Internal averaging tube**
- **Low pressure chamber**
- **Head**

The outer impact tube has a number of pressure sensing holes facing upstream which are positioned at equal annular points in accordance with a loglinear distribution.

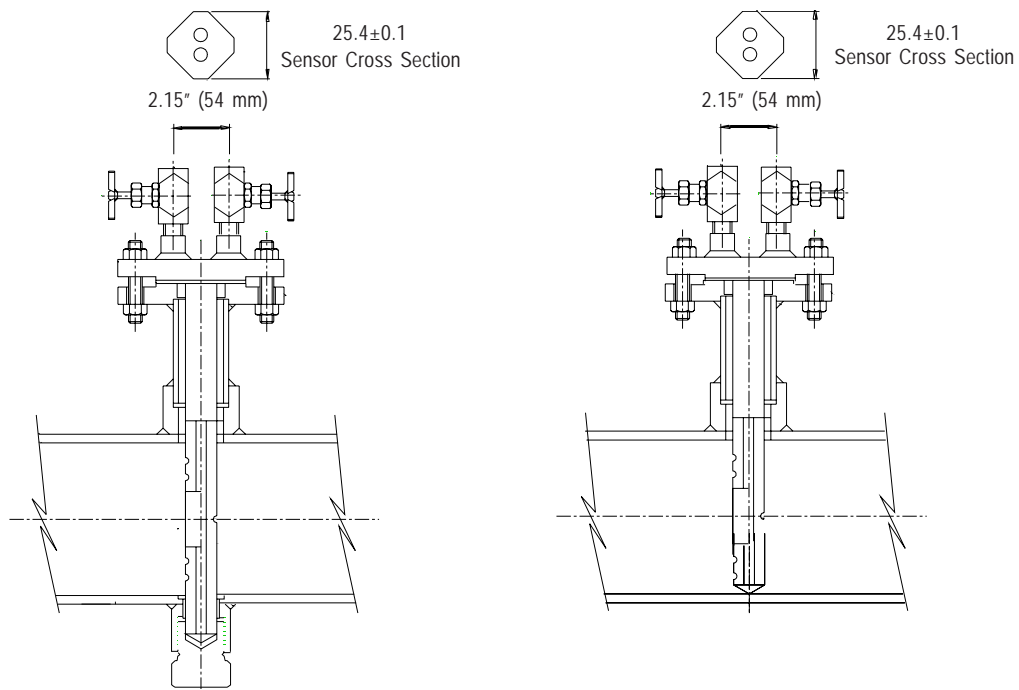
The 'total pressures' developed at each upstream hole by the impact of the flowing medium are firstly averaged within the outer impact tube and then to a second order (and more accurately) averaged within the internal averaging tube.

This pressure is represented at the head as the high pressure component of the DP output. The low pressure component is generated from a single sensing hole located on the downstream side of the outer impact tube. Stable flow coefficient which is the result of typical diamond shape, makes it a reliable flow measuring primary flow element.

Simple and inexpensive, long term accuracy within acceptable limits over wide range of flow, low permanent pressure loss & minimum operating cost makes it ideal choice of any design engineer.



Averaging Pitot Tube



Flow Element Assemblies

Bore Calculation Input Data

Name of the fluid & State :

Operating temperature / Ambient temperature :

Operating Pressure (abs) :

Viscosity (Cp) :

Maximum flow / Normal flow :

Differential range :

Base sp. gravity / density :

(only for gas)

Operating sp. gravity / density :

(for gas & liquid)

Specific heat ratio (Cp/Cv) :

Pipe size & schedule :

Pipe material :

Tap type :

Plate material :

Vent / Drain : Yes / No