Spraytech Systems (India) Pvt. Ltd.
The Flow Technologists

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In Touch with process schedule

SUBJECT	PAGE NO.

Spraytech Systems - A name recognized worldwide as a synonym for high-quality work, entrepreneurial spirit and innovative strength. We are known for a complete product line in flow instrumentation direct contact type and controls, but also offer the most modern integrated automation systems. Our field of expertise extends from applications in the largest chemical plants to oil and gas, power, offshore platforms, refineries to applications in Cryogenics and high temperature zone. Spraytech Systems operates wherever there is controlled flow of vapors, gases and liquids.

The history of Spraytech Systems is filled with the spirit of invention. "Spraytech Systems (India) Pvt. Ltd." was started by Mr. Bapusaheb Kharade,in early 2000 as a Spray Nozzles Manufacturer Primarily company was started in a 1000 sq. feet workshop & within a decade it is expanded to 7000 sq. feet modern factory. Another factory is functioning at Indapur 100 kms. away from Pune with a area of 2,00,000 sq. feet Spraytech has another factory at Rabale (Navi Mumbai) with area of 12000 sq. feet. All three factories are with state of art technology with upto 9 axis CNC machine, heavy material handling equipments to serve rising market demands with no compromise on product quality.The Thane near Mumbai headquarters and the Spraytech Systems employ and train over 200 people to become highly skilled specialists with a genuine commitment to the company.

The reason for this loyalty to the company can be found in the sound working environment. There are still old ties between the descendants of the original owner and many of the employees whose average length of service exceeds over 15 years. The progressive, yet traditional management team is committed to the name Spraytech Systems, and the quality in technical competence and partnership it stands for.

Introducing, one of the most critical product lines in the Spraytech Systems is the flow measuring and control elements. With its marked preciosn and technical know how, the state of art measuring and control elements are manufactured to meet all most critical applications in flow sensing and control

Your Applications and Our Products - The Perfect Match

Chemical & Petrochemicals

As a main vendor, for process control instruments, we provide a comprehensive product range for chemical processes: from valves in modular design made of all common materials and exotic alloys according to DIN, ANSI and JIS to high-pressure and low pressure multistage assemblies, averaging pitot tubes and orifice assemblies all complying with important company standards. Forged bodies, live-loaded packings, metal bellows, pressure-balanced plugs, heating jackets as well as corrosion-resistant, valve trims for control valves, temperature and pressure compensated integral assemblies and temperature compensated averaging pitot tubes and bidirectional averaging pitot tubes are included in our product portfolio for this field.

We also provide solutions for highly specialized tasks, such as cryogenic applications, aseptic processes and tank blanketing. Round off our product range. Smart instruments including our communication-enabled transmitters for flow, pressure and temperature transmitters for compensation techniques allow efficient asset management and predictive maintenance.

Chemical Industry

Further, our spray nozzles manufactured are applied to Cleaning packing columns and Demister pads Packing columns are used in chemical and petrochemical industries,for washing of packing materials / beds spray nozzles are used.Specially non-cloging spray nozzles are used for this purpose.

Wet gas scrubber To absorb the chemical compounds from gas, some absorbents are sprayed into the gas scrubber. For even distribution of absorbents, spray nozzles are used. **Cleaning of fermentation tanks and reactors** Several types of cleaning agents and solvents are used to clean fermentation tanks and reactors. Thus, here specially designed selfrotating and stationary spray nozzles are used.

Air Pollution Control in Chemical & Petrochemical Plant

Spray nozzle manufactured by us are effectively udes in Emission regulations are made compulsory everywhere by government for small,large industries which creates dust, exhaust gases which are dangerous for environment.

Dust Suppression system Fine mist spray nozzle are used at various dumping, transfer points where large emission of dust happens to suppress flying contamination water spray nozzles are used.

These spray nozzles, we manufactured is further applied to.

- Wet Flue Gas Desulphurization
- Fire Protection Systems
- NOX Removal
- Spray Dry Absorber
- Circulating Fluidized Bed
- Gas Conditioning

Fire Suppression for Tanks in Chemical & Petrochemical Plant

Spraytech Systems Spray nozzles are used as Spray irrigation of tanks whics aims to protect tanks and other vessels against unacceptable heating during burning. Here, heating must be understood as a condition where an increase of a tank's inner pressure and a decrease of the tank walls' resistance will lead to bursting of the tank. Also important is the heatinfluenced breakdown of the sealing elements in detachable connections. Water spray simultaneously extinguishes and cools the complete surface of the incendiary matter

we also provide spray nozzles for

- Humidification with water and steam
- Desuperheating
- Oil burners
- Incinerator
- Gas Conditioning

Food and Beverages

Perfect hygiene is essential in the food industry. As a result, the aseptic orifice flow elements with temperature and pressure compensated integral assemblies manufactured by Spraytech Systems are tailored to the highest requirements applicable to food processing.

They ensure low-germ and sterile processes; the materials and designs used comply with the stringent FDA regulations. Of course, our valves can also be fitted with all common connections, such as flanges, hygienic couplings, Tri-Clamp® connections or welding ends. Spraytech Systems is working on all and various application for product upgradations in field of control applications

Our sensor and flow transmitters combine vibration resistance and measuring accuracy with quick response times. They also meet the highest aseptic standards and are suitable for CIP (cleaning-in-place) and SIP (sterilization-in-place).

Spraytech Systems spray nozzles are aggressively used in

a) Cooling and Heating (Pasteurization)
During the packaging of hot or cold foods full cone spray nozzles are used for thermal transfer, the uniform circular spray pattern helps to maintain uniform and steady heat transfer. In pasteurizing tunnels tangential entry hollow cone spray nozzles are used for both cooling or heating of packed cans, bottles, pouches of food or beverages.

b) Sanitizing, Washing Bottles and canes
Spray nozzles and spray balls are used for sanitizing, washing and drying packaged or empty bottles / barrels. This is being used in automated packages and material handling equipments

Life sciences and pharmaceutical

When producing drugs or when using enzymes, cells and microorganism for technical purposes, any contamination could pose a risk to the final result of the process. Control engineering and equipment from Spraytech Systems, establish the right conditions for safe processes thanks to the tailor-made integral assemblies which works under the principle of constant Reynolds number.

The pressure and temperature compensation further adds to the regularity of production maintaining the correct dosing of the medicines. Critical heart attack dosage are the best example of maintaining the temperature related processing by integral assemblies.

To meet the high requirements stipulated in the regulations, our control valve bodies are made of stainless steel and so are our flow elements. All wetted surfaces are precision-turned or polished. Additional electro polishing is used to achieve surfaces with glossy or high-gloss finishes, which reduces the surface roughness to no more than 0.25 µm. The valve bodies, integral assemblies, orifice assemblies, metre run assemblies are free of cavities and suitable for CIP (cleaning-in-place) or SIP (sterilization-in-place).

EPDM and PTFE diaphragms are used to shut off the valve towards the actuator and the atmosphere. End connections are available as either detachable or fixed for all flow elements and valve applications. Exact dosing and proportioning, which are indispensable in this sector, are ensured by the high control accuracy characteristic of all our products.

our spray nozzles are applied for

a) Tablet coating
After making a good tablet, you must often coat it. The coating can have several functions. It can strengthen the tablet, control its release, improve its taste, colour, it makes it easier to handle and package, and protect it from moisture.

b) Clean In Place (CIP)
For efficient cleaning of mixing tanks, containers, equipment, coating pans spray balls / turbo disc spray nozzles are installed inside the equipments made of pharma grade stainless steel which cleans the equipments in place.

Oil and gas

The oil and gas sector supplies the fuels and lubricants used in everyday life. Extraction and processing of the raw materials often occur under rough conditions, particularly if they take place in extreme climate zones or offshore. This calls for particularly reliable and corrosion-resistant instruments with a long service life. The products from Spraytech Systems are perfectly tailored to these requirements.

Our control and flow elements equipment is installed in upstream and downstream processes. We can supply orifice assembly, averaging pitot tube, multistage assemblies, modular control valves in various pressure ratings, materials and styles at short notice. The stainless steel versions of our process flow elements and valves, actuators also withstand the severest offshore conditions. In addition, highly resistant materials are available for installation on FPSO (Floating Production, Storage and Offloading) units or drilling rigs. For LNG (Liquefied Natural Gas) applications on shore and on tankers, we offer special cryogenic equipment to meet all safety requirements.

We develop and produce highly specialized series for unusual control tasks. In addition, we provide tailored multistage and orifice and valves to meet the specific requirements defined by the customer.

Power plants

Power plants produce the most important "raw material" for a properly functioning economy and society: electricity. Spraytech Systems supplies the necessary control equipment, from simple control valves, high-quality multistage assemblies and averaging pitot tubes, orifice assemblies for feed water and minimum flow recirculation valves to steam pressure reducing stations with integral assemblies and multistage assemblies. High-pressure and low-pressure bypass stations valves as well as spray and steam atomizing desuper heaters with our special pressure and temperature compensated integral assemblies round off our product range for the energy sector. Valve designs include globe, in forged versions that can be fitted with either flanges or welding ends. Our actuator range comprises pneumatic, electric and hydraulic actuators that can be controlled conventionally or equipped with state-of-the-art bus technology conforming to HART®, FOUNDATION™ fieldbus or PROFIBUS specifications. Depending on the pressure drop to be handled, single-stage or multi-stage assemblies, with noise reducing and removal of choking, are used.

Air Pollution Control in Power Plant

Spray nozzle manufactured by us are effectively udes in Emission regulations are made compulsory everywhere by government for small,large industries which creates dust, exhaust gases which are dangerous for environment.

Dust Suppression system

Fine mist spray nozzle are used at various dumping, transfer points where large emission of dust happens to suppress flying contamination water spray nozzles are used.

These spray nozzles, we manufactured is further applied to.

- Wet Flue Gas Desulphurization
- Fire Protection Systems
- NOX Removal
- Spray Dry Absorber
- Circulating Fluidized Bed
- Gas Conditioning

Paper Industry

Paper remains indispensable, even in the electronic age. When making pulp and processing it further to get paper, large flows of media must be routed through the individual production steps in a defined time sequence. Spraytech Systems has the right control and measuring technology for this field.

Our products ensure efficient processes during the mechanical and chemical treatment of the pulp. Thanks to their high control and measuring accuracy, the fresh water required for the processes is used economically and waste water treatment does not burden the environment or resources.

In the paper machines, our products are involved in the entire steam and condensate system, the exact control of the basis weight and humidity profile as well as the optimum drying of the paper webs. Innovative flow measuring accessories, such as our smart flow transmitters for integral attachment, ensure the safe exchange of data in the process and allow for predictive maintenance.

Our spray nozzles are aggressively used in

a)Coating
Surface sizing operations are performed to provide increased surface strength, as well as to produce paper with an increased resistance to penetration by liquid solutions. Treatment can also provide better surface characteristics and improve certain physical properties of the paper sheet.

b) Showers and Oscillators
spray showers with the built-in cleaning device have been successfully used in paper mills around the world for years. A simple turn of the handwheel sweeps contaminants away from the nozzle orifices and directs all debris down the flushout valve.

c)Trimming
Paper trim and edge sprays are used in various sections of paper machines. Generally, they improve the mill speed and reduce risk of web breaks. Some machines use trim nozzles after the last drying roll as well.

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Mining & Metallurigical industry

Mining provides a large proportion of the raw material needed for modern technologies. Spraytech Systems supply the averaging pitot tubes, integral and orifice assemblies and multistage assemblies to regulate and control valves required in deep mining to vent, cool and drain shafts.

Our control valves also play an important role in the extraction of metals. Where mechanical separation processes no longer suffice, the metal is leached with the help of chemicals. To do so, ground ore is mixed with different liquids. Usually, the created slurries are highly abrasive and corrosive. Controlling them requires equipment that functions reliably even under the most adverse conditions and requires minimum maintenance.

our multistage and orifice assemblies used in these applications, They not only withstand corrosive solutions and the strong abrasion, they are also resistant to the heavy vibration found at many places in the huge plants.

In addition, the valves fulfil ecologically relevant control tasks in recovering and treating the water used. Innovative smart accessories, such as our smart flow transmitters for integral attachment, ensure the safe exchange of data in the process and allow for predictive maintenance.

Air Pollution Control in Mining & Metallurigical industry

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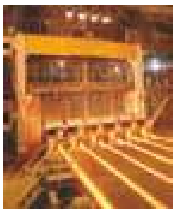

Our spray nozzles in the metallurgical Industry include in application

a)Continuous Casting of steel Secondary Cooling
For higher productivity secondary cooling plays critical part where various rates of heat flux are to be removed from hot slab at various stages. Thus, spray nozzles are used for secondary cooling. For this purpose single fluid, twin fluid spray nozzles are used.

b)Descaling
During the process of cooling, iron oxide scales are formed on hot steel surface where high pressure water jet are used to remove this scales. For this purpose specially designed flat spray nozzle are used which has operating pressure range from 80 to 450 bar.

c)Roll Cooling
As hot slab rolls through series of rollers, heat transfers due to mutual contact; Thus to recover this heat from rolls, spray nozzles are used. This also helps to control and improves the shape of rolls.

d)Coke ovens
- Coke quenching
- Gas cleaning and droplet separators
- Strip spray-off and blow-off

e)Hot rolling
- Settlement of oxide dusts in the stan
- Intermediate stand cooling
- Strip surface quenching to protect the work rolls

Salient Features of Spraytech Systems Flow & Control Element, Orifice & Averaging Pitot Tube

Table 2.1

Description	Square edge concentric	Eccentric	Conical	Segmental
Flow rangeability	8:1	3:1	3:1	5:1
Minimum input pressure	500mmwc	5000mmwc	10000mmwc	1000mmwc
Reynolds number	7500 onwards	3000-12000 only since principle is on sedimentation	80-1500	5000-20000, for solid particles inclusive and for specific applications resulting accuracy
Viscocity	Max upto 30 cst at 30 deg cent	Max upto 30 cst on liquid	Max upto 100 cst at 70 deg cent, i.e at 30 deg cent, it shall be at 140 cst	Max upto 60 cst
Bi directional flow	Uni directional	Uni directional	Uni directional	Uni directional
Flow recovery coefficient within the prescribed free length depending on beta value	85 % due to our 45 deg bevel at the plate	65%	65%	65%
Pressure recovery coefficient	60%	60%	60%	60%
Flange taps	Concept is agreed till standard for flange with relevant thickness applicable for tap designing	Concept is technically advisable	Not technically recommended	Concept is technically advisable
Corner taps	Yes but upto 11/2" line size	Not technically recommended	Yes very much required	Not technically recommended
Vena contracta taps	Concept same as flange taps	Concept is technically advisable	Not technically recommended	Concept is technically advisable
D and D/2 taps	Concept applicable essentially for higher line size, but it depends strictly on media applications	Concept applicable essentially for higher line size, but it depends strictly on media applications	Not technically recommended	Concept applicable essentially for higher line size, but it depends strictly on media applications
Free length in upstream	Depends on beta value and varies between 8 D till 44 D	Depends on beta value and varies between 8 D till 44 D	Depends on beta value and varies between 8 D till 44 D	Depends on beta value and varies between 8 D till 44D
Free length in downstream	Depends on beta value and varies between 2 D till 8 D	Depends on beta value and varies between 2 D till 8 D	Depends on beta value and varies between 2 D till 8 D	Depends on beta value and varies between 2 D till 8 D
Noise level	At defined position of free length and number of stages defined, within 75 decibels	At defined position of free length and number of stages defined, within 75 decibels	Well within 50 decibels, as per applications, noise in such applications is indefined as the viscosity is quite high	At defined position of free length and number of stages defined, within 60 decibels
Choking in flow	Will occur with high drop across and flow being more than the line size	Phenomenon is not possible	Phenomenon is not possible	Phenomenon is not possible
Accuracy	0.25%	Max upto 0.75%	Max upto 0.75%	Max upto 0.75%
Repeatability	0.25%	0.25%	0.25%	0.25%
Hysterisis	0.25%	0.50%	0.50%	0.50%
Application in fertilizers unit	Applicable in Nitric acid, stem generation, Ammonia plant, methanol plant	Not technically preferred	In PAP, Urea plant application where viscous liquid is high and needs higher controllability range	Not technically preferred
Application in offshore platforms	Yes, only preferred as space is a constraint, for medias at 6000 reynold application is ascertained	Not technically preferred	Not technically preferred	Not technically preferred
Applications in refineries	Application in DHDS, utilities, VDU	Application in SRU	Applications in Aromatic Unit	Not prefered
Applications I chemicals plant	Only on final utilities and storages	More on chemical formations where sedimentations are in processes	With high viscous liquids, filterations for converting to byproducts	Selected on media interface and 2 pahse mixed at low pressure
Application in Food and Beverages	Application in storage units	Not preferred	Application in food processing units	Not preferred
Application in Boilers	Yes, 100% application on all steam water, boiler run and feed applications	Not preferred	Not preferred	Not preferred
Application in petrochemicals	For all CUs and Dehydrogenation, LLDPE plants usage and applications, and steam generation plant	Not preferred	For LLDPE sections with high range ability and high viscous zone controllability	Not preferred
Application in metal formation industry	For steam water blasting	Not applicable	Not applicable	Not applicable
Application in dyes and intermediates	Initial process for chemical water, steam generation and for mixture content sterilization	Initial process for chemical water, steam generation and for mixture content sterilization	Initial process for chemical water, steam generation and for mixture content sterilization and with high viscous	Not used
Application in veg oil refinery	Not used	Not used	For all application of controllability at 100 cst and accuracy less than 2%, used alongwith butterfly valves	Not used
Application in nuclear power / thermal power / coal power	For steam water application	Not applicable	Not applicable	Not applicable
Application in SHAAR	For all low pressure steam till 1500# and upto 20"	Not applicable	Not applicable	Not applicable
Application in BARC	Yes at FCCU, R PhD, FRD, RED, RMD, Cyrus, for ll applications till 12" and 2500# with most higher accuracy, with 300ppm solids in liquids, steam, radiological water, helium, inert gas application	At FRD, at RED, at RMP, at WIPP where sedimentation is a process	Yes at FRD, RED, with high accuracy of control and precision is desired with high viscous	Not preferred technically
Application in cement industry	Not preferred	Sedimentation process applicable at initial stages and is applicable till 6"	Yes only with high accuracy wherever required, but mostly with 4" till 16" applications with muddy water and high viscous	Not preferred
Application in pharmaceutical industry	For chemical water application at pressure upto 300#	Not preferred	Not preferred	Not preferred

Salient Features of Spraytech Systems Flow & Control Element, Orifice & Averaging Pitot Tube

Description	Quadrant edge	Averaging pitot tube	Restriction orifice with square edge design without beveling	Multistage assemblies measuring flow, in liquid
Flow rangeability	3:1	15:1	10:1	8:1
Minimum input pressure	2500mmwc	25mmwc	500mmwc	1000mmwc
Reynolds number	1500-9000	7500 onwards without more than 300ppm solids	7500 onwards	5000 onwards
Viscocity	Max upto 100 cst	Max upto 20 cst at 30 deg cent	Max upto 30 cst at 30 deg cent	Max upto 30 cst at 30 deg cent
Bi directional flow	Uni directional	Uni directional	yes	Uni directional
Flow recovery coefficient within the prescribed free length depending on beta value	55%	90%	65%	65% at the end and 40% against each plate
Pressure recovery coefficient	45%	70%	60%	40% at each stage
Flange taps	Not technically recommended	Concept not applicable	Yes very much recommended	Concept is technically applicable
Corner taps	Yes very much required	Concept not applicable	Not applicable	Concept is not technically applicable
Vena contracta taps	Not technically recommended	Concept not applicable	Same as flange taps	Concept is technically applicable
D and D/2 taps	Not technically recommended	Concept not applicable	Concept applicable essentially for higher line size, but it depends strictly on media applications	Concept is not technically applicable
Free length in upstream	Depends on beta value and varies between 8 D till 44 D	Within 2 D when the flow rate is within pipe size and when retract mechanism is applicable and 3D to 7 D when flow rate is above pipe size and when retract mechanism is applicable	Depends on beta value and varies between 4 D till 8 D	Depends on beta value and varies between 4D till 8 D
Free length in downstream	Depends on beta value and varies between 2 D till 8 D	Within 1 D when the flow rate is within pipe size and when retract mechanism is applicable and 2D to 6 D when flow rate is above pipe size and when retract mechanism is applicable	Depends on beta value and varies between 2 D till 8 D	Depends on beta value and varies between 2 D till 8 D
Noise level	At defined position of free length and number of stages defined, within 75 decibels	It is defined well within 60 decibels as the basic principle is to have most desired min differential pressure with highest flow recovery	At defined position of free length and number of stages defined, within 75 decibels	At defined position of free length and number of stages defined, within 75 decibels
Choking in flow	Phenomenon is not possible	Phenomenon is not possible	Will occur with high drop across and flow being more than the line size, removed with multistage concept	Choking is removed with thorough design of multistage depending on stages and plate thickness at each stages
Accuracy	Max upto 0.75%	0.05%	Max upto 0.5% depending on perfect sizing selection	Max upto 0.5% depending on perfect sizing selection
Repeatability	0.25%	0.05%	0.25%	0.25%
Hysterisis	0.50%	0.05%	Max upto 0.5% depending on perfect sizing selection	Max upto 0.5% depending on perfect sizing selection
Application in fertilizers unit	Not technically preferred	Methanol plant, ammonia, nitric acid, in C N A plant, where the media is pure and also that high recovery coefficient is in demand at short space available, 4 hole, 8 hole and 12 hole method of averaging is quite common apply for fertilizers	Pressure killing device is required at steam generation plant, PAPA, ammonia plant, Nitric acid plant and at waste water treatment	Applicable in Nitric acid, stem generation, Ammonia plant, methanol plant
Application in offshore platforms	Not technically preferred	4 hole and 12 hole concept for space and clear liquid with 200 ppm can be ascertained since our flow recovery and pressure recovery is quite high and can replace orifice and ventury	Yes, for all applications, rigorously used for pressure killing	Yes, only preferred as space is a constraint, for medias at 6000 reynold application is ascertained
Applications in refineries	Application in Catalytic converter unit	Application in DHDS, utilities, VDU	Application in DHDS, utilities, VDU, CCU	Application in DHDS, utilities, VDU, CCU
Applications I chemicals plant	Yes with those with consumable goods on facial expressions chemicals	Only on final utilities and storages	Only on final utilities and storages	Not technically preferred
Application in Food and Beverages	Application in food processing units	Application in storage units	Application in storage units	Not technically preferred
Application in Boilers	Not preferred	Yes, 100% application on all steam water, boiler run and feed applications	Yes, 100% application on all steam water, boiler run and feed applications	Yes, 100% application on all steam water, boiler run and feed applications
Application in petrochemicals	Not preferred	For all CUs and Dehydrogenation, LLDPE plants usage and applications, and steam generation plant	For all CUs and Dehydrogenation, LLDPE plants usage and applications and steam generation plant	For all CUs and Dehydrogenation, LLDPE plants usage and applications, and steam generation plant
Application in metal formation industry	Not applicable	Yes very much for all reduce free length	For all steam water blasting application	For all steam water blasting application
Application in dyes and intermediates	Not used	Initial process for chemical water, steam generation and for mixture content sterilization	Initial process for chemical water, steam generation and for mixture content sterilization	Initial process for chemical water, steam generation and for mixture content
Application in veg oil refinery	Not used	Yes since space is less, with visc at upto 20 cst at the middle processing section	Yes with max single stage used only for pressure killing	Not overall technically required
Application in nuclear power / thermal power / coal power	Not applicable	For steam water application	For steam water application	For steam water application
Application in SHAAR	Not applicable	For all low pressure steam till 1500# and upto 40"	For all low pressure steam till 1500# and upto 20"	For all low pressure steam till 1500# and upto 20"
Application in BARC	Yes at FRD, RED, with high accuracy of control and precision is desired with high viscous	Yes at FCCU, R PhD, FRD, RED, RMD, Cyrus, for ll applications till 12" and 2500# with most higher accuracy, with 300ppm solids in liquids, steam, radiological water, with tight bellow seal application, helium, inert gas application application, helium, inert gas application	Yes at FCCU, R PhD, FRD, RED, RMD, Cyrus, for ll applications till 12" and 2500# with most higher accuracy, with 300ppm solids in liquids, steam, radiological water, with tight bellow seal application, helium, inert gas application	Yes at FCCU, R PhD, FRD, RED, RMD, Cyrus, for ll applications till 12" and 2500# with most higher accuracy, with 300ppm solids in liquids, steam, radiological water, with tight bellow seal
Application in cement industry	Not preferred	Not applicable killing and upto 10 bar application in single stage	Yes at only 200ppm application pressure	Not applicable
Application in pharmaceutical industry	Not preferred	For chemical water application at pressure upto 300#	For chemical water application at pressure upto 300#	Not preferred

Spraytech®
Systems (India) Pvt. Ltd.
The Flow Technologists

Salient Features of Spraytech Systems Flow & Control Element, Orifice & Averaging Pitot Tube

Description	Multistage assemblies measuring flow in gas and steam	Multistage assemblies killing pressure in gas and steam	Multistage assemblies killing pressure in liquid	Integral meter run assemblies
Flow rangeability	8:1	8:1	8:1	8:1
Minimum input pressure	500mmwc	500mmwc	10000mmwc	500mmwc
Reynolds number	7500 onwards	7500 onwards	5000 onwards	2000 onwards without solids and solid particles
Viscocity	Max upto 10 cst - being gas	Max upto 10 cst - being gas	Max upto 30 cst at 30 deg cent	Restriction depend on choice of plate design
Bi directional flow	Uni directional	Uni directional	Uni directional	Uni directional
Flow recovery coefficient within the prescribed free length depending on beta value	65% at the end and 40% against each plate	65% at the end and 40% against each plate	65% at the end and 40% against each plate	85% at the end of the assembly
Pressure recovery coefficient	40% at each stage	40% at each stage	40% at each stage	60%
Flange taps	Concept is technically applicable	Concept is technically applicable	Concept is technically applicable	Concept is technically applicable
Corner taps	Concept is not technically applicable	Concept is not technically applicable	Concept is not technically applicable	Concept is technically applicable for lower size and accuracy
Vena contracta taps	Concept is technically applicable	Concept is technically applicable	Concept is technically applicable	Concept is technically applicable
D and D/2 taps	Concept is not technically applicable	Concept is not technically applicable	Concept is not technically applicable	Concept is not technically applicable
Free length in upstream	Depends on beta value and varies between 4 D till 8 D	Depends on beta value and varies between 4 D till 8 D	Depends on beta value and varies between 4D till 8 D	Depends on beta value and varies between 8 D till 44 D
Free length in downstream	Depends on beta value and varies between 2 D till 8 D	Depends on beta value and varies between 2 D till 8 D	Depends on beta value and varies between 2 D till 8 D	Depends on beta value and varies between 2 D till 8 D
Noise level	At defined position of free length and number of stages defined, within 75 decibels	At defined position of free length and number of stages defined, within 75 decibels	At defined position of free length and number of stages defined, within 75 decibels	Controlled within 60-70 decibels by principle of operation as it matters on integral assemblies where the flow recovery is within assembly
Choking in flow	Choking is removed with thorough design of multistage depending on stages and plate thickness at each stages	Choking is removed with thorough design of multistage depending on stages and plate thickness at each stages	Choking is removed with thorough design of multistage depending on stages and plate thickness at each stages	Choking in integral design with metre run will not occur as in principle, the operation says with low differential pressure and with 80% max flow consumption
Accuracy	Max upto 0.5% depending on perfect sizing selection	Max upto 0.5% depending on perfect sizing selection	Max upto 0.5% depending on perfect sizing selection	Max upto 0.5% depending on perfect sizing selection
Repeatability	0.25%	0.25%	0.25%	0.25%
Hysterisis	Max upto 0.5% depending on perfect sizing selection	Max upto 0.5% depending on perfect sizing selection	Max upto 0.5% depending on perfect sizing selection	Max upto 0.5% depending on perfect sizing selection
Application in fertilizers unit	Applicable in Nitric acid, stem generation, Ammonia plant, methanol plant	Pressure killing device is required at steam generation plant, PAPA, ammonia plant, Nitric acid plant and at waste water treatment	Pressure killing device is required at steam generation plant, PAPA, ammonia plant, Nitric acid plant and at waste water treatment	Only application in processing of ammonia, at 3 rd pre stage, thus at ammonia plant, steam generation plant for pressure and temp compensating device
Application in offshore platforms	Yes, only preferred as space is a constraint, for medias at 6000 reynold application is ascertained	Yes, for all applications, rigorously used for pressure killing	Yes, for all applications, rigorously used for pressure killing	Not technically preferred
Applications in refineries	Application in DHDS, utilities, VDU, CCU	Application in DHDS, utilities, VDU, CCU	Application in DHDS, utilities, VDU, CCU	Not technically preferred
Applications I chemicals plant	Not technically preferred	Not technically preferred	Not technically preferred	Only on final utilities and storages
Application in Food and Beverages	Not technically preferred	Not technically preferred	Not technically preferred	Application in storage units
Application in Boilers	Yes, 100% application on all steam water, boiler run and feed applications	Yes, 100% application on all steam water, boiler run and feed applications	Yes, 100% application on all steam water, boiler run and feed applications	Not technically preferred
Application in petrochemicals	For all CUs and Dehydrogenation, LLDPE plants usage and applications and steam generation plant	For all CUs and Dehydrogenation, LLDPE plants usage and applications and steam generation plant	For all CUs and Dehydrogenation, LLDPE plants usage and applications and steam generation plant	Not technically preferred
Application in metal formation industry	For all steam water blasting application	For all steam water blasting application	For all steam water blasting application	For all low pressure drop especially with those at Vikram Ispat, TISCO, RSP, GMM ispat and SAIL, applications producing home consumables and pipes and rods
Application in dyes and intermediates	Initial process for chemical water, steam generation and for mixture content sterilization	Initial process for chemical water, steam generation and for mixture content sterilization	Initial process for chemical water, steam generation and for mixture content sterilization	Yes, quite essentially in tube filler control and final processes at media and mixture levels
Application in veg oil refinery	Not overall technically required	Not overall technically required	Not overall technically required	Yes preferred for all precision control on oil mixture and flow content and alongwith temperature compensating techniques
Application in nuclear power / thermal power / coal power	For steam water application	For steam water application	For steam water application	For temperature and pressure compensation techniques with assemblies for precision
Application in SHAAR	For all low pressure steam till 1500# and upto 20"	For all low pressure steam till 1500# and upto 20"	For all low pressure steam till 1500# and upto 20"	Not applicable
Application in BARC	Yes at FCCU, R PhD, FRD, RED, RMD, Cyrus, for ll applications till 12" and 2500# with most higher accuracy, with 300ppm solids in liquids, steam, radiological water, with tight bellow seal application, helium, inert gas application	Yes at FCCU, R PhD, FRD, RED, 12" and 2500# with most higher accuracy, with 300ppm solids in liquids, steam, radiological water, with tight bellow seal application, helium, inert gas application	Yes at FCCU, R PhD, FRD , RED, RMD, Cyrus, for ll applications till 12" and 2500# with most higher accuracy, with 300ppm solids in liquids, steam, radiological water, with tight bellow seal application, helium, inert gas application	At Reactor engineering division and at RMD where precision at low flow is required
Application in cement industry	Not applicable	Not applicable	Not applicable	Not applicable
Application in pharmaceutical industry	Not prefered	Not prefered	Not preferd	Tablet formation precision with correct Reynolds number of pipe and orifices that the concentration of tablet is maintained with additions of temperature and pressure compensation

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Salient Features of Spraytech Systems Flow & Control Element, Orifice & Averaging Pitot Tube

Description	Integral assemblies	Carrier ring assembly	Globe valve
Flow rangeability	8:1	Aiding to 3:1	30:1, hand operated, 50: 1 pneumatic operated and 50:1 electronic operated (electric actuator)
Minimum input pressure	500mmwc	500mmwc	10000mwc
Reynolds number	2000 onwards without solids and solid particles	7500 onwards	7500- 1000000
Viscocity	Restriction depend on choice of plate design	Restriction depend on choice of plate design	0.1CST to 60 cst at 50 deg cent
Bi directional flow	Uni directional	Uni directional	Uni directional at a time for max controllability
Flow recovery coefficient within the prescribed free length depending on beta value	65%	Upto 2" 85% and from 3" to 24" only upto 40%	80%
Pressure recovery coefficient	50%	25% at higher size and only 30% at any given point of time barring upto 2" which is 55%	70%
Flange taps	Concept is technically applicable		Concept not applicable since it has orifice vertical to ground
Corner taps	Concept is technically applicable for lower size and accuracy		Concept not applicable since it has orifice vertical to ground
Vena contracta taps	Concept is technically applicable		Concept not applicable since it has orifice vertical to ground
D and D/2 taps	Concept is not technically applicable orifice vertical to ground		Concept not applicable since it has
Free length in upstream	Depends on beta value and varies between 8 D till 44 D	Depends on beta value and varies between 8 D till 44 D	No such free length
Free length in downstream	Depends on beta value and varies between 2 D till 8 D	Depends on beta value and varies between 2 D till 8 D	No such free length
Noise level	Controlled within 60-70 decibels by principle of operation as it matters on integral assemblies where the flow recovery is within assembly	By it self the noise is controlled with the additional help of plate design and free length defined accordingly	Controlled with design considerations upto 80 decibels in all control applications with noise reducer and special designs
Choking in flow	Choking in integral design will occur if diff. pressure is high and can be removed by increasing the plate thickness, but provided with integral assembly so that the pressure recovery is hastened to clear the choking	Choking feature is media phenomenon with differential pressure and high flow against size, carrier ring increases choking phenomenon	Choking is removed with thorough special design of trim section
Accuracy	Max upto 0.5% depending on perfect sizing selection	0.5% till 2" and till 12" 1% and above max upto 3%, thus carrier ring is most technically till 2"	0.10%
Repeatability	0.25%	0.25%	0.10%
Hysterisis	Max upto 0.5% depending on perfect sizing selection		0.10%
Application in fertilizers unit	Applicable in Nitric acid, stem generation, Ammonia plant, methanol plant	Together with assembly at PAP and at C N A and at ammonia plant where the line size is strictly upto 3" and where the flange rating is beyond 600#, but only where accuracy is less required	Applicable in Nitric acid, stem generation, Ammonia plant, methanol plant
Application in offshore platforms	Not technically preferred	Not preferred	Only on utility and sizes below 4"
Applications in refineries	Not technically preferred	Yes at VDU and at CCU for line size upto 3", since application calls for less accurate	In CCU, steam generation, DHDS
Applications I chemicals plant	Only on final utilities and storages	Not preferred much till, only at processing end when accuracy is less and that too for line size quite high	For all applications till 60 cst and upto 10"
Application in Food and Beverages	Application in storage units	Not technically preferred	Plenty in use for all applications in final recovery
Application in Boilers	Not technically preferred	Not technically preferred	Yes for all steam water applications till 16"
Application in petrochemicals	Not technically preferred	Not technically preferred	For all CUs and Dehydrogenation, LLDPE plants usage and applications and steam generation plant
Application in metal formation industry	For all low pressure drop especially with those at Vikram Ispat, TISCO, RSP, GMM Ispat and SAIL, applications producing home consumables and pipes and rods	Yes, but only with size upto 2" to reduce the inaccuracy for higher sizes and recommend only for clean liquids	For steam application only a upto 12"
Application in dyes and intermediates	IMR more preferred	Not technically recommended	Yes only at those application with good controllability
Application in veg oil refinery	Yes preferred for all precision control on oil mixture and flow content and alongwith temperature compensating techniques	Not technically recommended	For all application at end pruct but vis - 20 cst
Application in nuclear power / thermal power / coal power	For temperature and pressure compensation techniques with assemblies for precision	Not preferred technically	For all low power application in Nuclear and thermal power application for better controllability at lower size
Application in SHAAR	Not applicable	Not applicable	For all low pressure steam till 600# and upto 10"
Application in BARC	At Reactor engineering division, and at RMD, FRD, waste water management, where precision is required	Not preferred	Yes at FCCU, R PhD, FRD, RED, RMD, Cyrus, for ll applications till 12" and 2500# with most higher accuracy, with 300ppm solids in liquids, steam, radiological water, with tight bellow seal application, helium, inert gas application
Application in cement industry	Not applicable	Yes, in plenty as the accuracy is immaterial	Not preferred at all
Application in pharmaceutical industry	Tablet formation precision with correct Reynolds number of pipe and orifices that the concentration of tablet is maintained with additions of temperature and pressure compensation	Not preferred	Yes and for all good controllability required in low sizes till 4"

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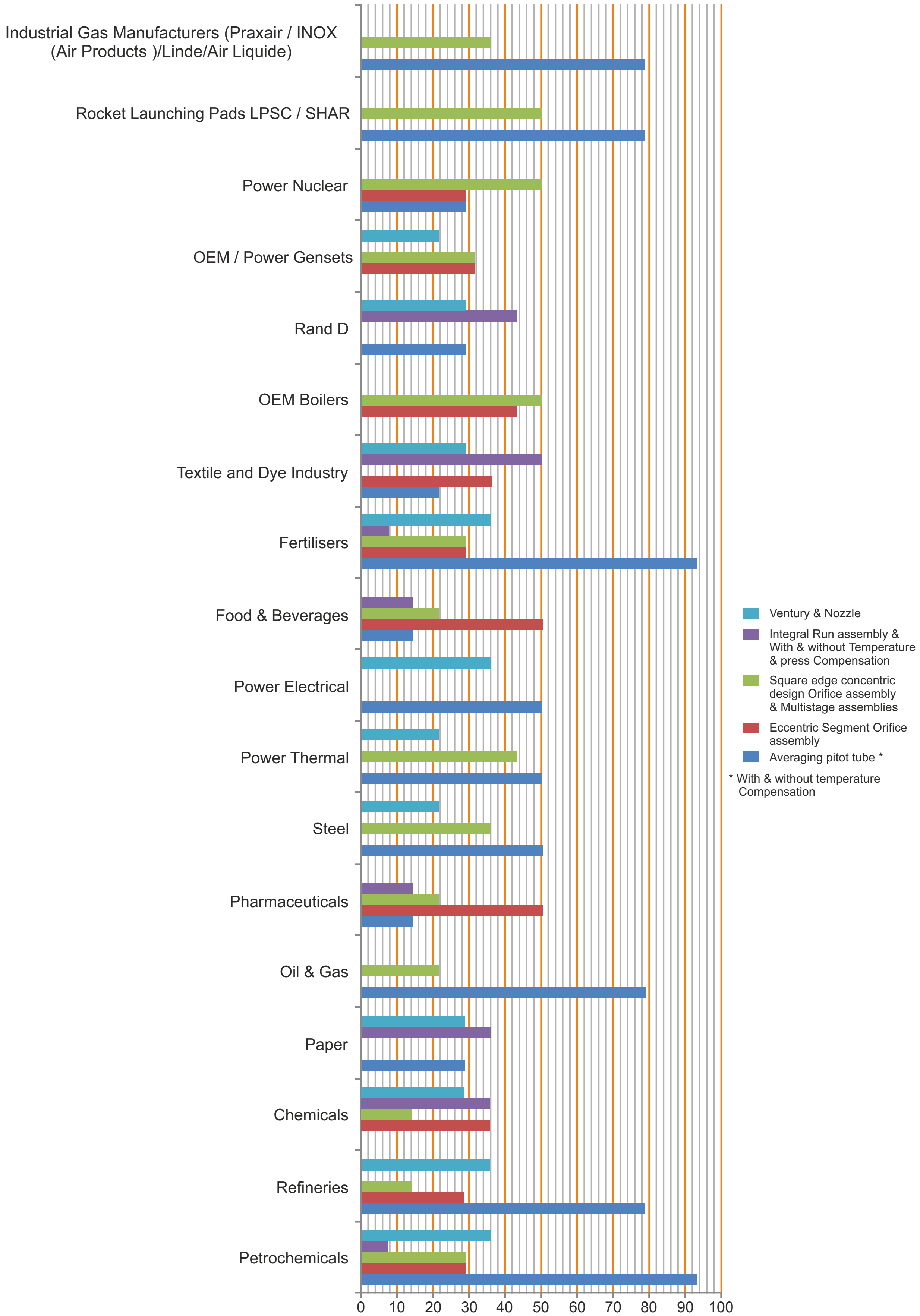
Applications and Demand Ratio in Industrial Sector of our Flow Elements, Orifice & Averaging Pitot Tube



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Spraytech Systems
Pressure Reducing & Desuperheation Station

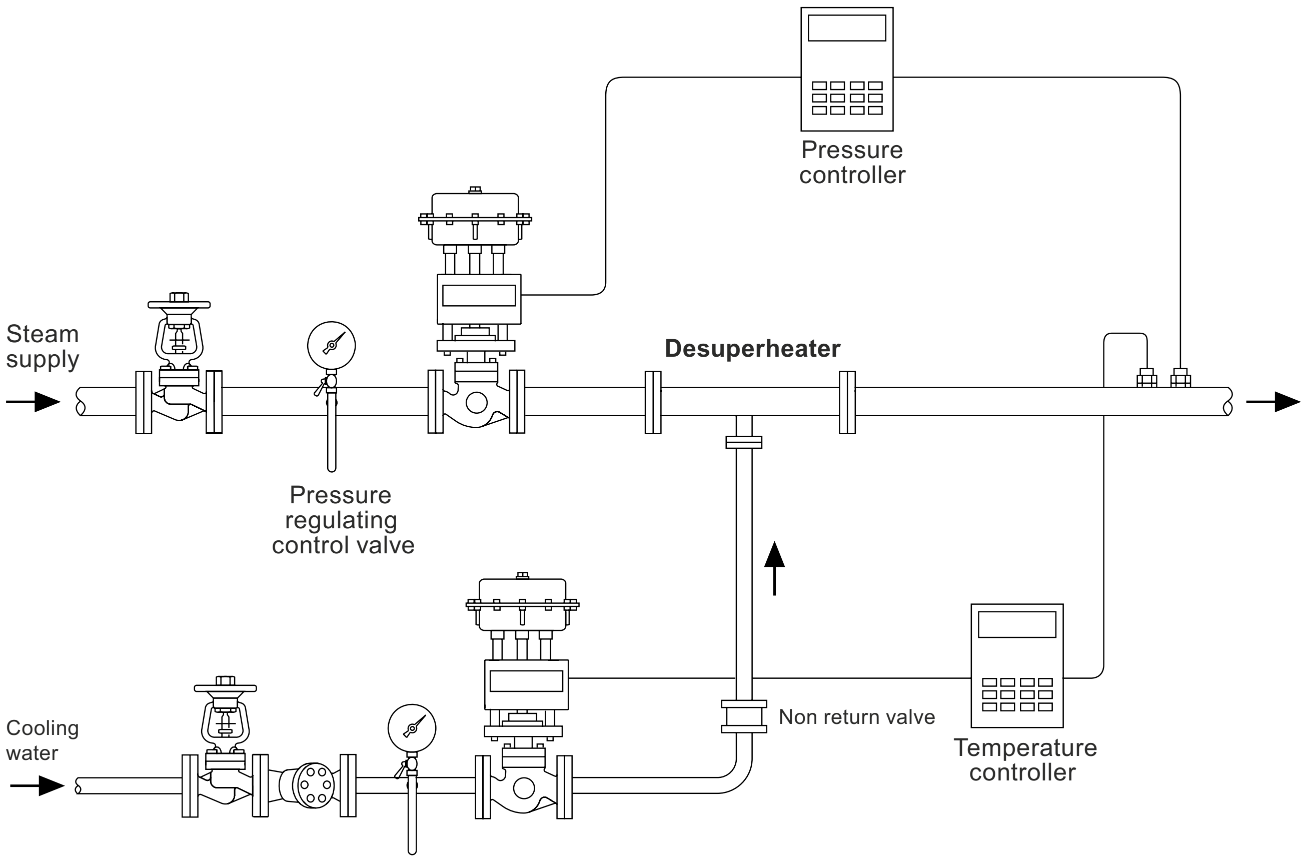
In typical process plants, process steam is usually superheated or heated to a temperature above saturation. The difference, between the saturation temperature and the actual temperature of the steam is called 'superheat'.

Desuperheated steam is more efficient in the transfer of thermal energy, consequently desuperheaters are used to bring the outlet degree of superheat closer to that of saturation.

Desuperheaters reduce the temperature of superheated process steam by introducing finely atomized cooling water droplets into the steam flow. As the droplets evaporate, sensible heat from the superheated steam is converted into latent heat of vaporization.

A typical desuperheater installation is shown below:

Spraytech Systems Combined pressure reducing / desuperheating station for venturi and spray type desuperheaters

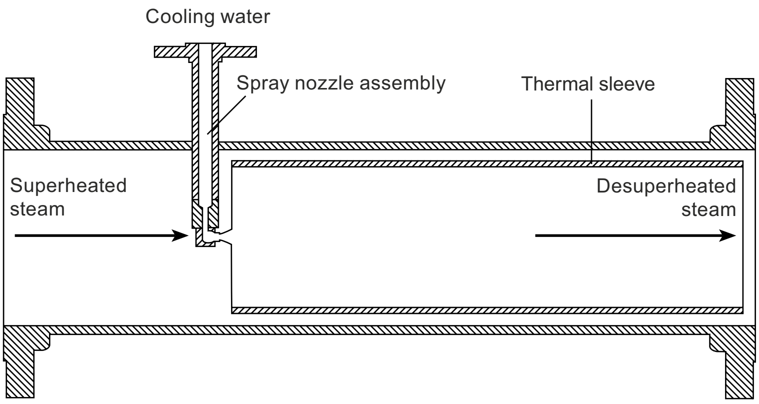


Types of desuperheater

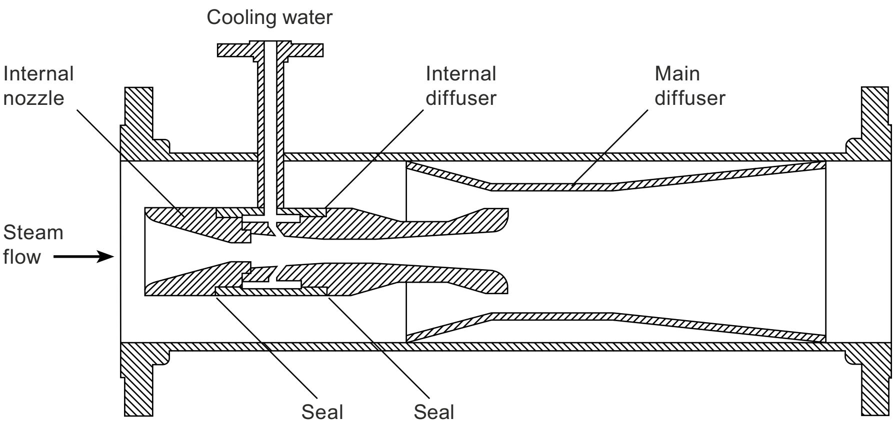
From the foregoing paragraphs, it is easy to understand why there has to be a period of good contactbetween the droplets of cooling water the superheated steam. If good contact is lost, the water can no longer absorb heat effectively from the steam, evaporation stops and the desuperheating process comes to a halt.

When the steam velocity is too low, 'water droplet fall-out' occurs and a pool of water is formed which runs along the bottom of pipe. At this point good contact between cooling water and the steam is lost and effective desuperheating will not occur. By following the guidelines presented in this document or using the Spraytech systems online sizing software, problems due to droplet fall-out can be avoided.

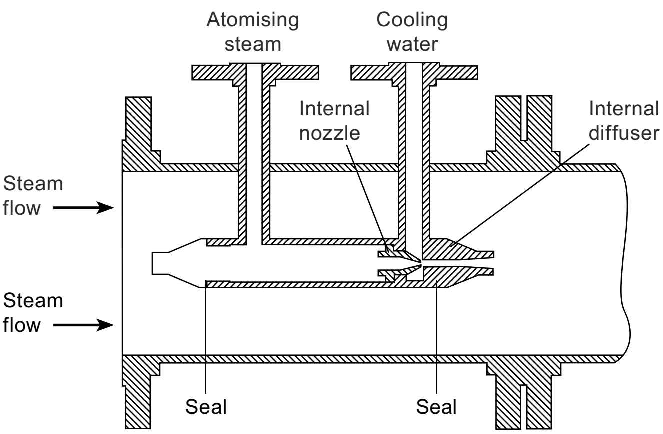
There are three basic types of Spraytech Systems desuperheater (shown below) which all use a different method to atomise the cooling water droplets. Each one has its own merits and the desuperheater selection chart shown on the following page determines which type should be selected.



Complete spray type desuperheater



Venturi type desuperheater



Steam atomising desuperheater

Finer droplets, therefore smaller absorbtion length and / or better turndown and approach to saturation

Desuperheater selection

There are various types of desuperheater available so evaluation of the process duty is crucial tensure selection of the right equipment. Turndown capability, pressure drop and outlet superheat play lead roles in desuperheater design and selection:

Turndown: (Maximum steam flowrate ÷ Minimum steam flowrate)
Turndown represents the variability of the steam flowrate. For many processes, turndown is very small or fixed. Generally, the higher the turndown, the more complicated the Desuperheater design.

Outlet superheat:
Although desuperheaters are capable of desuperheating to the saturation temperature of the steam, typically, desuperheaters are designed to produce steam temperatures at 3° C to 5°C above saturation. This is because it becomes increasingly difficult to control the process (and there is very little advantage) at lower temperatures.

Steam pressure drop (for venturi type desuperheaters):
For most pressure systems, a 0.4 to 0.7 bar g drop is considered reasonable. It should be noted that as the required turndown increases, so does the pressure drop. This is because there is a minimum acceptable pressure drop at the minimum flowrate case that ensures sufficient velocity to atomise the water droplets. Therefore, as the maximum steam flowrate increases, so does the velocity and hence the maximum pressure drop.

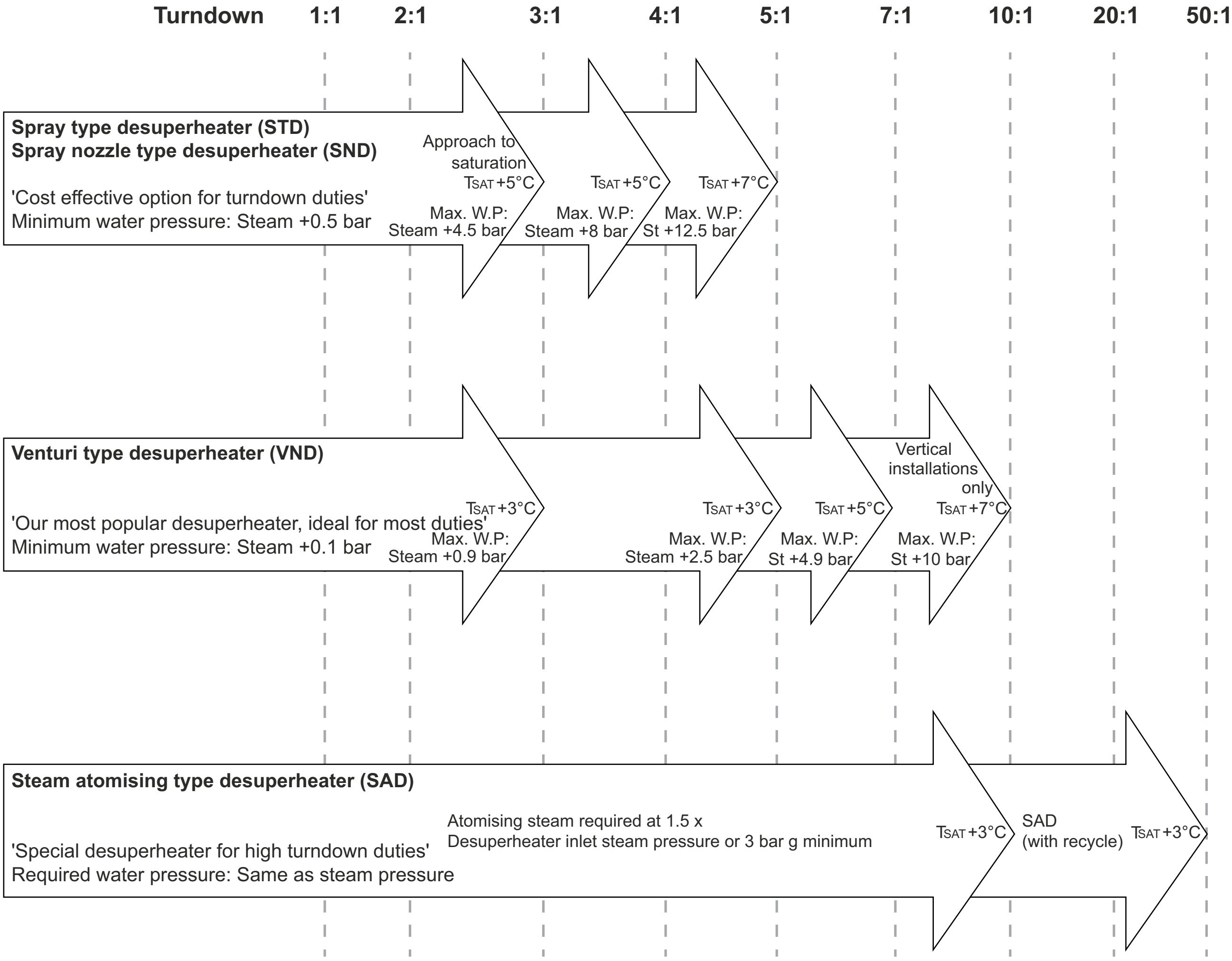
Water pressure drop (for spray type desuperheaters):
It should be noted that as the required turndown increases, the required cooling water pressure also increases.

Each type of Spraytech Systems desuperheater, employs a different method to create water droplets. The process by which the water droplets are created is usually referred to as 'atomisation'.

It must be remembered that the evaporation of the water droplets (and hence cooling of the steam) is a time dependent process and does not occur instantaneously. Consequently, most of the desuperheating does not occur in the desuperheater itself, but in the pipework immediately downstream. Thus, the design of the downstream pipework is a crucial factor in a successful desuperheater installation.

It is important that the water droplets remain suspended in the downstream pipework for as long as possible. To ensure this, it is necessary to maintain sufficient turbulence in the downstream piping by keeping the velocity relatively high – higher than is usually encountered in steam distribution systems (up to 60 m/s). This is the reason why desuperheaters and their associated pipework are often (not always) smaller than the distribution system in which they are being installed.

Desuperheater selection chart



Other considerations

Desuperheater orientation

Desuperheaters may be installed either horizontally or vertically (with the steam flowing upwards)In a vertical installation, increased turndown can be achieved; as the steam and water are countered by gravity, the water is less likely to fall out of suspension. Spraytech Systems strongly advises against installations in which the steam flow is vertically downwards, as the opposite would occur.

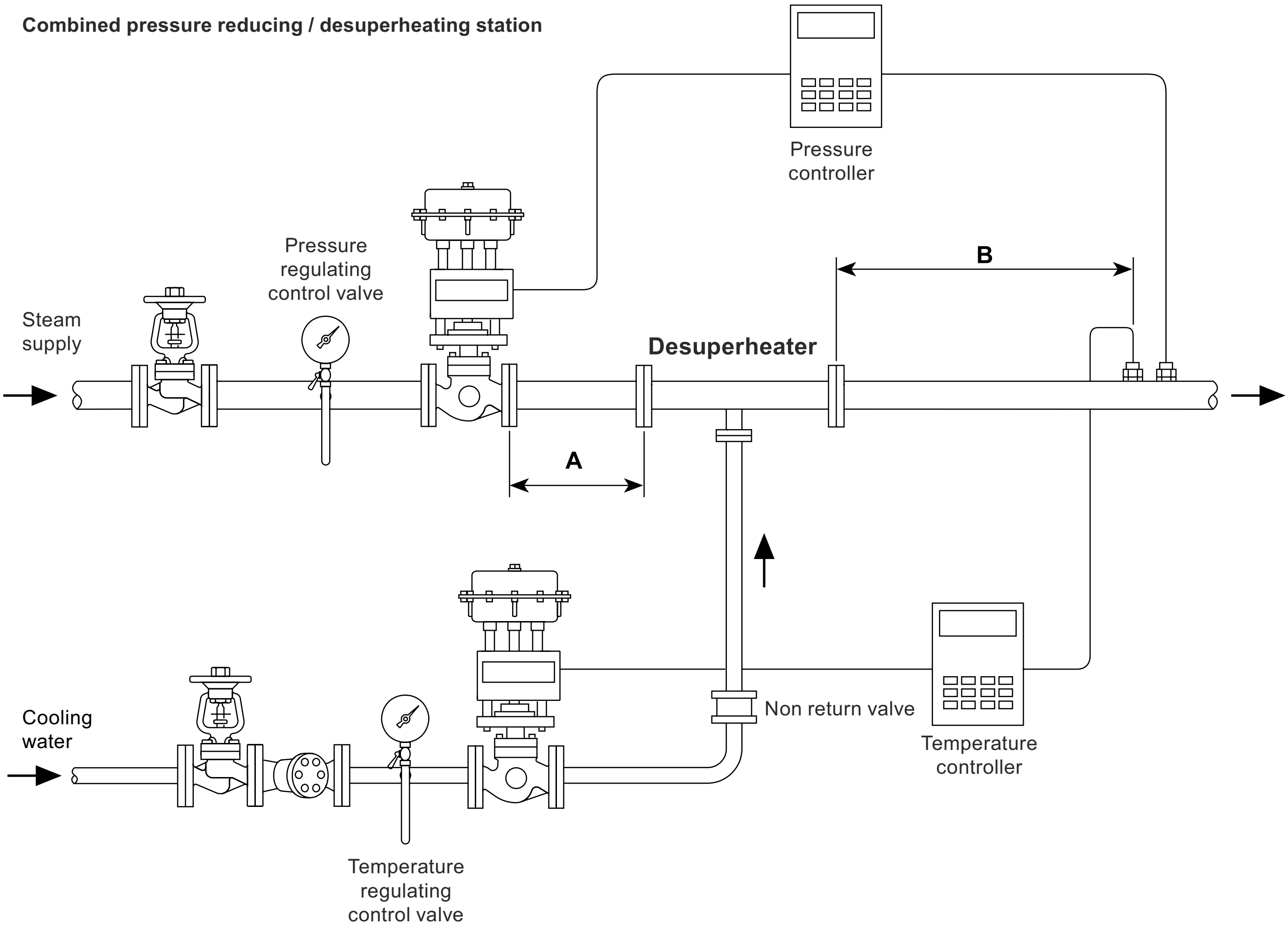
In the case of a horizontal installation the cooling water connection (and the atomising steam connection on a SAD (steam atomising desuperheater) should ideally point downwards, as this gives the best orientation for drainage of fluids in a shutdown situation. Other orientations are acceptable for satisfactory operation, but drainage is not as effective.

In a vertical installation we recommend that, the cooling water pipework (and atomising steam pipework, if applicable) should be brought to the desuperheater from below the corresponding connections on the desuperheater. This will provide the best layout for drainage of fluids on shutdown.

Distances

The diagram below indicates the recommended straight length distances between the desuperheater and upstream / downstream equipment. The distances are represented by length 'A' and 'B'.

Combined pressure reducing / desuperheating station



Recommended distances for location of pressure and temperature sensors and equipment:

Residual superheat	100°C	50°C	30°C	15°C	10°C	5°C
B Downstream distance required (straight)	2.5 m	3.7 m	5.0 m	6.25 m	6.8 m	7.0 m
A Upstream distance required (straight)	5 pipe diameters or 1.5 m minimum					

'The greater the residual superheat, the faster the water droplets are absorbed'

Other considerations (continued)

Cooling water supply

Typical cooling water supply options are as follows:

- Boiler feedwater (BFW) (taken from the pressure side of the boiler feedpump).
- Demineralised water.
- De-ionised water.
- Condensate.

Town's water or process water may also be used, but depending on hardness, salts may be deposited on the inside of downstream pipework and the face of valve seats and plugs.

Cooling water quality

The quality of the injected water is important. The TDS (Total Dissolved Solids) of the injection water should be as low as possible since all these solids will come out of solution and be deposited on the faces of valves and could block up the small orifices in the desuperheater nozzles.

Cooling water temperature

Generally, the hotter the better. This is because hot droplets need to absorb less heat to reach their flash temperature than cold ones. Hence, hot droplets will evaporate more quickly, producing a more efficient desuperheating process. Using hot water also has the additional advantage that smaller amounts of water will fall onto the inside walls of the pipework.

Because of the benefits of using hot water, it is logical to insulate the water supply pipes to minimise heat loss.

Cooling water pressure and flowrate

In order to inject the cooling water, its pressure at the desuperheater nozzle must be equal to or greater than the operating steam pressure in the pipe. The requirement varies from one type of desuperheater to another, but typical minimum values are:

- Spray type desuperheater steam pressure + 0.5 bar
- Venturi type desuperheater steam pressure + 0.1 bar
- Steam atomising type desuperheater equal to steam pressure

For the spray and Venturi type desuperheaters, the highest water inlet pressure required will be at the highest cooling water flowrate.

It should be noted that the water flowrate is a function of the square of the pressure difference between cooling water and the steam. So if the water flowrate is to be increased by a factor of 4 for example, then the pressure difference must increase by a factor of 42 = 16. This is the reason why it is important not to over-specify the turndown as high cooling water pressures are quickly reached (especially with spray type desuperheaters).

If an independent or booster pump is used, a spill-back will be required to ensure that there is always flow through the pump.

Cooling water control valve

A pressure drop will be required over the water control valve. We have already said that ideally the water should be as hot as possible so care is needed to ensure that flashing conditions do not exist across the control valve.

Superheated steam pressure control

It is desirable that a constant steam supply pressure be maintained.

The temperature of the steam after the desuperheater controls the amount of water added. The higher the temperature, the more the control valve will open and the greater the amount of water that is added. Usually the target is to reduce the steam temperature to within a small margin of saturation temperature. In virtually all applications the upstream pressure will be controlled and constant, however, if the superheated steam supply pressure is increased, the saturation temperature will also increase. The set value on the Controller will not change, and an excessive amount of water will be added as the control system tries to achieve the set temperature. This would result in very wet saturated steam with its attendant problems.

Control

In this document we have frequently used the term 'turndown' to describe the performance of the different types of desuperheater. However, as far as an installation is concerned, it should remembered that the desuperheater is only one element of a desuperheating station. Obviously, if the controls that are fitted have lower turndown than the desuperheater, then the turndown of the desuperheater station will be reduced.

For example, in a particular pressure reducing / desuperheating station, the rangability of the cooling water valve may not be as high as the desuperheater. In this case it will be the rangability of the water control valve that limits the turndown of the desuperheating station.

Separator station

In applications where there must be no moisture present in the resulting steam (such as prior to a turbine for example) it is recommended that a separator is installed downstream of the desuperheater. This will protect downstream pipework and equipment from the effects of moisture in the event of a control system failure or abnormal operating conditions, for example at start-up.

The separator must be located after the temperature sensor thereby giving the water droplets as much time as possible to evaporate.

Strainer
Spraytech Systems recommend that a strainer is incorporated in the cooling water supply line to protect both the cooling water control valve and the small bores within the desuperheater from becoming blocked.

Isolation valves
To allow maintenance to be safely carried out, isolation valves are recommended upstream of:

- The superheated steam pressure control valve.
- The cooling water control valve.

Safety valve
In applications involving simultaneous pressure reduction, a safety relief valve may be needed to protect both the desuperheater and downstream equipment from the effects of:

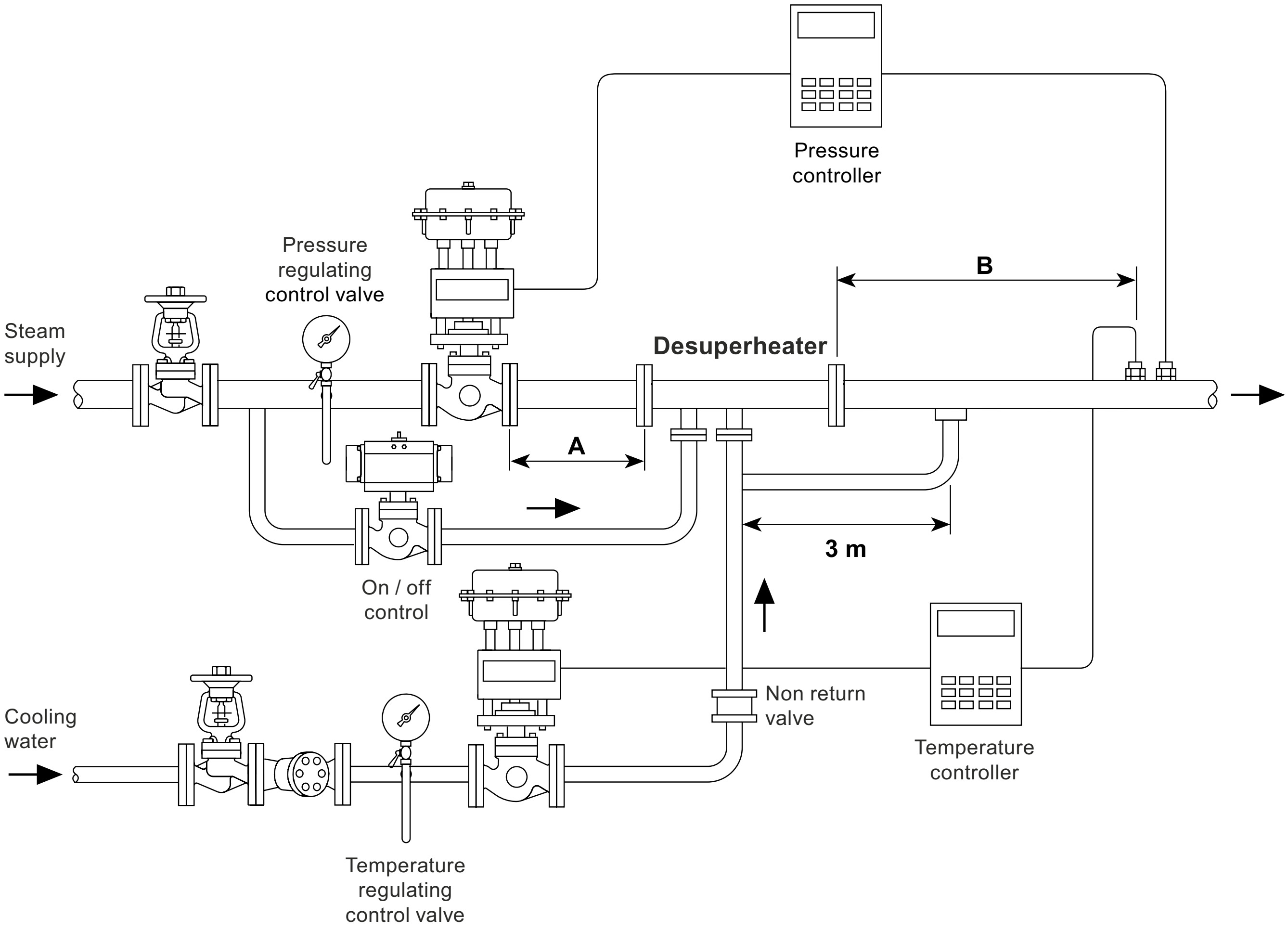
- Excess pressure in the event of pressure control system failure.
- Excess temperature in the event of temperature control system failure.

It is essential that the desuperheater and downstream equipment are suitable for the maximum temperature of the superheated steam. This is to protect these items in the event of a failure of both the pressure and temperature control systems.

Recycle loop
For SAD steam atomising desuperheaters with a very high turndown a 'catchpot and recycle loop' are often installed as shown on the diagram below. The recycled condensate is hot which leads to faster absorption.

The desuperheater generates a small suction effect to draw the recycle water back to the desuperheater ensuring that the water doesn't 'by-pass' the desuperheater.

Spraytech Systems Combined pressure reducing / desuperheating station for steam atomising type desuperheaters



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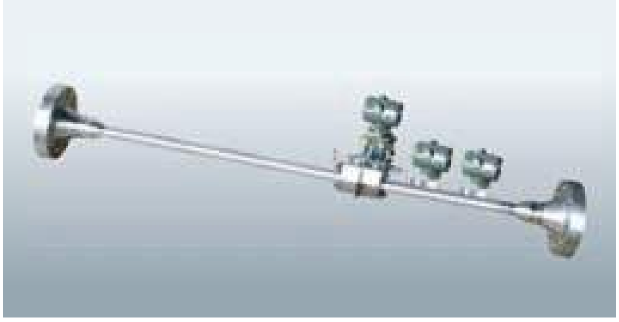
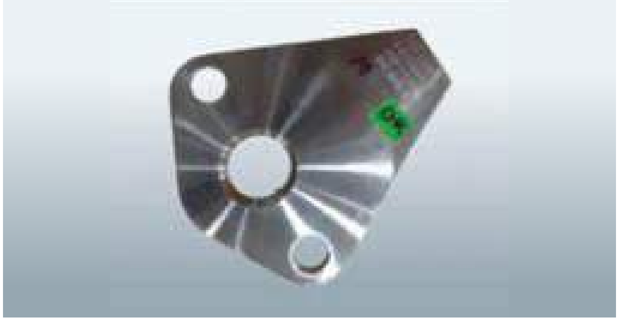
Sizing and Selection of Flow & Control Elements

Sizing and selection of Flow Elements, Orifice, Averaging Pitot Tube & Control Valves

1. Media
2. Media pressure
3. Media density
4. Media temperature
5. Media viscocity
6. Pipe size
7. Flow rate thru pipe
8. Velocity defined for liquid at 10m/sec, for gas max upto 40m/sec, and steam upto 60m/sec
9. For higher differential pressure to be maintained, refer for either flow measurement or for pressure killing application
10. If for pressure killing, select restriction plates
11. Single and multistage will be defined based on the choking condition is, depending on flow rate
12. Refer document on multistage for further clarification
13. If for flow measurement, follow the same method for restriction plates
14. Refer document on multistage for further clarification
15. To control noise please consider multistage
16. To control and remove choking, consider multistage only
17. To practice higher efficiency of plant for pure gas and liquid applications, prefer averaging pitot tube
18. Multiport averager helps you with most precise and higher flow recovery coefficient
19. Higher flow recovery means low upstream and downstream free length
20. For solid laden liquids and gasses prefer our direct acting orifices, segmental and eccentric design plates
21. For high viscous medias prefer conical entrance type
22. Refer our detailed selection of plates for direct sensing devices accuracy built processes
23. Media with most accurate Reynolds number required for processing, select our integral assemblies
24. With integral assemblies we offer most required processes medias for cold box applications
25. Media selection and high range ability and great controllability select the globe control valves
26. Pure liquids and gasses and steam for globe control valves with high range ability with controllability and most economical, most reliable solution, Spraytech's Globe control valves





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Conservation of Energy with Spraytech Systems Flow Elements

Energy conservation means to reduce the quantity of energy that is used for different purposes. This practice may result in increase of financial capital, environmental value, national and personal security, and human comfort.

Individuals and organizations that are direct consumers of energy may want to conserve energy in order to reduce energy costs and promote economic, political and environmental sustainability. Industrial and commercial users may want to increase efficiency and thus maximize profit.

On a larger scale, energy conservation is an important element of energy policy. In general, energy conservation reduces the energy consumption and energy demand per capita. This reduces the rise in energy costs, and can reduce the need for new power plants, and energy imports. The reduced energy demand can provide more flexibility in choosing the most preferred methods of energy production.

By reducing emissions, energy conservation is an important method to prevent climate change. Energy conservation makes it easier to replace non-renewable resources with renewable energy. Energy conservation is often the most economical solution to energy shortages.

The industrial sector represents all production and processing of goods, including manufacturing, construction, farming, water management and mining. Increasing costs have forced energy-intensive industries to make substantial efficiency improvements in the past 30 years. For example, the energy used to produce steel and paper products has been cut 40% in that time frame, while petroleum/aluminum refining and cement production have reduced their usage by about 25%. These reductions are largely the result of recycling waste material and the use of co-generation equipment for electricity and heating.

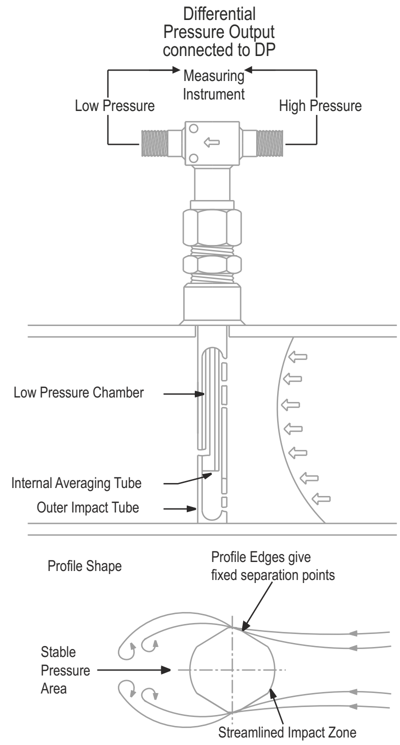
The energy required for delivery and treatment of fresh water often constitutes a significant percentage of a region's electricity and natural gas usage in light of this, some local governments have worked toward a more integrated approach to energy and water conservation efforts.

Spraytech Systems manufacture energy conservation devices which effects better savings in terms of the plant cost, in turn for the environment and finally increases the cost efficiency of plant operations.

Conservation of Energy with Spraytech Systems Flow Elements

Spraytech Systems flow elements ensures the perfect controllability in energy concepts too. Devices ensure zero cavitation, reduced industrial noise, thus converting the kinematics to its own energy and ensuring the flow is driven in plant with no excess of plant energy usage, increasing thus the plant efficiency. On record a flow loop with Spraytech Systems Averaging pitot tube with a velocity driven for 3 times the rate at which it should flow, when used offers at a free space of 4D and 2D in upstream and downstream enables a perfect 1% accuracy flow reading, thus affecting

1. Plant effieciency
2. No external excess energy used
3. Nois is within 75 decibels
4. Reading of actual flow is at minimum or at zero loss



This happens since averajing pitot tube has the following feature

1. Hexagonal sensor in forged construction, enables, perfect velocity and flow distribution, no erossion on the material with media thus
2. With aerodynamic design, enabling, perfect pressure distribution to enable most workable solution against cavitation and flashing conditions of the liquid media and against choking of the gas / vapour media
3. Cost effective measurement against orifice assembly, ventury and flow nozzle as the free length space involved with Spraytech Systems make, is only 2D in upstream and1D in downstream as compared to higher lengths defined as per beta ratio in ventury, orifice and nozzle
4. No moving parts
5. Type tested to radiography level - 1
6. MTBF is 10^{6}
7. Guranteed life cycles to 5,00,000
8. Helium lead test to $10^{(-6)}$ mbarltr/sec
9. Simple to use and install
10. Low pressure drop, resulting into most free accurate reading of flow measurement compared to other device
11. 90% flow recovery coefficient achieved with 4, 8, 12, 16, 24 averagers
12. Accuracy of flow measurement upto 0.05% of the max span of flow at min 75-80% consumption of flow
13. Temperature compensation device available with averagers enabling it to be used for perfect mass flow measurements in especially hydrogen and superheated steam line
14. Also applicable for bidirectional flow, especially used in gas lines

Conservation of Energy with Spraytech Systems Flow Elements

Further energy is further conserved by accurate measurements techniques in design of the averaging pitot tubes which helps in 90 % flow and pressure recovery as compared to any other contact flow element

The accurate designs are related to designs of the multiports noting differential pressure, below highlighted is basic concept in design which helps in conservation of energy

Line size	Consumption rate for steam and gas and liquids	Flow recovery coefficient results	Free length at upstream in mm	Free length at down stream in mm	Hysterisis	Accuracy	No of Averagers
X line size max upto 12"	Min 80%	90%	2D	1D	0.10%	0.05%	4
X line size max upto 12"	60% for liquids	70%	5D	2D	0.10%	0.25%	4
X line size max upto 12"	60% for gas and steam	80%	3.5D	1.5D	0.10%	0.15%	8
X line size max upto 12"	50%	70%	5.5D	2.5D	0.10%	0.25%	4
X line size max upto 12"	30%	60%	7.5D	4D	0.10%	0.50%	4
156"	80%	90%	2D	1D	0.10%	0.05%	24
156"	80%	70%	3.5D	2D	0.10%	0.20%	8
156"	30%	60%	7.5D	4D	0.10%	2.50%	4

Design options available at conditions	Non retract without end support	Retract with end support	Retract without end support	Non retract with end support
Velocity of media at max upto 70% of the max applicable on pipe size upto 16"	Yes	No	No	No
Velocity of media at max upto 70% of the max applicable on pipe size above 20"	No	No	No	Yes
Velocity of media at max above 70% and below 100% of the max applicable on pipe size upto 16"	No	No	Yes	Yes
Velocity of media at max above 70% and below 100% of the max applicable on pipe size above 20"	No	Yes	Yes	Yes
Velocity of media at max above 100% and upto 150% of the max applicable on pipe size upto 16"	No	Yes	Yes	Yes
Velocity of media at max above 100% and upto 150% of the max applicable on pipe size above 20"	No	Yes	No	No
Velocity recorded anything above 150% shud be analysed only for retract mechanism with end support	-	Yes	-	-

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The Flow Technologists

Conservation of Energy with Spraytech Systems Flow Elements

Spraytech Systems takes pride in introducing energy conservation techniques though the concept of flow elements, and applies well in introducing concepts of value engineering thus .

Energy conservation techniques used further with flow elements is with multistage assemblies and the basic design concepts lead to the same with what we have with Spraytech Systems Concepts

Spraytech Systems manufactured multistage orifice assemblies are another type of measuring flow with high differential pressure meters effectively removing cavitation and flashing conditions. It also helps in killing pressure and thus effectively acting as a pressure reducing element. These are basically used to detect flow of fluids, gasses, steam, steam water, acids, alkalies, crudes, high viscous fluids, fluids with solid particles, condensation liquids. Spraytech Systems make of multistage assemblies lead to a precise measure of differentialpressure leading to the most precise flow rate taking care of all factors of fluid cavitation related to its vapour pressure. The design is applicable from ½" to 64" of flow measurement. For higher sizes of impact and pressure reducing kindly do contact the design and engineering team of Spraytech Systems. It is measured at right angles to the flow direction, In a averaging Spraytech Systems make Multistage assemblies the kinetic energy of the flowing fluid is transformed into potential energy for measurement of fluid flow velocity by effectively abrupting to 40% recovery in between two stages and thus, effectively removing the choking content of the fluid in gas and steam and removing cavitation in especially liquid state thus essentially reducing industrial noise and restricting to below 80 decibels.

Applications

- Gas and Liquid Flows
- High Pressure Drops

Prevents

- Cavitation and Flashing in Liquid flows
- Choked flow in gases.
- Excessive Noise / Vibration

Restriction orifice plates have traditionally been used to reduce pressures in GAS AND LIQUID FLOWS by forcing the flow through a restricted bore. The precise pressure drop is produced by accurately calculating the orifice bore, having taken into account all the relevant process and flow conditions.

Where very HIGH PRESSURE DROPS in liquid flows are required MULTISTAGE RESTRICTION ORIFICE ASSEMBLIES may be required to achieve the desired pressure drop whilst preventing problems such as CAVITATION, FLASHING and high NOISE and VIBRATION levels.

The selection of DP and the number of stages are in such a way that the noise level is controlled and so is the complete removal of CHOKING

The same is considered with help of the engineering table as below

Flow rate consumption	Differential pressure in bar g	No of stages to be recorded, X value	Plate thickness of each stage	Multistage material Selection
10%	DP	DP = 2 $^{(X/0.1)}$	As per above table	As per media compatability
20%	DP	DP = 2 $^{(X/0.2)}$	As per above table	As per media compatability
40%	DP	DP = 2 $^{(X/0.4)}$	As per above table	As per media compatability
50%	DP	DP = 2 $^{(X/0.5)}$	As per above table	As per media compatability
60%	DP	DP = 2 $^{(X/0.6)}$	As per above table	As per media compatability
70%	DP	DP = 2 $^{(X/0.7)}$	As per above table	As per media compatability
80%	DP	DP = 2 $^{(X/0.8)}$	As per above table	As per media compatability
90%	DP	DP = 2 $^{(X/0.9)}$	As per above table	As per media compatability
100%	DP	DP = 2 $^{(X/1)}$	As per above table	As per media compatability
150%	DP	DP = 2 $^{(X/1.5)}$	As per above table	As per media compatability
200%	DP	DP = 2 $^{(X/2)}$	As per above table	As per media compatability
300%	DP	DP = 2 $^{(X/3)}$	As per above table	As per media compatability
500%	DP	DP = 2 $^{(X/5)}$	As per above table	As per media compatability

All in all energy conservation teqniques is largely related to flow concepts of plant in basic instrumentation and we at Spraytech Systems pioneers of flow level technology ensures the country with power devicing of the plant and offer a helping hand to the country's development by saving the costly usage of energy

Orifice and Orifice Assemblies

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	Viscacity @ 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 $Q_1 = \frac{\dot{m}}{\rho_1}$ and $\rho_1 = \frac{P_1}{Z R T_1}$ (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

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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.

Orifice and Orifice Assemblies

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

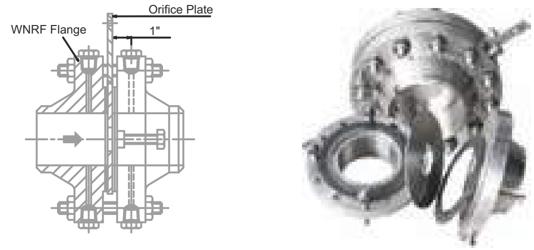
$$\Delta P_i = P_1 - P_1 = \frac{Q^2 p\,(1-\beta^4)}{2\,C_d^2\,A_2^2} = \frac{Q^2 p\,(1-\beta^4)}{2\,C_d^2\,A_2^2\,\beta^4}$$

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

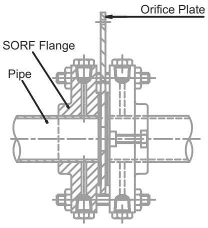
- The weld neck flange assembly is designed to transfer stresses to the pipe, thereby reducing high stress concentrations at the base of the flange. The pressure tappings are provided through the flange which are at a distance of approximately 20mm to 26mm from the face of the plate.



Orifice Assembly with WNRF Flange & Flange Taps

Fig 7.1

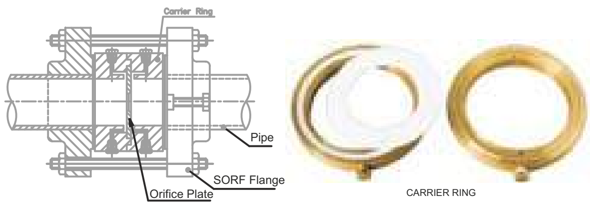
- The slip on flange has a low hub because the pipe slips into the flange prior to the welding. It is welded both from inside and out to provide sufficient strength and prevent leakage. The slip on flanges are bored slightly larger than the OD of the matching flange.



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".



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 .

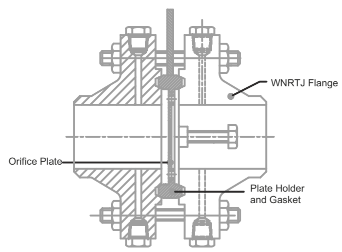
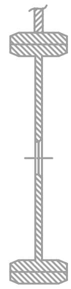


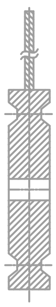
Plate with Plate Holder mounted in between RTJ Flanges

Fig 7.4



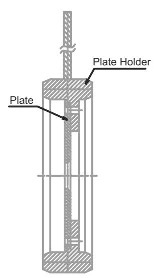
Integral RTJ

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

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The Flow Technologists

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:

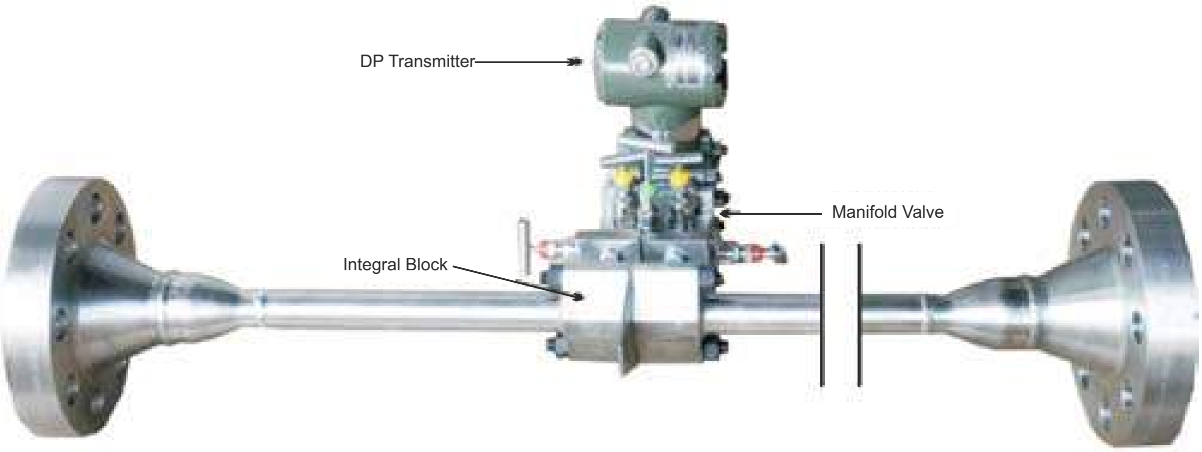
a) Integral meter run assembly upto 2”

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

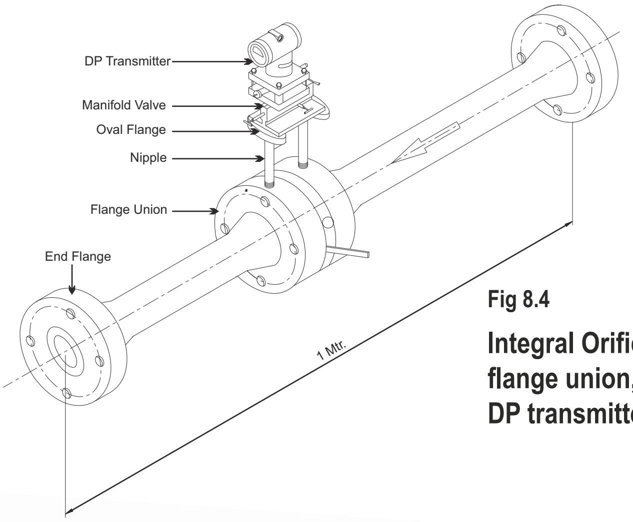


Fig 8.4

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

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

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 ($\nu = \mu / \rho$) (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, $\frac{\rho \mathrm{v}^2 L^2}{\mu \mathrm{v} L}$ 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:

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

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 ($\nu = \mu / \rho$) (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

$D_{H,\text{annulus}} = D_o - D_i$

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.

Multistage Orifice Assemblies

Standard as per R.W. Miller / ISO5167, AGA-3, B16.5, B16.36, B16.20, B16.47 Series B

Spraytech Systems manufactured multistage orifice assemblies are another type of measuring flow with high differential pressure meters effectively removing cavitation and flashing conditions. It also helps in killing pressure and thus effectively acting as a pressure reducing element. These are basically used to detect flow of fluids, gasses, steam, steam water, acids, alkalies, crudes, high viscous fluids, fluids with solid particles, condensation liquids. Spraytech Systems make of multistage assemblies lead to a precise measure of differential pressure leading to the most precise flow rate taking care of all factors of fluid cavitation related to its vapour pressure. The design is applicable from ½" to 64" of flow measurement. For higher sizes of impact and pressure reducing kindly do contact the design and engineering team of Spraytech Systems. It is measured at right angles to the flow direction, In a averaging Spraytech Systems make Multistage assemblies the kinetic energy of the flowing fluid is transformed into potential energy for measurement of fluid flow velocity by effectively abrupting to 40% recovery in between two stages and thus, effectively removing the choking content of the fluid in gas and steam and removing cavitation in especially liquid state thus essentially reducing industrial noise and restricting to below 80 decibels.

Applications

- Gas and Liquid Flows
- High Pressure Drops

Prevents

- Cavitation and Flashing in Liquid flows
- Choked flow in gases.
- Excessive Noise / Vibration

Restriction orifice plates have traditionally been used to reduce pressures in GAS AND LIQUID FLOWS by forcing the flow through a restricted bore. The precise pressure drop is produced by accurately calculating the orifice bore, having taken into account all the relevant process and flow conditions.

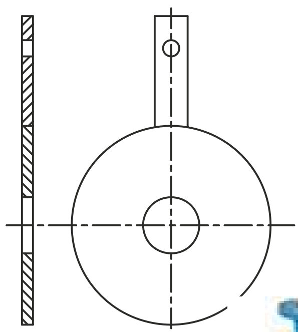
Where very HIGH PRESSURE DROPS in liquid flows are required MULTISTAGE RESTRICTION ORIFICE ASSEMBLIES may be required to achieve the desired pressure drop whilst preventing problems such as CAVITATION, FLASHING and high NOISE and VIBRATION levels.

CAVITATION is a potentially damaging, erosive condition which occurs when the internal pressure of the liquid passing through the orifice falls below its vapour pressure and vapour bubbles form. Further downstream from the orifice the pressure recovers sufficiently to collapse the bubbles with extreme violence. Cavitation calculations are performed during the design stage of a Multistage RO to calculate cavitation factors at each stage in the orifice assembly.

FLASHING is a similar phenomenon to cavitation except that the process pressure never recovers sufficiently to collapse the gas bubbles resulting in two phase flow - liquid and gas - downstream of the orifice. Erosion of pipe work and valves and other instrumentation can occur due to the impact of liquid droplets carried at high speed in the vapour flow.

CHOKED FLOW IN GASES - also know as critical flow - occurs when too large a pressure drop is attempted across a single orifice plate, or when too large flows are forced thru a lesser inlet pipe size. In such cases the flow through the orifice will become sonic, at which point no further increase in flow can be achieved by either increasing the upstream pressure or lowering the downstream pressure. Spraytech make multistage RO will enable staged reductions in pressure to prevent choked flow occurring.

Spraytech Systems make Multistage ROs are manufactured from a wide range of materials and are engineered to meet specific project process conditions and requirements. Plates are usually welded into pipe with a separation of one pipe diameter, the number of plates and orifice bores being determined by calculation. Process connections to existing pipe work can be either standard process flanges or machined ends suitable for butt welding.



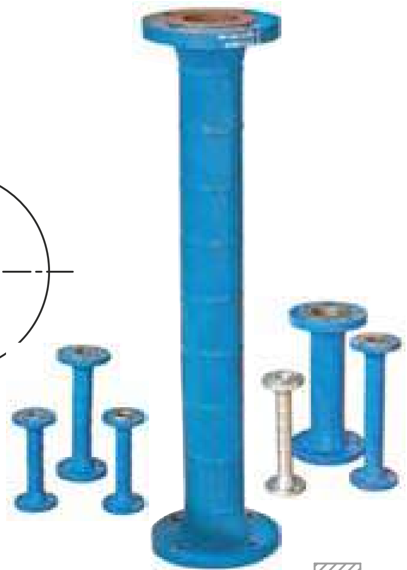


Fig 9.1

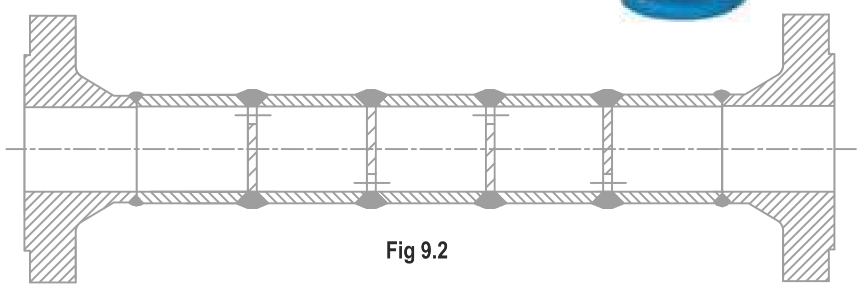


Fig 9.2

Multiple Restriction Orifice Assembly

Multistage Orifice Assemblies

The process of designing the multistage assemblies for flow measurements and reducing pressure

1. Check P1, inlet pressure, flow rate, and line size as the bare min parameter
2. Check for what application it is, either for flow measurements and or for pressure reducing
3. If for flow measurements, then check on what is the flow rate accounting to the velocity of the media as against pipe size and what is the drop of pressure required at the downstream
4. Here please use the basic formula for flow rate = 3.14 X R^2 X velocity of the media, Where R = Radius of the pipe
5. Now for all practical purpose, liquid is considered at 5 m/sec, gas at 40m/sec, steam at 40m/sec, mixed phase at 60m/sec as the velocity
6. Thus the R value, the radius of the pipe can be found out, double it and make the internal ID of the enquiry pipe check with your calculated value
7. Now if the conditions of the flow are as per the table below, then consider the pressure stages accordingly based on the calculations provided in the table, so that the final pressure drop at each stage when back calculated should match and all conditions of cavitation and flashing wherever applicable, in case will be considered and the best flow should result after the said pressure drop is completed
8. The total pressure drop is considered dividing the number of stages, which is now first decided depending on the table below. Thus each pressure drop is considered across each stage and then by multiplying the balance pressure drop by 1.6 times for subsequent calculations. This is done to take care of the 40% recovery and also thus to remove the relevant effect of choking and cavitation per stage. please refer to the example listed below for clarifications
9. Please note flow is not reduced or less end, please note it is a flow meter reading device while killing pressure and so on
10. The upstream and down stream length of the multistage assembly is also defined depending on the final stages applicable for flow measurements, please refer to the table below

For Pressure Temperature Considerations

Table 9.1

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
1 1/2"	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	38 bar and 350 deg cent	9.52mm
8"	XXXXX	XXXXX	XXXXX	24 bar g and 250 deg cent	6.35mm	38 bar and 350 deg cent	9.52mm
10"	XXXX	XXXXX	XXXXX	24 bar g and 250 deg cent	6.35mm	38 bar and 350 deg cent	9.52mm

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

For example

Line size is 3" and flow rate is at 500% consumption and the pressure drop is 120 bar g and temperature is 500 deg cent

Thus now to remove cavitation and effectively reduce noise within 80 decibles, for an application of steam water

Solution and how to proceed

Step 1: Since 500% consumption thus as per table above DP = $2^{(X/5)}$, therefore DP = 120 = $2^{(X/5)}$ thus X = 33.7 stages for a perfect noise to be within 70 decibels and choking is nil and thus increase the plant health bountifully and no external energy and more energy is utilized, thus saving plant energy cost. If not given then noise level is 200 decibels at say 7 stages and lot of energy is sapped and flow is lost and further plant life will reduce as more energy is required to drive the flow

Step 2: Thus 34 stages are noted

Step 3: Divide 120/34 this equals = 3.53 bar drop per stage

Step 4: As per above table, first impact of flow is 120 bar at 500 deg cent, plate thickness works out to be min 28mm for 3" thus

Step 5: Second stage inlet shall be 120 - (3.53x1.6) (since 40% recovery of press only at 1D distance of the second plate) =114.352 bar g but at 500 deg cent

Step 6: Thus second stage plate thickness shall be same as 28mm as stage 1

Step 7: This way onward calculations can be done and all stages of plate thickness can be calculated for all 34 stages

Step 8: After all calculations are completed the net result shall be ……..no choking, no cavitation, no noise beyond 70 decibels

Just for information the noise level for above calculation come down to 66decibels from a whopping 201 decibels. Such is the product applicability of Spraytech Systems Multistage design for measuring flow

Remember Multistage assembly of Spraytech Systems does measure flow and allows the maximum efficiency of the plant with very accuracy and no loss flow concept, thus increasing the life cycle of the assembly, the plant life.

Table 9:2

This table is achieved at 100% flow consumption. At lesser or more the ratio is multiplied at pressure column to have the resultant at that flow consumption.

Flow rate consumption	Differential pressure in bar g	No of stages to be recorded, X value	Plate thickness of each stage	Multistage material Selection
10%	DP	DP = $2^{(X/0.1)}$	As per above table	As per media compatability
20%	DP	DP = $2^{(X/0.2)}$	As per above table	As per media compatability
40%	DP	DP = $2^{(X/0.4)}$	As per above table	As per media compatability
50%	DP	DP = $2^{(X/0.5)}$	As per above table	As per media compatability
60%	DP	DP = $2^{(X/0.6)}$	As per above table	As per media compatability
70%	DP	DP = $2^{(X/0.7)}$	As per above table	As per media compatability
80%	DP	DP = $2^{(X/0.8)}$	As per above table	As per media compatability
90%	DP	DP = $2^{(X/0.9)}$	As per above table	As per media compatability
100%	DP	DP = $2^{(X/1)}$	As per above table	As per media compatability
150%	DP	DP = $2^{(X/1.5)}$	As per above table	As per media compatability
200%	DP	DP = $2^{(X/2)}$	As per above table	As per media compatability
300%	DP	DP = $2^{(X/3)}$	As per above table	As per media compatability
500%	DP	DP = $2^{(X/5)}$	As per above table	As per media compatability

Spraytech® Systems (India) Pvt. Ltd.
The Flow Technologists

Averaging Pitot Tube

Manufacturing standard ;ISO 5167, AGA -3 , B16.5, B16.36, B16.20, B 16.34, PTC 19.3 (temperature compensation averaging pitot tube), vibration analysis as per ASME PTC 19.3

Spraytech Systems manufactured Averaging Pitot Tubes are another type of differential pressure flowmeters. Averaging Pitot tubes are basically used to detect flow velocity of fluids, gasses, steam, steam water and absolutely all those medias which atmost with 3-5ppm of solids as the max size. Spraytech Systems make averaging Pitot tubes have the potential to measure two pressures at the same time i.e. impact (dynamic) and static. The static pressure is the operating pressure in the pipe, duct, or the environment, upstream to the Pitot tube. It is measured at right angles to the flow direction, In a averaging Spraytech Systems make Pitot-static tube, the kinetic energy of the flowing fluid is transformed into potential energy for measurement of fluid flow velocity.

Advantages in using Spraytech Systems make Averaging Pitot tube

1. Hexagonal sensor in forged construction, enables, perfect velocity and flow distribution, no erossion on the material with media thus
2. With aerodynamic design, enabling, perfect pressure distribution to enable most workable solution against cavitation and flashing conditions of the liquid media and against choking of the gas / vapour media
3. Cost effective measurement against orifice assembly, ventury and flow nozzle as the free length space involved with Spraytech Systems make, is only 2D in upstream and 1D in downstream as compared to higher lengths defined as per beta ratio in ventury, orifice and nozzle
4. No moving parts
5. Type tested to radiography level - 1
6. MTBF is 10^6
7. Guranteed life cycles to 5,00,000
8. Helium lead test to $10^{(-6)}$ mbarltr/sec
9. Simple to use and install
10. Low pressure drop, resulting into most free accurate reading of flow measurement compared to other device
11. 90% flow recovery coefficient achieved with 4, 8, 12, 16, 24 averagers
12. Accuracy of flow measurement upto 0.05% of the max span of flow at min 75-80% consumption of flow
13. Temperature compensation device available with averagers enabling it to be used for perfect mass flow measurements in especially hydrogen and superheated steam line
14. Also applicable for bidirectional flow, especially used in gas lines

Spraytech Systems Averaging Pitot Tube

With the advent of averaging pitot tubes, the difficulty of determining the average velocity point has almost been sorted out. Our averaging pitot tube is designed with manifold impact and static pressure ports. Besides, it is constructed in such a manner that it extends across the whole pipe diameter. Averaging pitot tubes offer better accuracy as compared to single port pitot tubes, particularly in cases where the flow is not entirely formed. It enables a flow recovery of 90% as compared to only 55% with single port pitot tube.

Averaging the application considers the following to have the best results in flow and pressure recovery of the system against which it has to measure.

Table 10.1

Line size	Consumption rate for steam and gas and liquids	Flow recovery coefficient results	Free length at upstream in mm	Free length at down stream in mm	Hysterisis	Accuracy	No of Averagers
X line size max upto 12”	Min 80%	90%	2D	1D	0.10%	0.05%	4
X line size max upto 12”	60% for liquids	70%	5D	2D	0.10%	0.25%	4
X line size max upto 12”	60% for gas and steam	80%	3.5D	1.5D	0.10%	0.15%	8
X line size max upto 12”	50%	70%	5.5D	2.5D	0.10%	0.25%	4
X line size max upto 12”	30%	60%	7.5D	4D	0.10%	0.50%	4
156”	80%	90%	2D	1D	0.10%	0.05%	24
156”	80%	70%	3.5D	2D	0.10%	0.20%	8
156’	30%	60%	7.5D	4D	0.10%	2.50%	4

For other combination, kindly contact the design cell of Spraytech Systems.

The above is the indicative table as to how the accuracy matters with respect to line size, flow rate consumption, no of averagers in the averaging pitot tube.

The free space indicated in upstream and downstream informs us that more the free space, beyond what is indicated does make the averaging pitot tube more accurate.

Principle of operation

Averaging pitot tube is nothing but an element which is suppose to measure the flow rate and offer the differential pressure to the flow meter mounted on top. The averaging pitot tube works on the 80% velocity of the media rate at the top of the centre line in a velocity gradient in a pipe line or duct and 70% velocity of the media in the below portion of the centre line. it does not work on the centre line velocity which is 100% for the media as what a orifice, a ventury and nozzle, and many more flow meter works. Thus the velocity of the media is perfectly averaged out and offered for DP measurement in the flow meter.

An averager on the inlet side measures the velocity at :

Table 10.2

No of averagers	Holes at the inlet part, % of the total length of sensor bulb	Holes at the outlet, % of the total length of sensor bulb	Flow rate consumption	Free length at the inlet	Free length at the out let	Direction of flow	Line size
4	At 70%, 60%, 30% and 20%	50%	80%	2D	1D	unidirectional	Max upto 12”
8	At 80%,73%,66%, 60%, 40%, 33%, 26% and 20%	50%	80%	2D	1D	unidirectional	Max upto 24”
12	At 85%,80%, 75%, 70%, 65%, 60%, 40%, 35%, 30%, 25%, 20%, 15%	50%	80%	2D	1D	unidirectional	Max upto 48”
16	At 90%, 86%,81%, 77%, 73%, 69%, 65%, 60%, 40%, 36%, 31%, 27%, 23%, 19%, 15%, 10%	50%	80%	2D	1D	unidirectional	Max upto 156”

The differential pressure created by the dynamic force at the inlet and static force at the output, creates the average at the out put to enable the flow rate measurement more accurately with lesser free length

For bidirectional measurement, the concept is completed by holes at the other side for measurement, at 1.5% lesser than the length at the dynamic side of the unidirectional flow measurement device.

The 4, 8, 12,….24 averagers works to enable the perfect flow recovery based on the consumption of the media in the pipe.

The choice of the non retract and retract mechanism is based on the activities of choosing the device under velocity considerations.

The following is to be considered accordingly

Table 10.3

Design options available at conditions	Non retract without end support	Retract with end support	Retract without end support	Non retract with end support
Velocity of media at max upto 70% of the max applicable on pipe size upto 16"	Yes	No	No	No
Velocity of media at max upto 70% of the max applicable on pipe size above 20"	No	No	No	Yes
Velocity of media at max above 70% and below 100% of the max applicable on pipe size upto 16"	No	No	Yes	Yes
Velocity of media at max above 70% and below 100% of the max applicable on pipe size above 20"	No	Yes	Yes	Yes
Velocity of media at max above 100% and upto 150% of the max applicable on pipe size upto 16"	No	Yes	Yes	Yes
Velocity of media at max above 100% and upto 150% of the max applicable on pipe size above 20"	No	Yes	No	No
Velocity recorded anything above 150% shud be analysed only for retract mechanism with end support	-	Yes	-	-

Spraytech Systems Pitot-static tube can measure the fluid flow velocity by Stagnation Pressure converting the kinetic energy in the fluid flow into potential energy.

The principle is based on the Bernoulli Equation where each term can be interpreted as a form of pressure

$p + 1/2\,\rho v^2 + \gamma h$ = constant along a streamline (1)

where

p = static pressure (relative to the moving fluid) (Pa)

ρ = density (kg/m^3)

γ = specific weight (kN/m^3)

v = flow velocity (m/s)

g = acceleration of gravity (m/s^2)

h = elevation height (m)

Each term of this equation has the dimension force per unit area - N/m^2 or in imperial units psi, lb/ft^2

Static Pressure

The first term - p - is the static pressure. It is static relative to the moving fluid and can be measured through an flat opening in parallel to the flow.

Dynamic Pressure

The second term - $1/2\rho v^2$ - is called the dynamic pressure.

Hydrostatic Pressure

The third term - γ h - is called the hydrostatic pressure. It represent the pressure due to change in elevation.

Since the Bernoulli Equation states that the energy along the streamline is constant, (1) can be modified to

$p1 + 1/2\rho v1^2 + \gamma h1$

$= p2 + 1/2\rho v2^2 + \gamma h2$

= constant along the streamline (2)

where

suffix 1 is a point the free flow upstream

suffix 2 is the stagnation point where the velocity in the flow is zero

Flow Velocity

In a measuring point we regard the hydrostatic pressure as a constant, h1 = h2 and this part can be eliminated. Since v2 is zero, (2) can be modified to:

$p1 + 1/2\rho v1^2 = p2$ (3)

or

$v1 = [\,2\,(p2 - p1)/\rho\,]^{1/2}$ (4)

where

p2 - p1 = DP (Differential Pressure)

With (4) it's possible to calculate the flow velocity in point 1 - the free flow upstream - if we know the differential pressure difference dp = p2 - p1 and the density of the fluid.

The averaging pitot tube is a simple and convenient instrument to measure the difference between static, total and dynamic pressure (or head).

The difference of pressure recorded is the minimum applicable depending on the flow consumption per pipe size and the inlet pressure.

As per the ISO 5167 std and also IEC 60534 for flow conditins and all internationally acclaimed conditions the flow rate recorded in averaging pitot tube and the one manufactured by Spraytech Systems records DP at the following conditions

Table 10.4

Flow rate at the pipe size	Inlet pressure	DP recorded	At the free length of in the upstream	No of averagers
20% and less	X pressure range	X*0.8	7.5D	4
30%	X pressure range	X*0.6	7D	4
50%	X pressure range	X*0.4	4D	4
70%	X pressure range	X*0.25	2.5D	4
90%	X pressure range	X*0.15	2D	4
100%	X pressure range	X*0.05	2D	4
150%	X pressure range	X*0.05	2D	4
Flow rate at the pipe size for media for gas and steam for eg	Inlet pressure	DP recorded	At the free length of in the upstream	No of averagers
20% and less	X pressure range	X*0.6	5.5D	8
30%	X pressure range	X*0.4	5D	8
50%	X pressure range	X*0.25	3.5D	8
70%	X pressure range	X*0.15	2.0D	8
90%	X pressure range	X*0.08	2D	8
100%	X pressure range	X*0.03	2D	8
150%	X pressure range	X*0.02	2D	8

The above is the briefing on how much it matters for DP keeping the flow rate and pressure in mind.

Retract Versus Non Retract Mechanism

Table 10.5

Type	Non retract mechanism	Retract mechanism
Selection	Velocity within 10 m/sec for liquids	Exceeds 10m/sec for liquids
selection	Velocity within 40m/sec for gas	Exceeds 40m/sec for gas
selection	Velocity within 60 m/sec for steam	Exceeds 60m/sec for steam
Suctionability and hold of characteristics	Within the above velocity control, the averaging pitot tube characteristics does not change thus the inherent characteristics is not affected while before and after maintenance	While velocity exceeds as above, non retract easily loses its characteristics before and after maintenance, and hence a retract mechanism, holds the suctionability and thus helps in maintaining the inherent control characteristics, since the retract mechanism maintains suctionability thru the ball valve and the mounting mechanism
Temperature compensation	Yes available	Yes available

For steam, air, and gas applications, considering unidirectional flow, internal IDs and port Size applicable for avaerajing pitot tube

Table 10.6

Consumption of fluid in pipe	Tube ID required (internal tube)	No of ports required for 2D and 1D upstream and downstream free length	Port dimensions at dynamic end, min size in mm	Port dimensions at static end in mm	Internal tube lengths
10%	0.8 mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 30% from bottom port end
20%	0.8 mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 30% from bottom port end
30%	1 mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 30% from bottom port end
40%	1.6 mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 30% from bottom port end
50%	1.6 mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 45% from bottom port end
60%	3 mm	4 nos till 6", 8 nos till 24" and 12 nos till 40" and 16 nos till 64"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 45% from bottom port end
70%	3 mm	4 nos till 6", 8 nos till 24" and 12 nos till 40" and 16 nos till 64"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 45% from bottom port end
80%	5 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 45% from bottom port end
90%	5 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 45% from bottom port end
100%	5 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 45% from bottom port end
150%	5 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 45% from bottom port end
200%	5 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 8 mm ID, after 14 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 45% from bottom port end

The above is to ensure that the flow is sensed for each changing phases in flow consumption of steam, air, or any gasses. This enables no choking or no noise applicable for the design considerations

Similarly for flow of water the following is the considerations

Table 10.6 cont.

Consumption of fluid in pipe	Tube ID required (internal tube)	No of ports required for 2D and 1D upstream and downstream free length	Port dimensions at dynamic end, min size in mm	Port dimensions at static end in mm	Internal tube lengths
10%	0.6 mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4" port shall be of 12 mm ID, after 16 mm for all sizes	8 mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% of consumption, from the bottom end and dynamic port length is till 10% from bottom port end
20%	0.6mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4", port shall be of 12mm ID, after 16 mm for all sizes	6 mm till 4" and after shall be 8-12 mm for all other sizes	Static port length is till 45% of consumption, from the bottom end and dynamic port length is till 10% from bottom port end
30%	0.6 mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4" , port shall be of 12 mm ID, after 16 mm for all sizes	8 mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% of consumption, from the bottom end and dynamic port length is till 10% from bottom port end
40%	1.25 mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4", port shall be of 12 mm ID, after 16 mm for all sizes	8 mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% of consumption, from the bottom end and dynamic port length is till 10% from bottom port end
50%	1.4mm	4 nos till 3", 8 nos till 16" and 12 nos till 32" and 16 nos till 56"	Till 4", port shall be of 12 mm ID, after 16 mm for all sizes	8 mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 10% from bottom port end
60%	2.25 mm	4 nos till 6", 8 nos till 24" and 12 nos till 40" and 16 nos till 64"	Till 4", port shall be of 12 mm ID, after 16 mm for all sizes	8 mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 10% from bottom port end
70%	2.25 mm	4 nos till 6", 8 nos till 24" and 12 nos till 40" and 16 nos till 64"	Till 4", port shall be of 12 mm ID, after 16mm for all sizes	8 mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 10% from bottom port end
80%	3 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 12 mm ID, after 16 mm for all sizes	8 mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 10% from bottom port end
90%	3 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 12 mm ID, after 16 mm for all sizes	8 mm till 4" and after shall be 10-16 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 10% from bottom port end
100%	3 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 12 mm ID, after 16 mm for all sizes	8 mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 10% from bottom port end
150%	3 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 12 mm ID, after 16 mm for all sizes	8 mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 10% from bottom port end
200%	3 mm	4 nos till 12", 8 nos till 36" and 12 nos till 56" and 16 nos till 82"	Till 4", port shall be of 12 mm ID, after 16 mm for all sizes	8mm till 4" and after shall be 10-14 mm for all other sizes	Static port length is till 45% from the bottom end and dynamic port length is till 10% from bottom port end

Averaging Pitot Tube

Averaging pitot tube takes the concept of upper and lower band of flow velocity in a pipe flow system and thus defines the averager of the upper and the lower band of the velocities, highlighting the best possible flow recovery in this type element as compared to nozzles, ventury and aerofoils and even in orifices, vortex, magnetic type flow meters and measurement technique.

Table 10.7

Type	Non retract mechanism	Retract mechanism
Material of Construction		
Sensor flange	SS316, SS316L, SS304, SS304L, PTFE, PP, Monel, Hastealloy	SS316, SS316L, SS304, SS304L, PTFE, PP, Monel, Hastealloy
Sensor	SS316, SS316L, SS304, SS304L, PTFE, PP, Monel, Hastealloy	SS316, SS316L, SS304, SS304L, PTFE, PP, Monel, Hastealloy
Mounting needle valves	SS316, SS316L, SS304, SS304L, PTFE, PP, Monel, Hastealloy A105	SS316, SS316L, Ss304, SS304L, PTFE, PP, Monel, Hastealloy A105
Mounting ball valves		SS316, SS316L, Ss304, SS304L, PTFE, PP, Monel, Hastealloy, A105
Mounting rods with pads		SS316, SS304, SS316L, Mild steel with anticorossion powder coat, MS, SS with PTFE coating
Mounting pipe chamber		MS, Carbon steel, Stainless steel, PTFE, PP
Tubes for differential pressure	Stainless steel, monel, hastealloy, SS304L, SS316L, SS304, PTFE, PP	Stainless steel, monel, hastealloy, SS304L, SS316L, SS304, PTFE, PP
Weld couple	SS316, SS316L, SS304, SS304L, PTFE, PP, Monel, Hastealloy, carbon steel	SS316, SS316L, SS304, SS304L, PTFE, PP, Monel, Hastealloy, carbon steel
Bonnet flange connection	SS316, SS316L, SS304, SS304L, PTFE, PP, Monel, Hastealloy, carbon steel	SS316, SS316L, SS304, SS304L, PTFE, PP, Monel, Hastealloy, carbon steel
Ball valves		11/2", 3", 4", 6 " ANSI 150#, 300#, 600#, 900#, 1500#, 2500#
Needle valves	1 1/2", 3", 4", 6 " ANSI 150#, 300#, 600#, 900#, 1500#, 2500#	11/2", 3", 4", 6 " ANSI 150#, 300#, 600#, 900#, 1500#, 2500#
Averaging pitot tubes	½" to 156"	4" to 156"
Sensor sizes	25.4mm, 57.3mm, 85mm, 115mm, 165mm	25.4mm, 57.3mm, 85mm, 115mm, 165mm

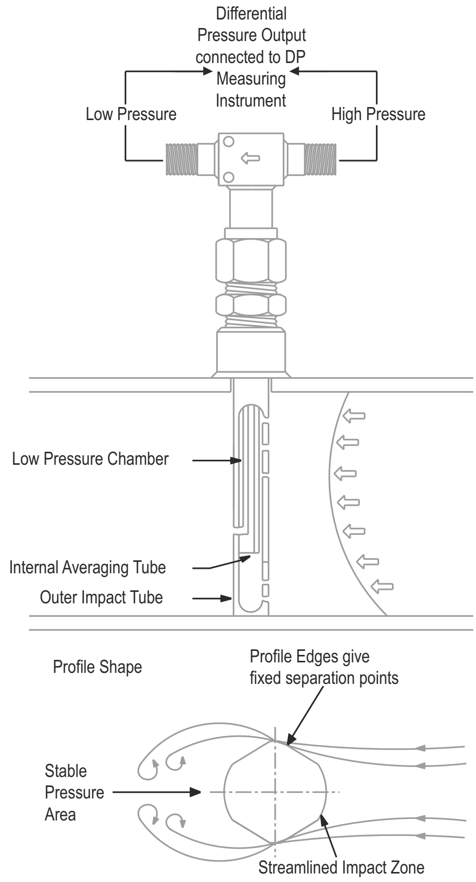


Fig 10.1

Table 10.7 contd

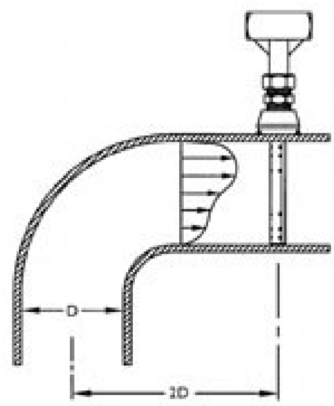
Type	Non retract mechanism	Retract mechanism
No of ports (averagers)	2, 4, 8, 12, 16, 24	2, 4, 8, 12, 16, 24
End support	SS316, SS304L, A105, SS316L, Hastealloy, Monel, PTFE, PP	SS316, SS304L, A105, SS316L, Hastealloy, Monel, PTFE, PP
End support	Flanged ends, screwed, welded	Flanged ends, screwed, welded
Temperature compensation	Yes with element upto 1200 deg cent compensation	Yes with element upto 1200 deg cent compensation
Temperature element	RTD, Thermocouple, graphite expansion technique	RTD, Thermocouple, graphite expansion technique
HART protocol based transmitter, single or multivariable transmitter	Yes available with mounting accessories	Yes available with mounting accessories
Mounting hardware with transmitter	Manifold valve and valves and nipples with various MOC as per sensor MOC	Manifold valve and valves and nipples with various MOC as per sensor MOC

Installing an averaging pitot tube is a simple process. However, problems can result that are difficult to correct later if a few basic factors are not considered during the mounting process. The first three steps to successful mounting are location, orientation and installation.

Some pitot tubes have hardware to support its far end. Tack weld such hardware with the pitot tube in place before performing final welds.

Step one: Location

First, determine if adequate straight run is available. Straight run refers to the amount of obstruction-free piping upstream and downstream of the averaging pitot tube. Elbows, control valves, changes in pipe size and other obstructions create flow disturbances that affect accuracy. Because the averaging pitot tube measures and averages the readings from multiple points along the flow profile **(see Figure 10.1)**, its straight run requirements are less stringent than most other devices, but upstream and downstream disturbances must still be taken into consideration.



Elbow Mount Installation

Fig 10.2

Most flow meter manufacturers publish straight run charts. However, the charts don't tell where to locate the pitot tube when adequate straight run is not available. Intuition may not always be correct when deciding. For example, when the only option is to install it immediately downstream of an elbow, one may be tempted to install it as far away from the elbow as possible. While it's true that upstream disturbances influence accuracy more than downstream disturbances, this is one case where installing the averaging pitot tube two diameters from the centerline of the elbow is best **(see Figure 10.2)**.

The velocity profile hugs the outside radius of the pipe immediately after an elbow in a predictable manner. At two pipe diameters from the centerline of a short-radius elbow, reasonable accuracy can be achieved if the instrument is mounted to the outside radius of the elbow and the flow coefficient is properly adjusted.

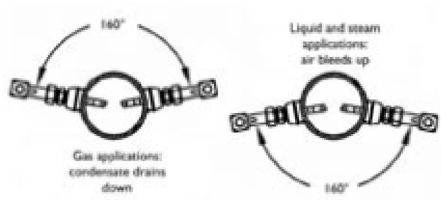
Notice how the pitot tube traverses the skew of the flow profile in Figure 10.2. If it were rotated 90 degrees from the position shown, it would not average the flow correctly. Another example of traversing the skew occurs downstream of a butterfly valve, with the instrument oriented 90 degrees from the valve axis.

Not all straight run rules are chiseled in stone. For example, the chart may require 24 pipe diameters after a valve. However, a fully open, full-throat gate or ball valve induces only a small flow disturbance. A modulating control valve or butterfly valve causes a much greater flow disturbance. Because there are so many combinations possible, consult the instrument manufacturer for a recommendation on where it should be installed and for an estimated accuracy. One pointer: always provide a sketch or diagram. Verbal descriptions are not always conveyed or interpreted accurately. In addition, there may be something in the diagram that seems irrelevant, such as a temperature sensor or pressure tap, but may affect the accuracy of the device.

Step two: Orientation

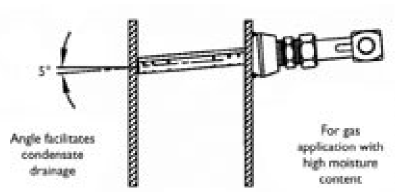
Consider horizontal piping runs first. For gas applications, mount the pitot tube in the upper 160-degree portion of the pipe to prevent condensate from collecting in the instrument lines or transmitter **(see Figure 10.3)**. This is especially critical when the gas is saturated or operating at a temperature above ambient.

For liquid applications, the pitot tube should be mounted in the lower 160-degree portion to prevent air from collecting in the instrument lines or transmitter. Because steam applications require liquid legs to isolate the transmitter, the same consideration applies.



Horizontal pipe orientation

Fig 10.3

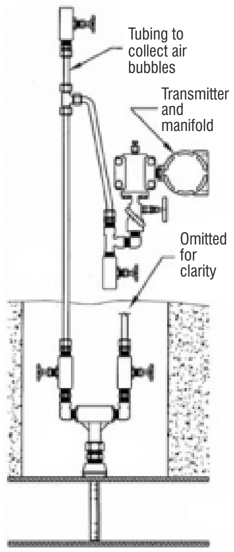


Vertical pipe orientation

Fig 10.4

For vertical piping, mount the pitot tube in any location around the circumference of the pipe. For gas with a high moisture content, mount the instrument at a five-degree angle to allow drainage **(see Figure 10. 4)**.

Indicate if the line is vertical when you order the device. The manufacturer will orient the connections parallel to the ground to eliminate low points for condensation build-up.



Buried water pipe

Fig 10.5

Non-standard orientation

Occasionally, it's not practical to mount the pitot tube in the recommended orientation. For example, a buried water line does not allow access to the lower portion of the pipe; therefore, the instrument must be mounted to the top. In such cases, special mounting considerations prevent entrained air from collecting in the instrument lines or transmitter **(see Figure 10.5)**.

Step three: Installation

An averaging pitot tube can be installed through various connections. The two most common methods are flanged and threaded. Regardless of the connection size or type, the size of the hole drilled in the pipe is critical to measurement accuracy.

Hole size

The averaging pitot tube is designed to pass through a specific hole size. For example, if the pitot tube diameter is 7/8", the manufacturer will probably recommend a 1" hole. In short, the hole should be just large enough to allow the instrument to pass and be de-burred whenever possible. Drilling an oversized hole or using a cutting torch affects accuracy. A large or jagged hole produces a disturbance that can wash out the signal from the sensing ports located closest to the pipe wall **(see Figure 10.6)**.

In smaller line sizes, the sensing ports are located closer to the pipe wall. The smaller the pipe and the larger hole, the greater effect on accuracy. To quantify the error, for example, a 1-3/8" hole in a 6" pipe to pass a 7/8" pitot tube will generate a potential error of 8 to 10 percent.

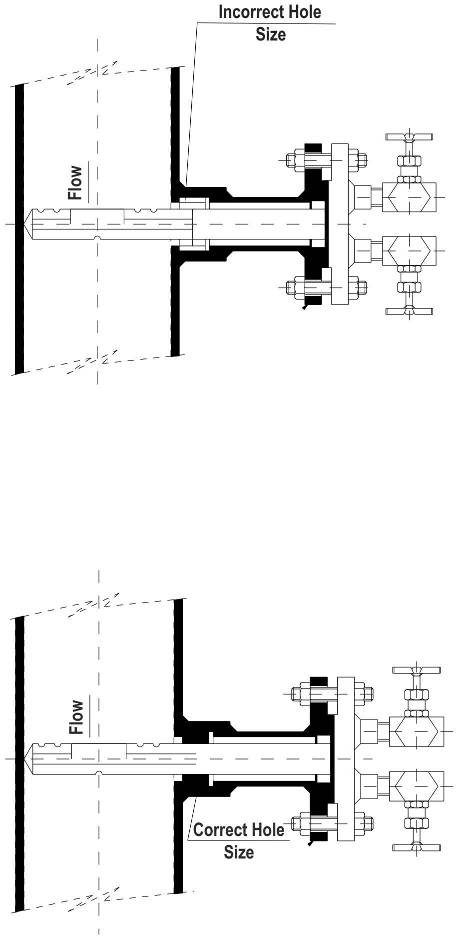
If there is an existing oversized hole in the pipe but no alternate mounting location, it is better to have the manufacturer refrain from drilling the sensing ports closest to the pipe wall. While this sacrifices some averaging capabilities, the effect on accuracy is far less than having sensing ports in the swirl zone. As the pipe gets larger and the sensing ports move farther away from the pipe wall, the effect of a large hole diminishes.

Too often, the hole size is ignored, especially when the fitting is welded to the pipe by a contractor working without installation instructions. A common mistake is burning out the hole to match the

inside diameter of the fitting. For example, a 1" FNPT 3000# threaded weld coupling actually has an inside diameter of 1-5/16" Burning out this hole instead of drilling the manufacturer's recommended 1" hole can introduce a significant error.

Simply specifying the connection size for the pitot tube is not enough. The specification sheet and submittal and certified drawings should identify the hole size as well. It's imperative that this information be passed to the relevant pipe fitters and subcontractors.

Another common error is overlooking the pipe schedule. For example, a 6" Sch 40 pipe has an inside diameter five percent greater than a 6" Sch 80 pipe. Not only would specifying the wrong schedule cause the averaging pitot tube's sensing ports to be positioned incorrectly in the pipe, there would be a flow rate error of 11% from the differences in flow area. For pipe sizes 12" and larger, the inside diameter of schedule standard pipe is different than Sch 40 pipe. Because Sch 40 and schedule standard are identical up to 12", it is commonly (and mistakenly) assumed that they are identical in larger lines. Verify pipe size and schedule before ordering the averaging pitot tube.



Hole size effect

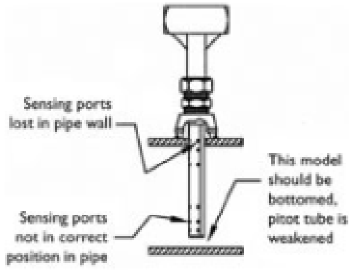
Fig 10.6

Threaded Connections

An averaging pitot tube mounted through a threaded connection should be bottomed firmly against the opposite wall of the pipe. This ensures the sensing ports are aligned properly in the flow stream and the pitot tube has structural support. **Figure 10.7** shows why an averaging pitot tube that is not bottomed against the opposite wall has sensing ports “lost” in the pipe wall.

In addition, an averaging pitot tube that merely is cantilevered in the flow stream is structurally weak. A cantilevered pitot tube withstands approximately one-half the velocity of a firmly bottomed pitot tube. The leading cause of pitot tube breakage is leaving it cantilevered in the flow stream. Some manufacturers offer a spring-lock mechanism to ensure the pitot tube is firmly bottomed.

Some pitot tubes have hardware to support its far end. Tack weld such hardware with the pitot tube in place before performing final welds.



Improper installation

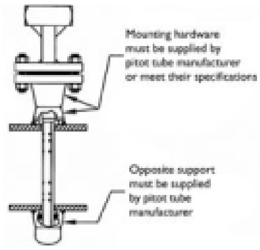
Fig 10.7

Flanged connections

Severe service applications, such as high-pressure steam and explosive gases, usually require flanged connections. Some companies, especially refineries and power plants, require flanged connections throughout, regardless of service.

Most averaging pitot tube manufacturers supply the necessary flanged mounting hardware with the instrument **(see Figure 10.8)**. This is desirable because the hardware height determines how the sensing ports align in the flow stream. Pitot tube manufacturers have set dimensions for 150#, 300# and 600# hardware and the pitot tube is located accordingly. For this reason, specify “mounting flange to be supplied by manufacturer.”

If the mounting flanges are provided by others or if the pitot tube is to be mounted through an existing flange, it’s important that the flange installation match the manufacturer’s installation instructions. For example, mounting a 7/8" pitot tube through an existing, unused 2" 150# flange results in loss of accuracy.



Flanged connection with opposite support

Fig 10.8

Another consideration when mounting a pitot tube to an existing flange is whether the flange bolt holes are properly aligned. Bolt holes should straddle the pipe centerline, an industry standard orientation **(see Figure 10.9)**.

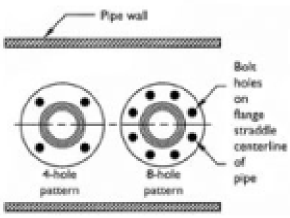
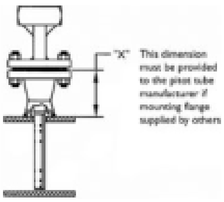


Figure 9. Bolt-hole patterns

Fig 10.9

The pitot tube flange locates off the bolt hole pattern to ensure it lines up properly in the flow stream. Provide the flange height dimension so the pitot tube can be manufactured according to the specific installation **(see Figure 10.10)**.

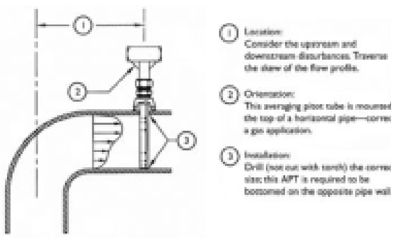


Customer supplied mounting flange

Fig 10.10

For certain applications, the sensor may be strong enough to be cantilevered rather than with the support hardware. The manufacturer determines the adequacy of the cantilever style based on the flow conditions.

Figure 10.11 summarizes the most important points of a good installation. If you follow the basics of location, orientation and installation, you can ensure accurate long-term performance.



Correct installation summary (side view)

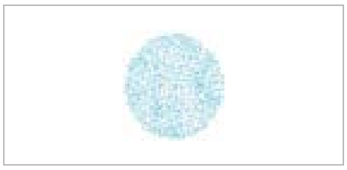
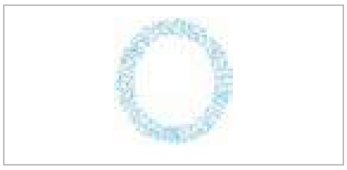
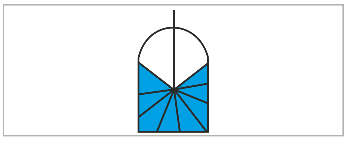
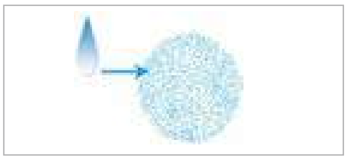
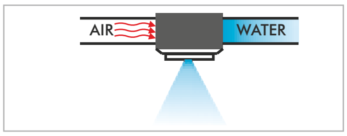
Fig 10.11

Technical comparison between averaging pitot tube with other direct acting / contact flow elements

Table 10.8

Item	Orifice assembly, manufactured by Spraytech	Averaging pitot tube manufactured by Spraytech	Flow nozzles, ventury	Aerofoil
Media service	conductive and non conductive with 15ppm at most solid particles	conductive and non but with 5ppm of solids atmost max	conductive and non conductive with 500ppm at most of solid particles	non conductive and conductive, gases and only liquids
Flow recovery coefficient	60-85% depending on accuracy of the beveling ad the free length available on Beta value	Strictly 90% flow recovery and independent of flow free length	strictly 70% but will depend on free length	60% flow recovery
Pressure recovery coefficient	75% pressure recovery co-efficient depending on bevelling	strictly 95% pressure recovery and is independent of free length	strictly 80% but will depend on free length	55 % flow recovery
Free length upstream and downstream	depends on beta value and varies between 7D to 44D in upstream and between 2D and 8D in the downstream	max 2D and 1D and that too for accuracy to be maintained at 0.1% and if not then no requirement of free length	depends on beta value and varies between 15D till 2D in upstream and 6D till 1D in downstream	15D upstream and 8D downstream
Accuracy	0.25% provided the free length is maintained, depending on beta value	0.1% at 2D and 1D free length forupstream an downstream or at 0.2% at no available free length	0.5% at the available free length	2% and is dependent on free length both up-stream and down stream
Repeatability	0.15%	0.05%	0.1%	1%
Hysterisis	0.1%	0.005%	0.1%	2%
Pressure loss for the device	10% to 60% of the input pr depending on requirements	strictly 0.1% to 5% at any conditions applicable	5% to 30% of the input pr depending on requirements	5% to 20% of the input pr depending on requirement
Size of manufacture	upto 64”	upto 132”	upto 104”	Upto 36”
Guaranteed cycles of operation	70,000	1,00,000	70,000	25,000
MTBF	10^5	10^8	10^6	10^2
Dynamic response test	most linear stable reading at upto 30 decibels reading and then at 0.25 fall at upto 100 decibels	most linear stable reading at upto 70decibels reading and then at 0.15 fall at upto 100 decibels	most linear stable reading at upto 40 decibels reading and then at 0.25 fall at upto 100 decibels	most linear stable reading at upto 40 decibels reading and then at 0.5 fall at upto 100 decibels
Conservation of energy	plant usage energy is limited to 17% to drive in beveled related flow elements	plant energy is limited to only 6% todrive averaging pitot tube, flow elements, since it has got 90% flow and pressure recovery coefficient	plant usage energy is limited to 20-22% to drive in beveled related flow elements	plant usage energy is limited to 20-22% to drive in beveled related flow elements
Differential pressure	average differential pressure, lowest possible is 100mmwc but applicable accuracy will be upto 2%, with 70% flow recovery	lowest possible with special holes designed at the input to keep the highest possible flow recovery coefficient and highest value of accuracy with vortices being averaged out at all flows thus maintaining min differential pressure even for sizes beyond 100”, lowest possible diff pressure is 1mmwc at 0.2% accuracy and 90% flow recovery	average differential pressure, lowest possible is 70mmwc but applicable accuracy will be upto 1.5%, with 80% flow recovery	average differential pressure, lowest possible is 90mmwc but applicable accuracy will be upto 2.5%, with 80% flow recovery
Applicability in thermal power sector	yes with available free length but for rating till 4000#	for steam water application and for rating till 2500#, since pressure recovery an flow recovery is very high, this helps in perfect application of flow measuring element and also in maintaining most economical cost solution for plant	yes with available free length but for rating till 4000#	yes with available free length but for rating till 4000#
Exclusive boiler application	yes	yes	yes	yes

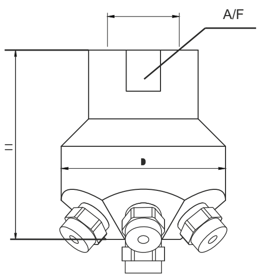
Spray Nozzle Selection Guide - by Application & Spray Pattern

Category of Nozzles	Applications	Spray Patterns
FLAT	Degreasing, Roll Cooling, Rinsing, High Pressure Cleaning,	
FULL CONE	Surface Spraying, Desuperheating, Washing & Cooling of flue gases, Scrubbing	
OIL BURNER SPRAY NOZZLE	LDO firing in kilns of cement, sponge, Iron plants & Dust suppression.	
HOLLOW CONE	Fugitive dust suppression, Scrubbing essentially small droplet size	
OIL BURNER SPRAY NOZZLE	LDO firing in kilns of cement, sponge, Iron plants & Dust suppression.	
TANK CLEANING	Cleaning of inside surface of barrels & tanks.	
FINE ATOMIZING NOZZLE	Gas cooling, conditioning or humidifying applications, for improving the chemical reaction by increased contact surface	
AIR ATOMIZING NOZZLE	Coating, Atomizing of viscous liquids, Gas cooling, conditioning or humidifying, Chemical process engineering.	

DH Series Multiple Full Cone Spray Nozzles

Multiple Full Cone Nozzles

The nozzle assembly consists of a nozzle body and seven removable atomizing spray caps. Each cap has an internal core which is easily removed for cleaning or replacement. The nozzle provides large flow capacities with relatively small drops.



Characteristic :

With the aid of multiple fine full cone nozzles it gives large full cone with small droplets.

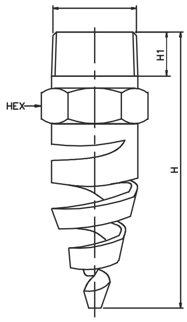
G	H	D	A/F
3/4"	44	60	55
1"	50	60	55
1/2"	65	90	85

Application :

- Gas Scrubbing
- Gas Cooling
- Dust Control
- Tank Rinsing
- Humidifying Applications

DF Series Spiral Full Cone Spray Nozzles

Characteristic : The absence of any internal parts make these nozzles non-clogging.
Design : One piece construction, non clogging type.
Application : Gas Washing, Cooling Towers , Fire Fighting Systems.
Flow Rate : 5 LPM TO 3410 LPM
Pressure : 2.0 Kg/cm² or Specified
Spray Angle : 60° To 180°
End Connection : 1/4” TO 4” BSP/BSPT /NPT
M.O.C. : SS. 316, 304, Brass, PVDF, PVC, PP, Teflon

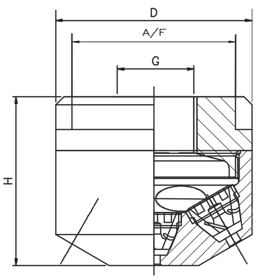


The helix spiral full cone nozzles combine small nozzle sizes with wide flow openings.

G	H	H1	HEX
1/4"	45	10	16 mm
3/8"	58	10	17 mm
1/2"	76	13.2	22 mm
3/4"	86	14.5	27 mm
1 "	108	16.8	36 mm

DG Series Multiple Full Cone Spray Nozzles

Multiple spray nozzles, consisting of seven finely atomizing hollow cone nozzles, provide a fog-like full cone pattern with relatively high flow volumes. The overlapping hollow cone nozzles produce a 130° full cone spray pattern of very fine droplets that cannot be achieved by a single orifice spray nozzle of the same flow rate size. The resulting increased droplet surface area of the atomized liquid provides greater efficiency in gas treatment and cooling application ideal for reaction towers which do not use packings.



Characteristic :
This type of nozzle gives fine atomization with the aid of several hollow cones spraying into one another.

Applications :

- Cooling Of Gaseous And Soild Material
- In Desuperheaters
- Chlorine Precipitation
- For Improving The Chemical Reaction By Means Of Enlarging the Contact Surface

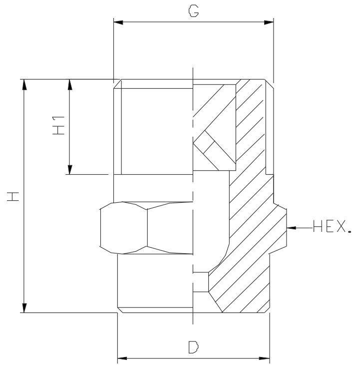
G	H	D	A/F
3/4"	46	75	65
1/2"	30	50	46

DA Series for Full Cone Spray Nozzles

D type spray nozzles offer a simple and efficient design full cone spray nozzle, that is a wide passage vane assembled into a male threaded body. For sizes up to flange connection the vane islocked in place which allow the nozzle to be fitted under any possible orientation without the risk of the vane falling out.

Application : Surface spraying, Washing & Cooling of flue gasses to remove fly ash , Cooling condenser, Scrubbing, Foam breaking.

M.O.C. : S.S. 316, 304, BRASS, PVC, PVDF, PP, Teflon

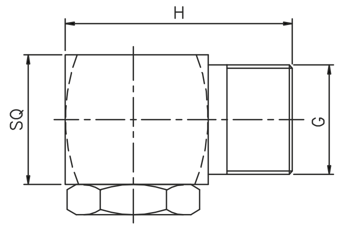


G	H	H1	D	HEX
⅛"	18	6.5	10.2	11 mm
¼"	22	10	13	14 mm
⅜"	25	10	16	17 mm
½"	32	13.2	21	22 mm
¾"	42	15	32	27 mm
1"	56	17	39	36 mm

BA Series Hollow Cone Spray Nozzles

Tangential Entry Hollow Cone Standard Angle Spray Nozzles (Non-Clogging) :

These hollow cone nozzles work on the tangential flow principle and are manufactured by machine tool operation from metal bar stock. This offers versatile construction of small sized nozzles. In addition nozzles can be made on request from any special materials and alloys that are available as a bar stock. This flow pattern is essentially a circular ring of liquid. Hollow cone nozzles are best for application requiring good atomization of liquids at lower pressures or where quick heat transfer is needed. These nozzles also feature large and unobstructed flow passage which provide a relatively high resistance to clogging.



There are Following types of hollow cone nozzles.

1) Tangential Entry
2) Inline (Axial) Entry
3) Spiral Hollowcone.

Characteristic : High resistance to clogging

Design : Vaneless (Two Piece Construction) Non clogging

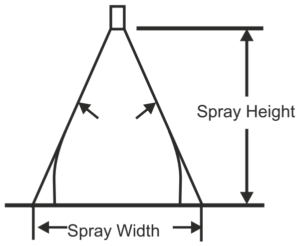
Application : Cooling & Washing of gas

G	H	Sq
¼"	35	20 mm
⅜"	35	20 mm
½"	45	25 mm
¾"	57	32 mm
⅛"	25.5	16 mm

Spray Coverage & Data Sheet

CAPACITY : All capacity tabulations given in this catalogue are based on water. The specific gravity affects its flow rate. The capacity must be multiplied by the given conversion factor for the specific gravity of the liquid sprayed.

Specific Gravity	0.84	0.96	1.00	1.08	1.20	1.32	1.44	1.5
Conversion Factor	1.09	1.02	1.00	0.96	0.91	0.87	0.83	0.82



$$Q_2 = Q_1 \sqrt{\frac{P_2}{P_1}}$$

Where Q = Flow rate
P = Pressure

Spray Coverage Table

This table lists the theoretical coverage of spray patterns as calculated from the included spray angle of the spray and the distance from the nozzle orifice. These values are based on the assumption that the spray angle remains same throughout entire spray distance. In actual practice, the tabulated spray angle does not hold for long spray distance.

Theoretical spray Width (in mm) at various height from nozzle tip												
Spray Angle	50	100	150	200	250	300	400	500	600	700	800	1000
5°	4	9	13	18	22	26	35	44	52	61	70	87
10°	9	18	26	35	44	53	70	88	105	123	140	175
15°	13	26	40	53	66	79	105	132	158	184	211	263
20°	18	35	53	71	88	106	141	176	212	247	282	353
25°	22	44	67	89	111	133	177	222	266	310	355	443
30°	27	54	80	107	134	161	214	268	322	375	429	536
35°	32	63	95	126	158	189	252	315	378	441	505	631
40°	36	73	109	146	182	218	291	364	337	510	582	728
45°	41	83	124	166	207	249	331	414	497	580	663	828
50°	47	93	140	187	233	280	373	466	560	653	746	933
55°	52	104	140	208	260	312	417	521	625	729	833	1040
60°	58	116	173	231	289	346	462	577	693	808	924	1150
65°	64	127	191	255	319	382	510	637	765	892	1020	1270
70°	70	140	210	280	350	420	560	700	840	980	1120	1400
75°	77	154	230	307	384	460	614	767	921	1070	1230	1530
80°	84	168	252	336	420	504	671	839	1010	1180	1340	1680
85°	92	183	275	367	458	550	733	916	1100	1280	1470	1830
90°	100	200	300	400	500	600	800	1000	1200	1400	1600	2000
95°	109	218	327	437	546	655	873	1090	1310	1530	1750	2180
100°	119	238	358	477	596	715	953	1190	1430	1670	1910	2380
110°	143	286	429	571	714	857	1140	1430	1710	2000	2290	2860
120°	173	346	520	693	866	1040	1390	1730	2080	2430		
130°	215	429	643	558	1070	1290	1720	2150	2570			

Unit	bar	Pascal [Pa]=N/m²	kg/cm² = 1 at	psi	lb/sq.ft.
1 bar	1	100000	1.02	14.5	2089
	-5		-5	-5	
1 Pascal	1x10	1	1.02x10	14.5x10	0.0209
1 at					
kg/cm²	0.9807	98070	1	14.22	2048
1 Psi	0.06895	6895	0.07031	1	144
	-3		-3	-3	
1lb/sq.ft.	0.479x10	47.9	0.4882x10	6.94x10	1

Unit	l/s	l/min	m³/hr	Us-gal/min	Imp-gal/min
1 l/s	1	60	3.6	15.85	13.2
1 l/min	0.01667	1	0.06	0.2642	0.22
1 m³/hr	0.28	16.67	1	4.4	3.66
1 Us-gal/min	0.0631	3.785	0.227	1	0.8327
1 Imp-gal/min	0.076	4.546	0.273	1.201	1

Service Life

The service life of nozzle is dependent on various circumstances such as spray application, service conditions, the quality of the liquid to be sprayed. According to the material used, service life of nozzles can considerably differ. This short survey gives you an idea about proper nozzle selection.

Spray Headers Fabrication

We are manufacturing **"SPRAY HEADERS"** as per **Indian, British, German, & US Standard** for various applications. Spray Headers that accommodate different types of Nozzles and ensure perfect overlapping spray patterns or non-overlapping spray patterns for applications where uniform coverage is critical.

We Design, Engineer & Manufacture complete **Roll Coolant Systems** including Headers, Spray Pipes ; also Laminar Spray Headers for Hot Strip Mill, Spray Pipes for Mould & Caster segment of Integrated Steel Plants, Lance with & with out Spill Back Type system for Sponge Iron Plants.

Spray Lance Fabrication

Special Purpose Spray Nozzle

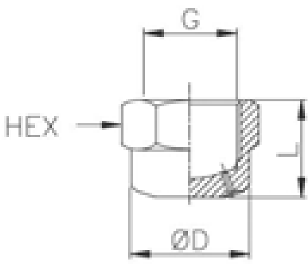
Max Flow Spray Nozzle

Application example :

Gas Cooling in medium sized and large Gas Cooling Towers, e.g. in the Cement, Lime, Glass and Iron & Steel Industry

Technical data :

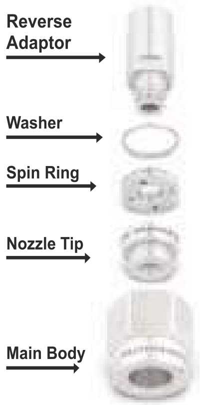
Spray Angle: 90°, 60°, 45°
Turn down ratio: ≥ 10 : 1
Typical operating pressure: 35 bar (g)



Nozzle Conn. (G)	D	L	Hex
3/4"	31.5	25.4	32
1"	40.5	29.4	41
1-1/4"	45.5	31	46

M.O.C. : S.S.304, S.S.316, Brass, PVC, etc.

Spillback Spray Nozzle



Atomize liquids as a fine hollow cone Irrespective of the atomized flow rate, the medium is always carried to the nozzles at the same high pressure.

Regulation is performed by opening a control valve in the Reverse Flow Nozzle line which takes a partial flow rate from the atomization and carries it back to the tank. The maximum atomized flow rate is achieved with the control valve closed. Even, fine liquid atomization is achieved across the entire control range.

Fog Spray Nozzle

Design Features : This non clogging nozzle gives fine atomization with the aid of several flat spraying into one another.

Applications : Fire Protection, Dust Control, Aerating, \Chemical Processing.

Nozzle Inlet Conn. NPT/BSP T/ BSPP	Hose Size	Nozzle Type		Capacity					
		Spray Angle	Conn. Female	1 bar	2 bar	3 bar	5 bar	7 bar	10 bar
3/4"	1"	70°/ 90°	✓	11	16	19.5	25.5	30	36
3/4"	1"	70°/ 90°	✓	21.5	30	36.5	47	56	67
3/4"	1"	70°/ 90°	✓	28	40	49	63	75	89.5
3/4"	1"	70°/ 90°	✓	42.5	60	73.5	95	112	134
1"	1-1/4"	70°/ 90°	✓	57	80	98	126.5	150	179
1"	1-1/4"	70°/ 90°	✓	79	112	137	177	209	250.5
1-1/4"	1-1/2"	70°/ 90°	✓	113	160	196	253	299.5	358
1-1/4"	2"	70°/ 90°	✓	159.5	225	275.5	356	421	503

Dry Fog Spray Nozzle

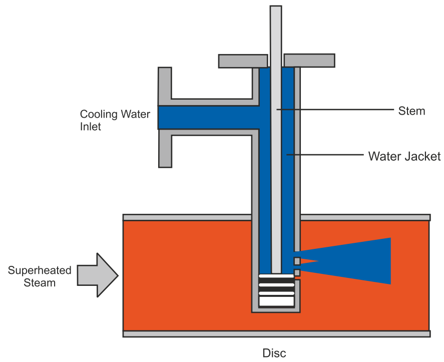
Nozzle For Humidification -
Nozzle Flow Charts at Nominal Settings

Water Flow Litres / hour	Water Pressure Bar	Air Pressure Bar	Air Rate Litres / sec (cfm)	Droplet Size Range micron
Nozzle size 03 5H	**0.4-8 lts/hr**			
3	1.0	4.0	0.8 (1.7)	1 to 5
Nozzle size 05 2H	**1-20 lts/hr**			
8	1.0	5.0	1.84 (3.9)	3 to 8
Nozzle size 08 6H	**2-26 lts/hr**			
20	1.0	5.0	5.19 (11.0)	5 to 20
Nozzle Size 12 5H	**4-55 lts/hr**			
40	1.0	5.0	7.08 (15.0)	25 to 65
Nozzle size ST52	**1-20 lts/hr**			
8	1.0	5.0	1.84 (3.9)	3 to 10
Nozzle size ST47	**2-30 lts/hr**			
18	1.0	5.0	5.19 (11.0)	5 to 20
Nozzle size ST33	**8-55 lts/hr**			
40	1.0	5.0	7.08 (15.0)	25 to 65

Desuperheaters

Desuperheating, sometimes called attemperation or steam conditioning, is the reduction of gas temperature. Its most common application is the reduction of temperature in a steam line through the direct contact and vaporation of water. Desuperheaters use uniquely effective methods to inject the water and maximize the surface contact area between the steam and water to increase the rate of water evaporation. Most of our Desuperheaters inject water through several small holes into the path of the high velocity steam where the water is atomized into small water droplets and quickly evaporated into the steam.

The simple spray type Desuperheater is used in applications where the steam load remains relatively constant. Cooling water is injected into the superheated steam through a nozzle. The steam temperature is reduced by evaporative cooling. The maximum turndown ratio of the spray type Desuperheaters is 2:1. **Air atomizing type Spray Nozzles** & **Hollow Cone type Spray Nozzles** are a good option for Spray type Desuperheaters.

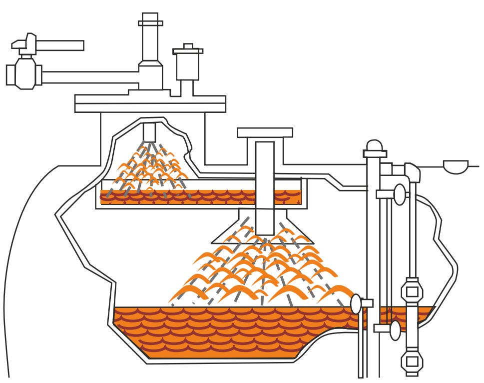


Deaerator

Deaeration is a process by which dissolved gases are removed from water. Since proper deaeration of boiler feed water is essential to minimise oxygen corrosion and carbon dioxide attack, almost every boiler plant uses deaerating systems. Nowadays modern deaerating systems can be designed to obtain a residual oxygen content as low as 0.005 ml/liter.

Spray type Deaerators are simple, cost effective and virtually maintenance free systems that can operate under variable loads without significant impact on heating or deaerating performances. For the above reasons, this kind of Deaerator is widely used for industrial applications. Spray Deaerators do not require corrosion resistant materials because all the water in contact with the shell is sufficiently deaerated and non-corrosive at the operating conditions.

Full Cone and Spiral Full Cone series of Spraytech Nozzles can be used for this purpose.



Engineering - Strainers & Filters - Spray Systems

Our Product Range

FILTERS

- Simplex Basket Filters
- Duplex Basket Filters
- Self Cleaning Filters
- Sand Filters
- Lube Oil Filters
- Compressed Air Filters
- Air Filters - Panel type
- Bag Filters

STRAINERS

- Strainers 'Y','T', 'Conical'

SEPARATERS

- Cartridge Filters
- Mobile Cleaning Devices
- Travelling Water screens
- Belt Filters

(Spares for all Above)

VALVES

- Fabricated Gate Valves
- Slide Valves
- Butterfly Valves
- Repairs/Servicing of
- any cast Valves
- Gate/Globe/Check/Ball/
- Butterfly/Plug Etc.

Simplex Basket Filters

1) **Fabricated design with MOC in**
A 106 / A53 / ISI304 / 316 / 304L / 316L / A312 TP 304 / 316 / 304L / 316L / A240 T 304 etc. Nonferrous like Monel etc

2) **Cast Design**
A216 Gr. WCB / A351 Gr. CF8[M]
A217 Gr. C5 / WC6 / WC9 / A352 LCB etc

Technical Data on Request

Duplex Basket Filters

1) Sizes up to 6", 8", 10", 12" in Ball Valve design common lever, change over

2) 6", 8", 10", 12" and above in
   a] Transfer Valve design
   b] Butterfly Valve design
   c] Header design fabricated / cast, and operation by pneumatic / electrical actuator, used where down time is unavailable.

Technical Data on Request

"T" strainers

"Y" Strainers

1) 'Y' type cast / fabricated / forged
2) 'T' type cast / fabricated
3) 'Conical / temprary, fabricated MOC in
   CS/SS/alloy steel / non-ferrous,
   CSRL for housings and Ss304 / 316 /
   304L / 316L/ Monel / PP / Brass for elements.

Technical Data on Request

Spraytech Systems Flow Nozzle is used in typically high-velocity, non-viscous, erosive flow. They are suitable for determining the flow rates of fluids at high temperature and high pressure.

Spraytech Systems 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. Also we have an IBR approval for our manufacturing unit hence we can provide IBR form IIIC certificate for flow nozzles.

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 ($0.25 < \beta < 0.5$), with throat tap
- ASME long radius, high beta ratio ($0.25 < \beta < 0.8$), 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 nozzles 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.

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

HOLDING RING TYPE FLOW NOZZLE

These types of nozzles are 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 FLOW NOZZLE

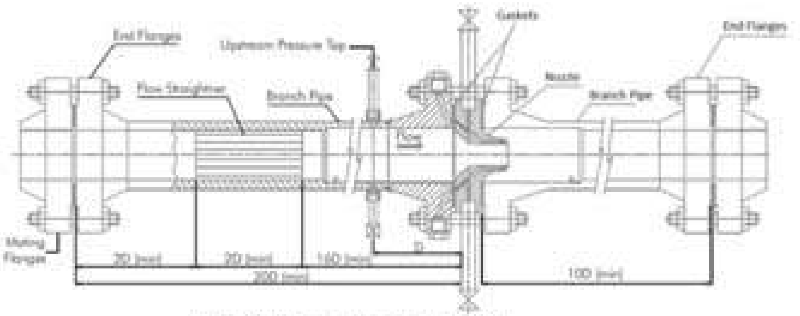
These types of nozzles are the most commonly used for insertion between pipe flanges. This type of nozzle is designed for pipe wall taps whose locations are determined by Beta ratio and pipe.

WELD-IN TYPE FLOW NOZZLE

This type of nozzle has a machined tongue around its greatest diameter designed to fit between bevelled 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.

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.These types of nozzles are manufactured in strict accordance with ASME performance test code PTC-6.



Flow Nozzle Assembly as per ASME PTC-6

Spraytech® Systems (India) Pvt. Ltd.
The Flow Technologists

Flow Calibration Test Bench for Flow Elements and Control Valves

Flow Calibration bench for Orifice and Valves:

Spraytech Systems enters into a new age of flow calibration bench. The unit is now ready for:

Table 13.1

Flow Calibration	Orifice assembly upto 12"	Upto 8" from beta value 0.15 till 0.9 and 10" and 12" till beta 0.15 to beta = 0.5	Accuracy, max upto 0.5%	Hysteresis is max upto 0.2%	Repeatability = 0.25%	For 10" and 12" for beta = 0.55 till 0.8, the accuracy shall be max upto 1.5%	Standard being followed is under ISO 5167 and IEC 60534-2, also confirming to the basic BS code 1042	Conditions applicable for volumetric designing and provisions under gravimetric conditions available on demand
Flow Calibration	Valves with size upto 12"	For kv value equal to 1440 m3/hr	Accuracy, max upto 0.5%	Hysteresis is max upto 0.2%	Repeatability = 0.25%	No restrictions till 12" size	Under strictly to IEC 60534-2	Strictly to volumetric conditions as per required IEC 60534-2

The orifice assembly or the flow control element, valve, is calibrated under fluid mechanics standards of ISO 5167 and IEC 60534 standards. The process and the procedure of the measuring flow calibration of the device and the design is as per the international standards applicable for volumetric and gravimetric conditions

The flow calibration bench for upto 12" size, is applicable for pressure rating upto 3 kg /cmg ^{2} and for all ambient conditions. The testing media is water. The calibration unit is under free length or straight length as per the ISO standards for mounting in such conditions applicable for orifice assemblies with water as media and with calculated beta value to decide the free length for calibration of sensors. For valves, the condition is kept at ambient conditions with water and based on IEC 60534 standard the flow coefficient value of the valve is matched with desired flow rate applicable under differential pressure conditions, under applicable and available free or straight lengths

The bench gets the water from an underground tank with an overall capacity of (7500mmX1500mmX2000mm)…m3 which is having a magnetic level gauge mounted to check the level of water. The level in turn helps to clear the pressure applicable under the centrifugal pump which is mounted to the side to generate the desired and the requisite pressure for the flow assembly, either valve or orifice.

The differential pressure in the assembly is created by either manually adjusting the input pressure, with adjustable valves at the input line to the device for calibration or by pneumatically adjusting the variations thru control pneumatic actuators adjusting to set points .

The differential pressure is maintained and fixed for the assembly under measurement, by adjusting the downstream valve and is adjusted at

Table 13.2

Adjustment of pressure at downstream of assembly	Differential pressure at the assembly maintained
2.5 kg/cm ^{2}(g)	5000mmwc
2.55 kg/cm ^{2}(g)	4500mmwc
2.6 kg/cm ^{2}(g)	4000mmwc
2.65 kg/cm ^{2}(g)	3500mmwc
2.7 kg/cm ^{2}(g)	3000mmwc
2.75 kg/cm ^{2}(g)	2500mmwc
2.8 kg/cm ^{2}(g)	2000mmwc
2.85 kg/cm ^{2}(g)	1500mmwc
2.9 kg/cm ^{2}(g)	1000mmwc
2.95 kg/cm ^{2}(g)	500mmwc

Flow Calibration Test Bench for Flow Elements and Control Valves

The bench is marked with calibrated pressure gauges and differential pressure gauges to note the readings.

The assembly is further connected to noting the flow readings through a magnetic flow meter which is noted upto the range of 8000LPM of flow. The reading in magnetic flow meter which works at 230 VAC supply and the magnetic field is generated on passing of water and thus recording the flow rate in the LCD assembly. The magnetic flow meter is further able to transmit 4 top 20 mA signal to a recorder which records the differential pressure reading and the flow reading and is able to generated the all important flow versus DP curve to indicate the calibration result. The differential pressure reading transmitted is done by HART protocol out put to the recorder which also as the input of the magnetic flow meter.

The process is first done and completed by inserting the calibration of an assembly as follows:

Calibration of orifice assembly

Plate OD in mm	Plate bore in mm	Media	Media pressure in bar g	Media temperature in deg cent	Beta value practical reading	Free length recorded upstream in mm	Free length recorded downstream in mm	Pressure reading in upstream in bar g	Pressure reading in downstream in bar g	Flow reading noted in LPM in magnetic flow meter	DP reading in mmwc noted in DP gauge/ Transmitter	Calculated C value on noting the reading	Calculated C value via ISO 5167 method of calculation with actual parametric values of application

Calibration of valve assembly

Valve size	Valve seat bore in mm	Valve opening defined at 20%, 40%, 60%, 80% and at 100%	Valve Kv value	Differential pressure recorded in mmwc	Pressure in upstream of valve in bar g	Pressure in downstream of valve in bar g	Flow reading noted in LPM in magnetic flow meter	DP reading in mmwc noted in DP gauge / Transmitter	Calculated Kv value on noting the reading	Calculated Kv value via the IEC 60534 std with actual parameter of the assembly

The calibration of the valve is done based on the same method as explained above, Here the orifice assembly in the above method is replaced with the valve. Here one change is that there is no free lengths required.

The valve is operated at 20%, 40%, 60%, 80% and at 100% by either

Table 13.3

Type	By which the openings can be had
Hand operated valves	Manually adjusting the handwheel
Pneumatically operated valves	By adjusting the compressor air to the valve actuator and by noting the desired spring range in the actuator
Electrically operated valves	By having 3 phase or single phase connection to the actuator and here it is only done at 100% as the operations for electrical actuator is only with and for on - off conditions
Hydraulically operated valves	By having 3 phase or single phase connection to the actuator, the intermediate levels are possible when switching off the supply at the desired opening levels

The calculation of the Kv value for valve as per IEC 60534 standard is done by the following way

Table 13.4

Medium	Liquids in m^3/hr	Liquids in kg/hr	Gasses in m^3/hr	Gasses in kg/hr	Steam in kg/hr
Pressure drop					
P2>(P1/2)	Kv=Q(SQRT (ρ/1000*Dp))	Kv=(W/(SQRT (1000*ρ*Dp))	Kv=(Qg/519)* (SQRT((pg*T1)/ (dp*P2))	Kv=(W/519)* (SQRT((T1)/ (dp*P2*pg))	Kv=(W/31.62)* (SQRT((V2/Dp))
Dp<(P1/2)	Kv=Q(SQRT (ρ/1000*Dp))	Kv=(W/(SQRT (1000*ρ*Dp))	Kv=(Qg/519)* (SQRT((pg*T1)/ (dp*P2))	Kv=(W/519)* (SQRT((T1)/ (dp*P2*pg))	Kv=(W/31.62)* (SQRT((V2/Dp))
P2<(P1/2)	Kv=Q(SQRT (ρ /1000*Dp))	Kv=(W/(SQRT (1000*ρ *Dp))	Kv=(Qg/259.5* P1)*(SQRT(pg*T1))	Kv=(W/259.5* P1)*(SQRT (T1/pg))	Kv=(W/31.62)* (SQRT((2V*/P1))
Dp>(P1/2)	Kv=Q(SQRT (ρ /1000*Dp))	Kv=(W/(SQRT (1000*ρ *Dp))	Kv=(Qg/259.5* P1)*(SQRT(pg*T1))	Kv=(W/259.5* P1)*(SQRT(T1/pg))	Kv=(W/31.62)* (SQRT((2V*/P1))

Where :

P1 Inlet pressure in bar
P2 Outlet pressure in bar
Dp Differential pressure in bar
T1 Deg Kelvin = 273 + t1, where t1 = deg cent
Qg m3/hr flow rate for gasses at 0 deg cent and at 1013mbar
ρ Density of liquids in kg/m^3
Pg Density of gasses at zero deg cent and at 1013mbar, in kg/m3

V1 In m^3/kg, specific volume for P1 and t1, for steam application only
V2 m^3/kg, specific volume for P2 and t2, for steam application only
V* m3/kg, specific volume for P1/2 and t1
Kv Flow coefficient in m^3/hr
Q Flow rate in m^3/hr
W Flow rate in Kg/hr
SQRT Square root

The calculation of the C value for orifice plate is as per IS 2952 part II and in ISO 5167, standard is done by the following way

Qm=((C/(SQRT(1- Beta^4))* 3.14*d$^{2/4}$ * Fa*Y (SQRT(2 Dp*q)))

Where
Qm Flow rate in kg/sec
C Discharge coefficient
Fa Area factor for thermal expansion of coefficient
Beta Diameter ratio
Y Expansibility factor
d Diameter of bore of orifice
Dp Pressure differential in N/m^2
q Density of fluid I kg/m^3

here Y = 1 when media is incompressibile like water

also Reynold number is calculated as

Rd= 4 Qm / 3.14*D *mue

Where
mue Dynamic viscocity of the fluid in kg/m-sec
D Diameter of pipe in metre

Spraytech®
Systems (India) Pvt. Ltd.
The Flow Technologists

Venturi Tubes

Spraytech Systems 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, vapour, 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 high pressure taps are located on the middle of inlet 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 annular slot to give an average pressure.

Salient features & benefits

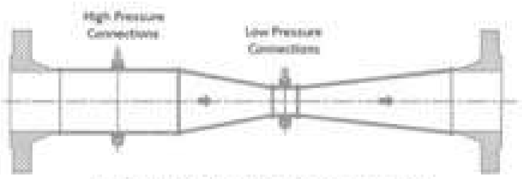
- Can be used on slurries and dirty fluids
- Short upstream piping required
- Low installation costs
- Lower susceptibility to erosion
- Low permanent pressure loss
- Extended product life with no moving parts
- Vertical or horizontal installation

Up to 12 inches, the entire venture is machined from a single solid bar-stock. Above 12 inches the venture is fabricated from sheet. Rectangular type venturi used in ductwork are also fabricated from sheet.

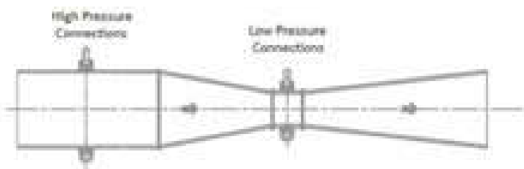
Many times the piping geometry does not allow full length of the Venturi Tube. In such case, 'Truncated' classical Venturi Tube can be offered wherein the divergent section can be truncated down by about 35% of its length without modifying the divergent angle. The outer diameter of the divergent section 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.

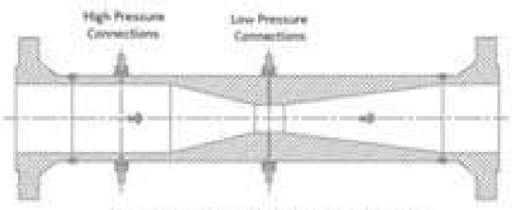
Spraytech Systems Venturi Tubes serve users with accurate measurement of non-viscous fluids in clean & dirty streams. Venturi Tubes are virtually maintenance-free and corrosion-resistant. Venturi tubes are manufactured in strict accordance with ASME MFC-3M, BS-1042 and ISO-5167 standards. There measurement standards provide users with +/- 1.0% uncertainty of discharge coefficient. For critical measurement applications 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.



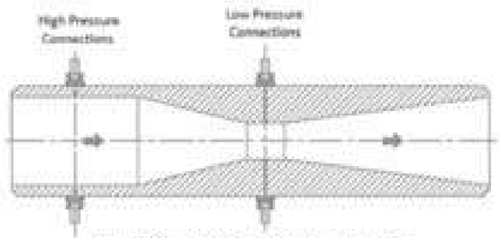
Fabricated with Flanged ends



Fabricated with Weld ends



Machined with Flanged ends



Machined with Beveled ends

Spraytech® Systems (India) Pvt. Ltd.
The Flow Technologists

Globe Control Valves

Spraytech Systems have gone ahead with its endeavor of optimizing in process control instruments, in adding control elements in its range of manufacture. We at Spraytech Systems have globe control valves till 6" and upto 600#RF for applications from minus 196 deg cent till 550 deg cent .

Applications in flow element control lead to control of flow through a globe control valve affecting control of flow, pressure and temperature thus a playing a vide role in the control element of the plant, used in either

- Isolation of plants
- In field of linear level and temperature control
- In field of fasting acting parameter of pressure and differential pressure and flow control through PID controllers

Spraytech Systems 4" 300# Globe Control Valve

Spraytech System's Globe valve provides a flow rangeability of 50:1 and carries the effect in controlling cavitation, flashing and the choking concept of the media. With its level of control the affect of start up conditions of the plant where shearing off the internal closing member in form of plug and seat of the trim section take place, Spraytech Systems own high density flow control plug which carries the special design to take care of all such critical start up and cavitation effect of the media help you solve a major cost effectiveness and reduce your major man hour usage and maintenance cost of the plan.

Following are the main features of Spraytech Systems Globe control valve

- The energy conservation of the plant
- High flow control rangeability
- High flow recovery and controllability factor
- Low maintenance driven design
- Usage from minus 196 deg cent till plus 550 deg cent application
- High density valve sealing gasket design for high and low temperature
- Used for special chemical sealing design concept in plant for all critical applications
- Modular concept thus introducing major plant design concept feasibility with reduce cost of manpower, maintenance
- Highly efficient build up design

Spraytech Systems Flow control effectively uses the closing member of plug falling or closing in on seat of the trim section of the valve and thus with its contour of

- Linear
- Modified equal percentage
- Equal percentage
- Quick opening

Enables a perfect control of the media effectively to the tune of desired level as per your requirements. Spraytech Systems Manufactures pneumatic actuator with multiple springs and a rolling diaphragm which helps in

- Linear hysteresis of control
- High life cycle of the diaphragm
- Less tension on spring and diaphragm
- Most linear travel record of plug movement

Specifications of Spraytech Systems globe control valve

Table 15.1

Material of construction for body	Carbon steel, stainless steel, SS316, SS304, SS304L, SS316L, PTFE lined valves, PP
Size	½", 1", 1 1/2", 2", 2 1/2", 3", 4" and 6"
Rating of valve	150#,300#, 600# and as per DIN std PN10, PN16, PN25, PN40
Pressure rating	From full vaccum till plus 52 bar g till 300#
Temperature rating	Minus 196 till plus 550 deg cent
Material of construction for trim	SS316, SS410, SS316L, PP, PTFE, Monel, Hastealloy
Design	Globe
Plug	V skirted anti cavitation trim, parabolic plug, balanced plug
Seat	Screwed in seat, welded seat
Bonnet	Square bonnet, yoke bonnet design, extended bonnet design
Extension bonnet	Forged construction bonnet design depending on small and large extension bonnet depending on temperature and pressure rating
Bellows sealing bonnet	With multifunction bellows sealing for critical application applicable from minus 196 till plus 550 deg cent
Sealing gland packing	PTFE sealing V ring packing versions and Graphite sealing version available, 3ring, 5 ring, 7 ring sealing rings for maximum sealing versions available for rating till $10^{(-6)}$ mbarltr / sec
Body bonnet sealing ring	SS316 impregnated graphite and PTFE sealing available, depending on applications
Plug and seat leakage class sealing	Class III, class IV, class V, class VI sealing tightness is available
Leakage class for trim	Is achieved by metal / metal version with special design plug, with special design PTFE soft seal for low temp and upto 120 deg cent and for temperature above Titanium sealing for class VI is achieved, also available is leakage class V with high performance sealing with special hand grinding, lapping method, desired for high temperature application
Guide bushing MOC	SS410, SS316L, SS316 stellited
Actuator	Multispring actuator, with rolling diaphragm concept, with MS actuator cover with anticorossion powder coated
Actuator diaphragm	Nitrile Butyl Rubber, Ethylene Propylene Dimonomer
Valve end connection	Screwed, NPT or BSP connections, but welded, socket welded, flanged end connections both ANSI and DIN std
Heating jacket and cooling jacket	Available for all sizes as applicable till 300#X 600#, jacketing for valve body and bonnet design
Base construction design	Forgings and castings
Special test versions	NACE, Radiography level -1, 2, 3 std available, helium leak tested version till $10^{(-6)}$ mbarltr/sec
Trim hardening versions	All hardening versions with stelliting version available

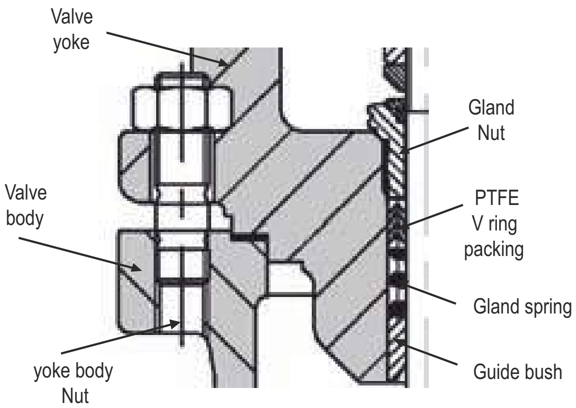
The process medium flows through the valve in the direction indicated by the arrow. The position of the valve plug determines the cross-sectional area of flow between the seat and plug.

Depending on how the compression springs are arranged in the actuator the control valve has two different fail-safe positions that become effective

when the supply air fails:

Actuator stem extends (FA): The actuator springs close the valve when the supply air fails.

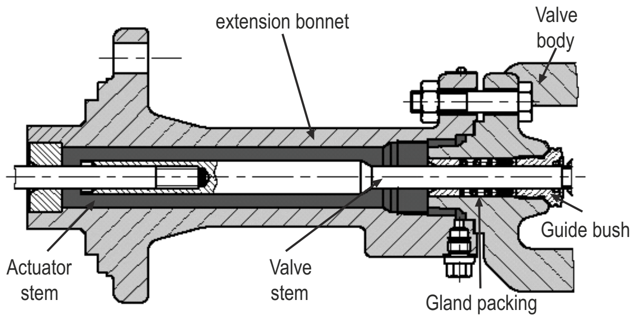
Actuator stem retracts (FE): The actuator springs open the valve when the supply air fails.



The Gland Sealing

Fig. 15.1

Spraytech Systems in process automation in the chemical, petrochemical, power and refinery industry have developed designs to suit the most such critical applications. The resulting products define the industry standard in many applications.



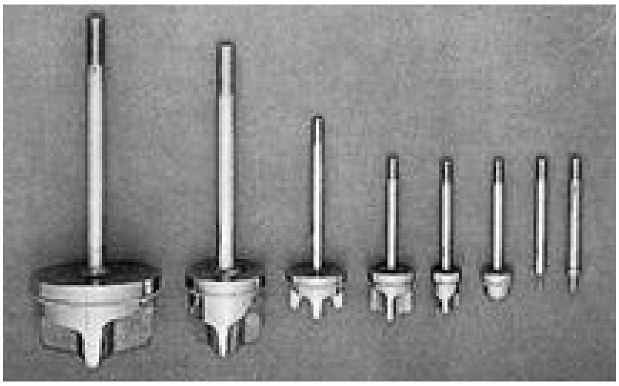
Extension Bonnet For Cryogenic Application And High Temperature Application

Fig. 15.2

Application

As a main manufacturer of process Instruments, we provide a comprehensive product range for all chemical processes from light and heavy-duty valves in modular design made of all common materials and exotic alloys according to DIN, ANSI to high-pressure valves complying with important company standards. Forged bodies, live-loaded packings, metal bellows, pressure-balanced plugs, heating jackets as well as corrosion-resistant, low-noise and low-wear valve trims are included in our product portfolio for this field.

We also provide solutions for highly specialized tasks, such as cryogenic applications, aseptic processes and tank blanketing.



High profile plugs with v skirt for low noise control and high controllability

Spraytech Systems high definition actuator selection criteria:

Table 15.2

Actuator model	SCT1				
	SCT11	SCT12	SCT13		
Actuator, actuation torque kN	0.48	0.96	1.44		
Travel in mm	17	17	17		
Air supply in kg/cm^2g	1.4	2.4	3.2		
Shut off pr in kg/cm^2g	15	24	33		
Actuator model	SCT2				
	SCT21	SCT22	SCT23	SCT24	SCT25
Actuator actuation torque kN	0.7	1.4	2.1	4.9	7.35

Travel	17	17	17	17	17
Air supply in kg/cm^2g	1.4	2.4	3.2	2.5	3.5
Shut off pr in kg/cm^2g	20	31	42	48	55
Actuator model	SCT3				
	SCT31	SCT32	SCT33	SCT34	SCT35
Actuator actuation torque kN	1.4	2.8	4.2	9.8	14.7
Travel	17	17	17	34	34
Air supply in kg/cm^2g	1.4	2.4	3.2	2.5	3.5
Shutoff pr in kg/cm^2g	26	39	50	60	70

Spraytech Systems Globe control valves and its complete engineering application available design

Table 15.3

Sizes	½"	¾"	1"	1½"	2"	2½"	3"	4"	6"
Available kv value in m3/hr (flow coefficient value)	0.1, 0.16, 0.25, 0.4, 0.63, 1, 1.6,2.5, 4	0.1, 0.16, 0.25, 0.4, 0.63, 1, 1.6, 2.5, 4, 6.3	0.1, 0.16, 0.25, 0.4, 0.63, 1, 1.6, 2.5, 4, 6.3, 10	0.1, 0.16, 0.25, 0.4, 0.63, 1, 1.6, 2.5, 4, 6.3, 10, 16, 25	0.1, 0.16, 0.25, 0.4, 0.63, 1, 1.6, 2.5, 4, 6.3, 10, 16, 25, 35, 40	0.1, 0.16, 0.25, 0.4, 0.63, 1, 1.6, 2.5, 4, 6.3, 10, 16, 25, 35, 40	0.1, 0.16, 0.25, 0.4, 0.63, 1, 1.6, 2.5, 4, 6.3,10,16, 25, 35, 40, 63, 80	63, 80,100, 160	63,80,100, 160, 260, 360
Pressure rating available Temperature rating available	Full vaccum till plus 52 bar g minus 196 till 550 deg cent	Full vaccum till plus 52 bar g minus 196 till 550 deg cent	Full vaccum till plus 52 bar g minus 196 till 550 deg cent	Full vaccum till plus 52 bar g minus 196 till 550 deg cent	Full vaccum till plus 52 bar g minus 196 till 550 deg cent	Full vaccum till plus 52 bar g minus 196 till 550 deg cent	Full vaccum till plus 52 bar g minus 196 till 550 deg cent	Full vaccum till plus 52 bar g minus 196 till 550 deg cent	Full vaccum till plus 52 bar g minus 196 till 550 deg cent
Valve stem travel in mm	17	17	17	17	17	17	17,34	34	34
Flow range ability	50:1	50:1	50:1	50:1	50:1	50:1	50:1	50:1	50:1
Extension bonnet design available version	Both short and long extension version	Both short and long extension version	Both short and long extension version	Both short and long extension version	Both short and long extension version	Both short and long extension version	Both short and long extension version	Both short and long extension version	Both short and long extension
Max pr shut off for actuator available based on 150# rating	22 bar	22 bar	22 bar	22 bar	22 bar	22 bar	22 bar	22 bar	22 bar
Max pressure shut off for actuator available based on 300# rating	50 bar	50 bar	50 bar	50 bar	50 bar	50 bar	50 bar till lower kv value and 30 bar from kv value from kv 63	30 bar	30 bar
Face to face as per 150#	184mm	188mm	193mm	225mm	260mm	280mm	312mm	360mm	465mm
Face to face as per 300#	190mm	194mm	197mm	240mm	272mm	295mm	330mm	385mm	485mm
Actuator phase with available air supply controlling the max shut off pressure, depending on design of Kv	SCT-1, SCT-2, SCT3 with air supply of 1.2 till 4 bar and pressure shut off till 52 bar	SCT-1, SCT-2, SCT3 with air supply of 1.2 till 4 bar and pressure shut off till 52 bar	SCT-1, SCT-2, SCT3 with air supply of 1.2 till 4 bar and pressure shut off till 52 bar	SCT-1, SCT-2, SCT3 with air supply of 1.2 till 4 bar and pressure shut off till 52 bar	SCT-1, SCT-2, SCT3 with air supply of 1.2 till 4 bar and pressure shut off till 52 bar	SCT-1, SCT-2, SCT3, SCT 4 with air supply of 1.2 till 4 bar and pressure shut off till	SCT-1, SCT-2, SCT3, SCT-4 with air supply of 1.2 till 4 bar and pressure shut off till 40 bar 52 bar	SCT3, SCT4 with air supply of 1.2 till 4 bar and pressure shut off till 40 bar	SCT3, SCT4 with air supply of 1.2 till 4 bar and pressure shut off till 40 bar

Spraytech Systems actuator model versus Kv value and the shut off pressure, applicable for seat leakage class IV and class VI

Table 15.4

Kv value in m3/hr	0.1	0.16	0.25	0.4	0.63	1	1.6	2.5	4	6.3	10	16	25	35	40	63	80	160	260	360
Actuator model applicable	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT2, SCT3, SCT1	SCT3,	SCT3,	SCT4, SCT3,
Seat bore in mm	2	3	3	5	5	8	8	8	10	12	24	26	38	46	50	65	80	100	125	150
Valve stem dia in mm	3	3	3	3	3	6	6	6	6	10	10	10	10	10	10	12	12	16	25	25
Max shutoff pr in bar g available w r t to kv value	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	30	30	30	30	30
Max available air supply in bar g for actuator	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6	6
Valve travel in mm	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	34	34	34	34	34
Actuator spring travel in mm	17	17	17	17	17	17	17	17	17	17	17	17	17	17	17	34	34	34	34	34
Actuator stem dia in mm	3	3	3	3	3	6	6	6	6	10	10	10	10	10	10	12	12	16	25	25

Approval of engineering consultants & certificate

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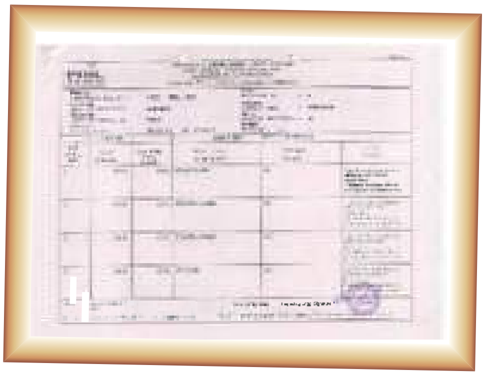

PDIL

TUV INDIA

ISO 9001

Spraytech®
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The Flow Technologists

Manufacturing & Testing Facilities for Flow Elements

- PMI Test Bench
- Hydro Test Bench Meeting Shell Test
- sand blasting machine
- Helium Leak Test Bench
- Radiography Test Bench
- 02 Cleaning Facility And Test Bench
- IBR Testing And Compatibility
- 5 Axis CNC Machine
- Lathe machine
- 9 Axis VMC Machine
- Flow Calibration Test Bench
- Transmitter Operational Test With Full Calibration
- Drilling Machine
- Grinding Machine
- Cutting Machine
- PWHT Facility
- Painting and Powder Coat Facility

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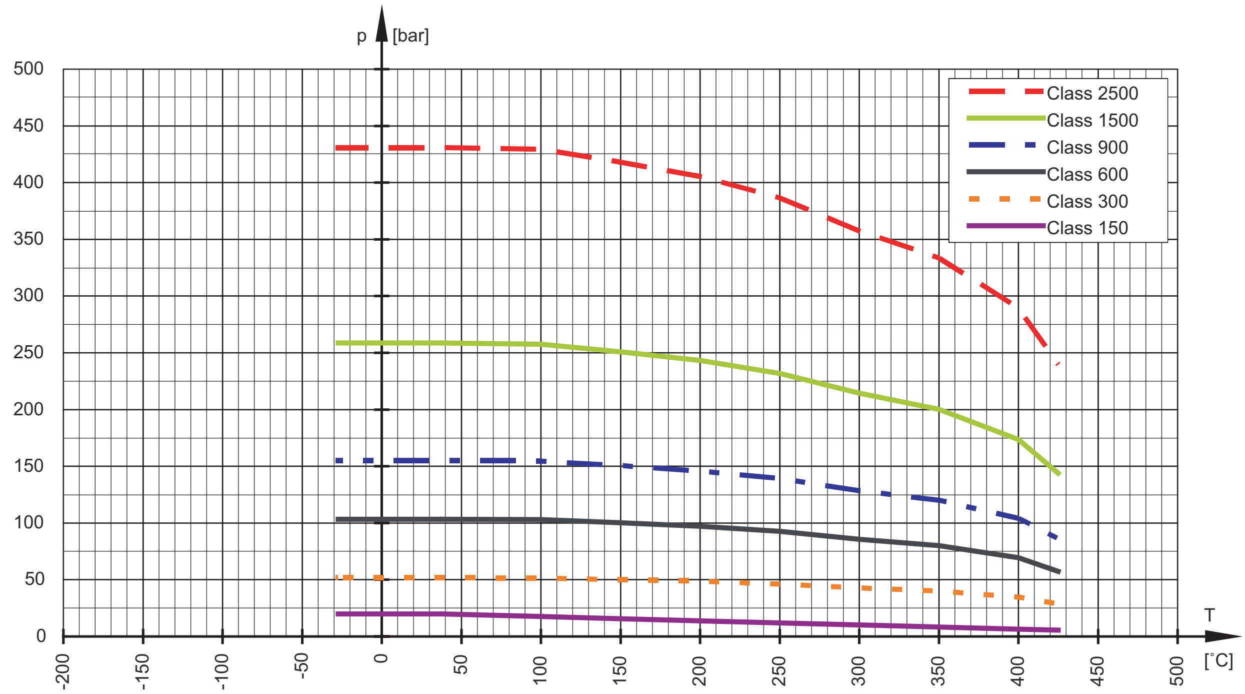
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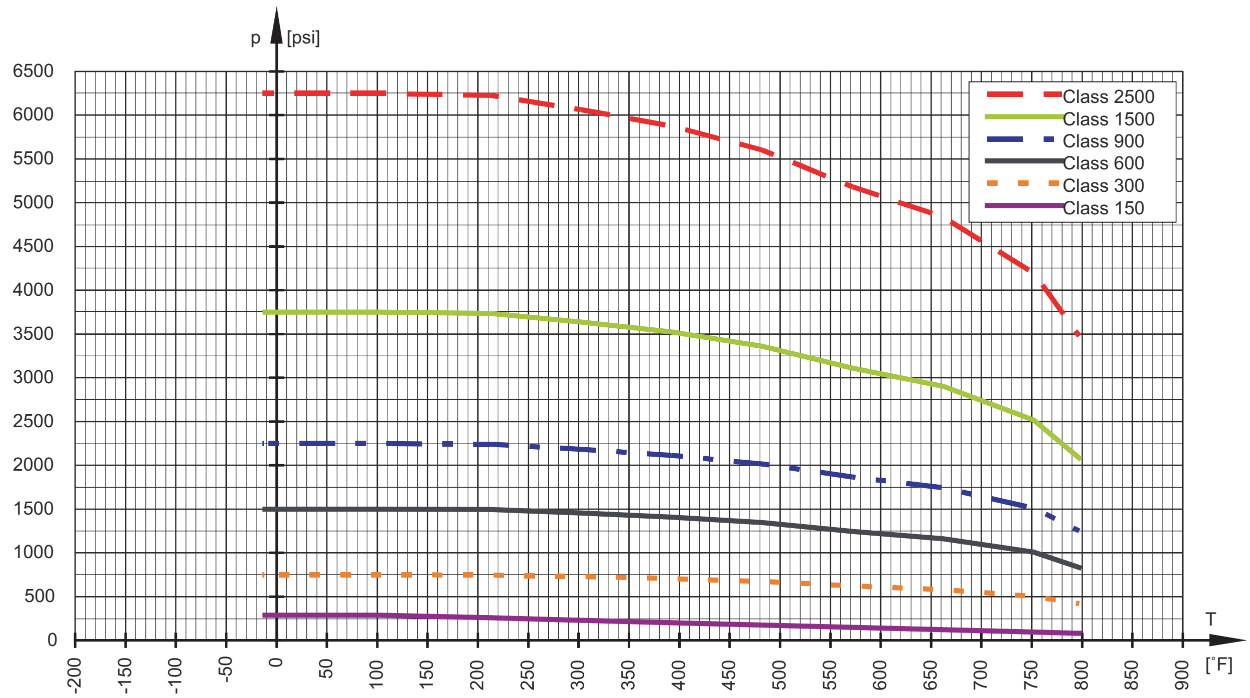
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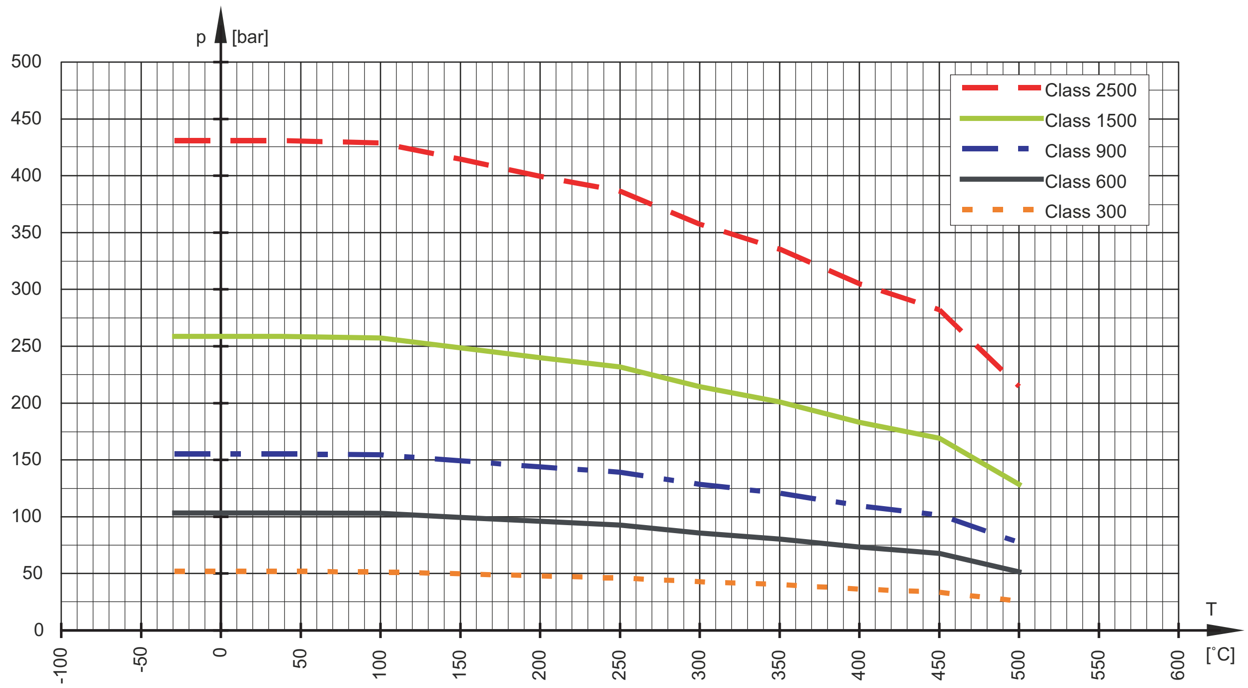
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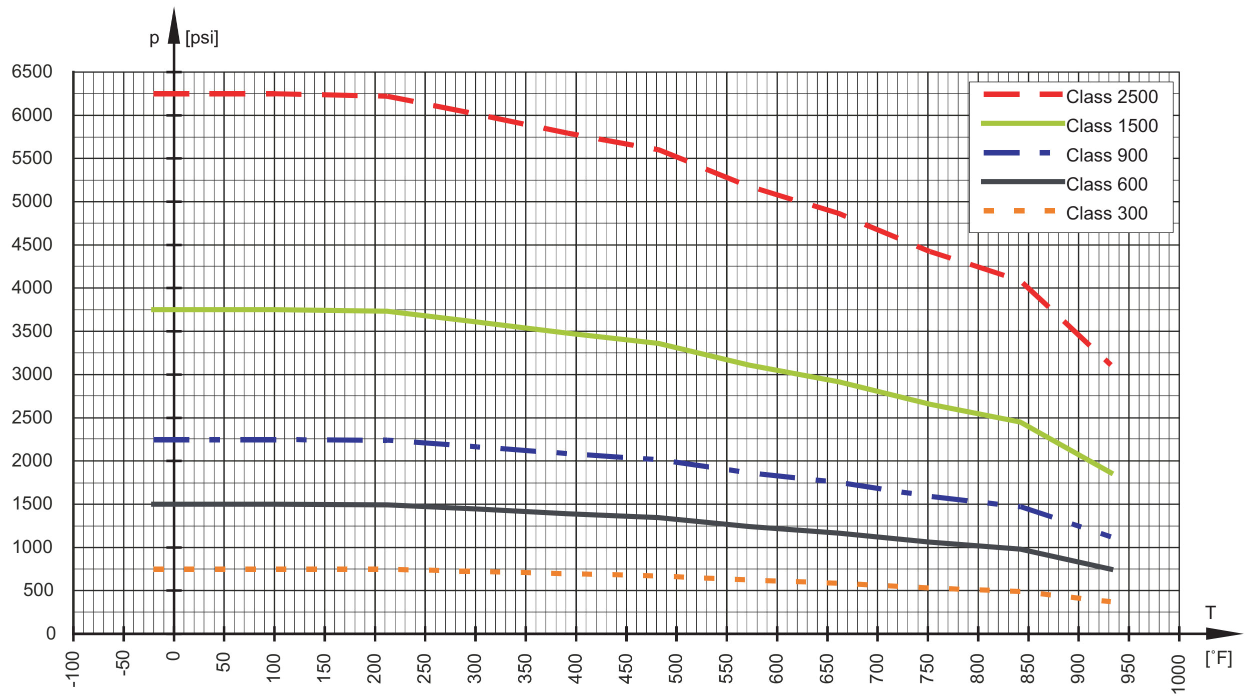
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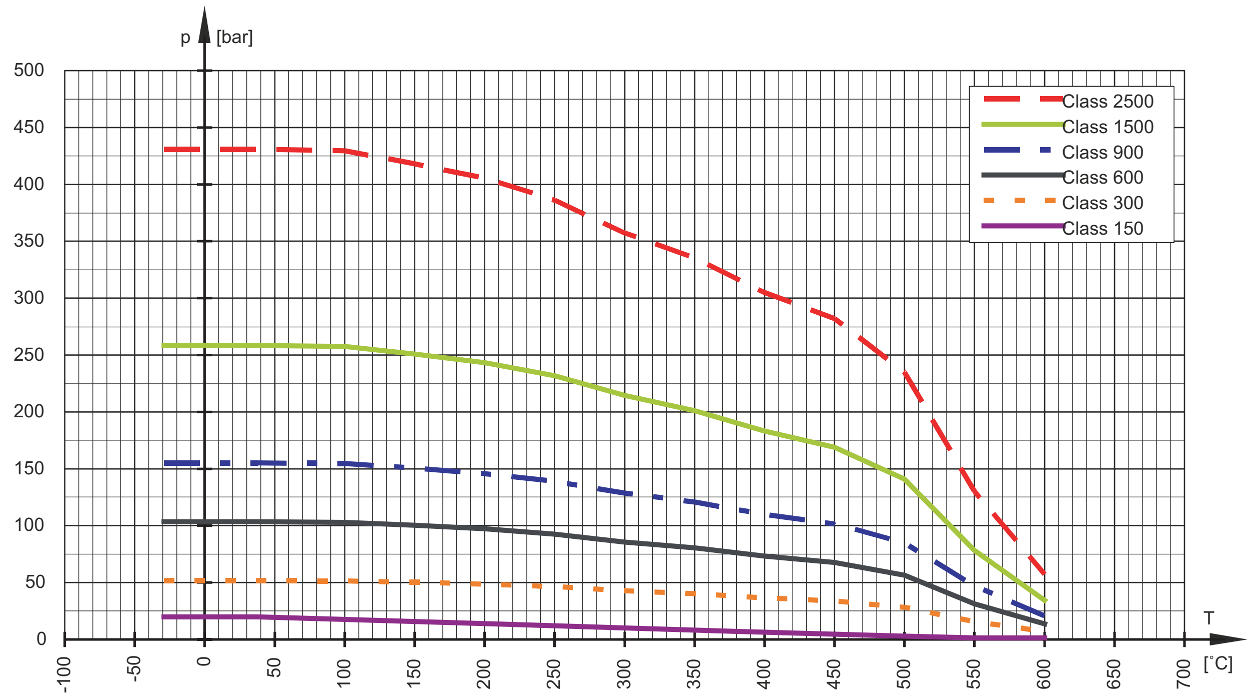
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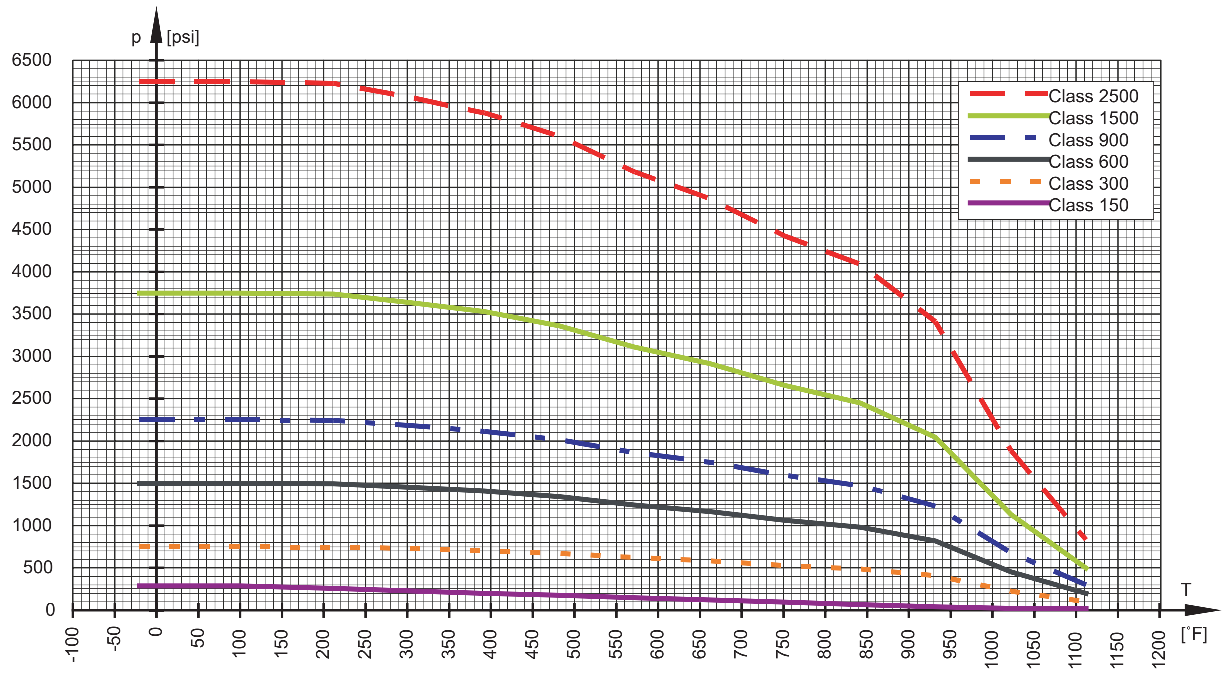
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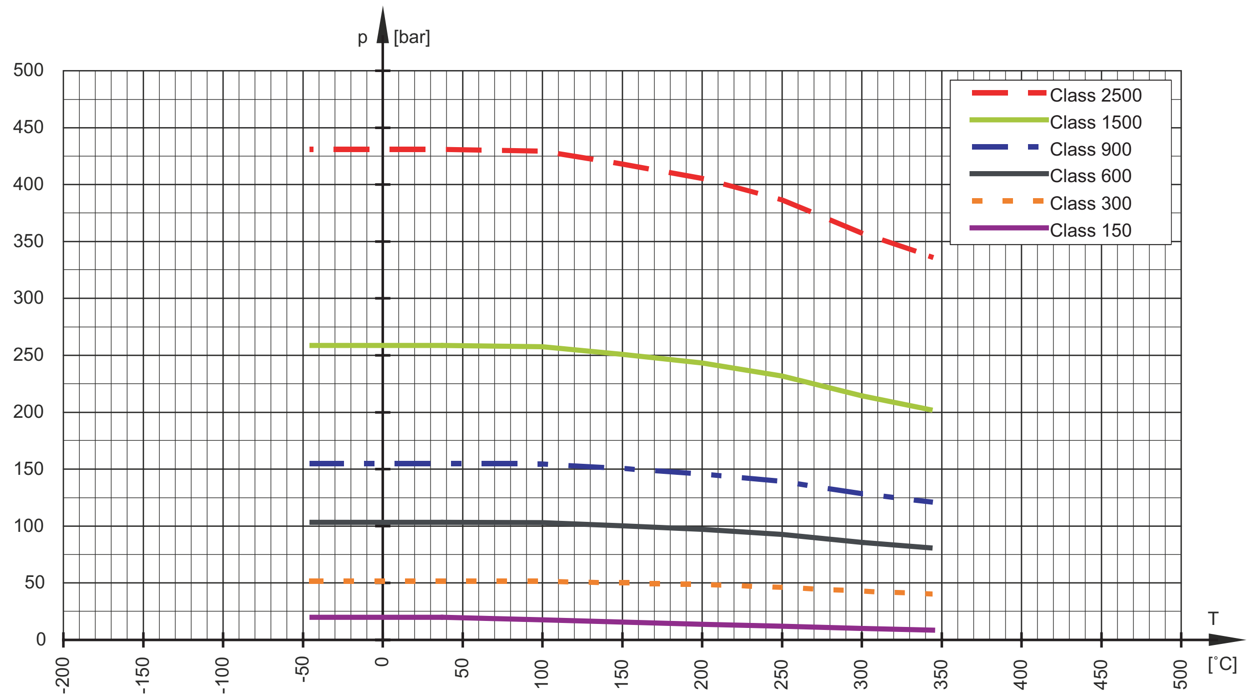

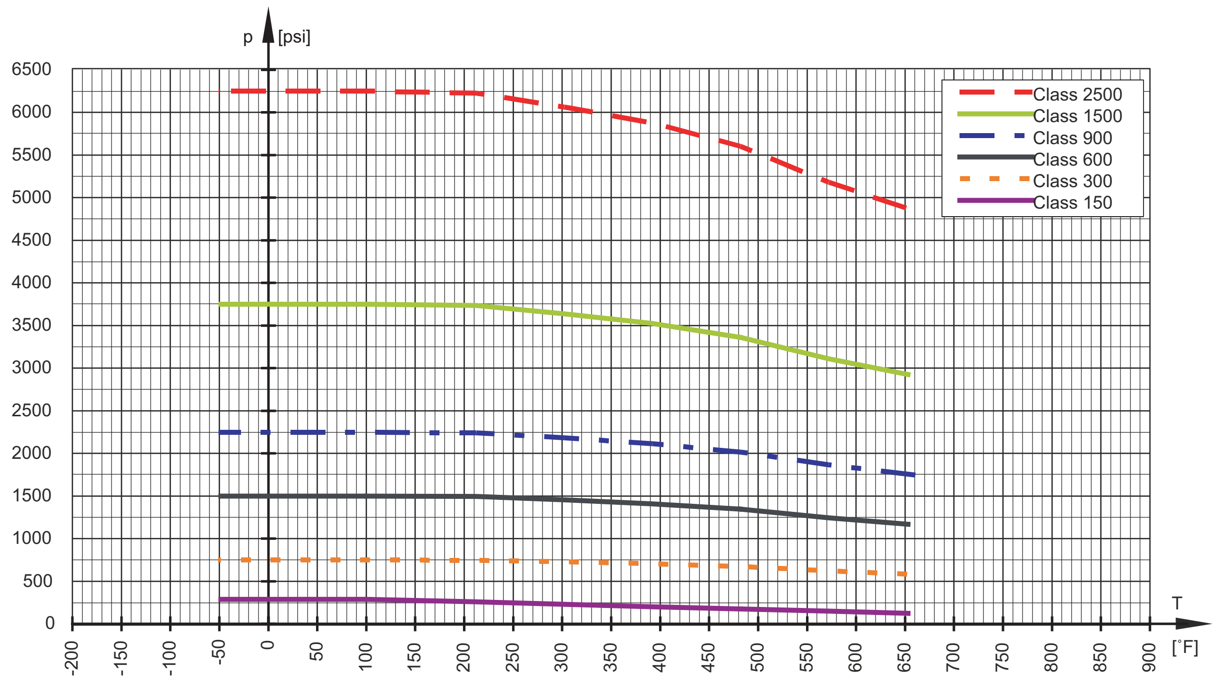

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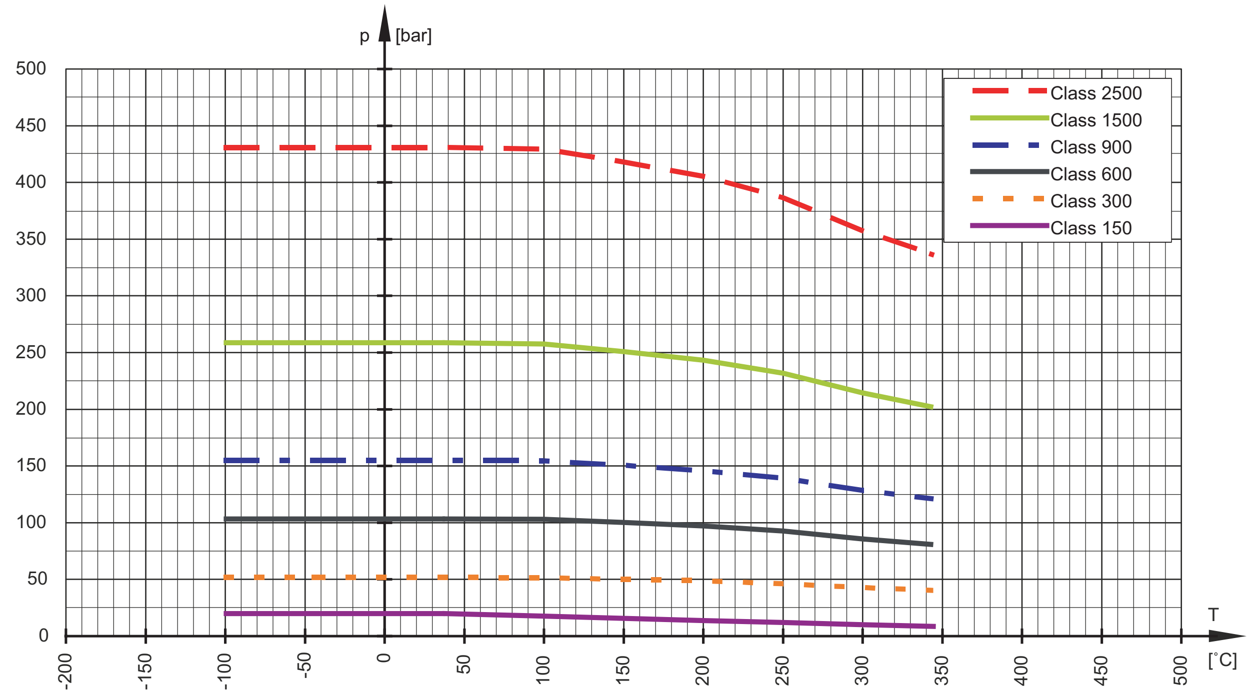

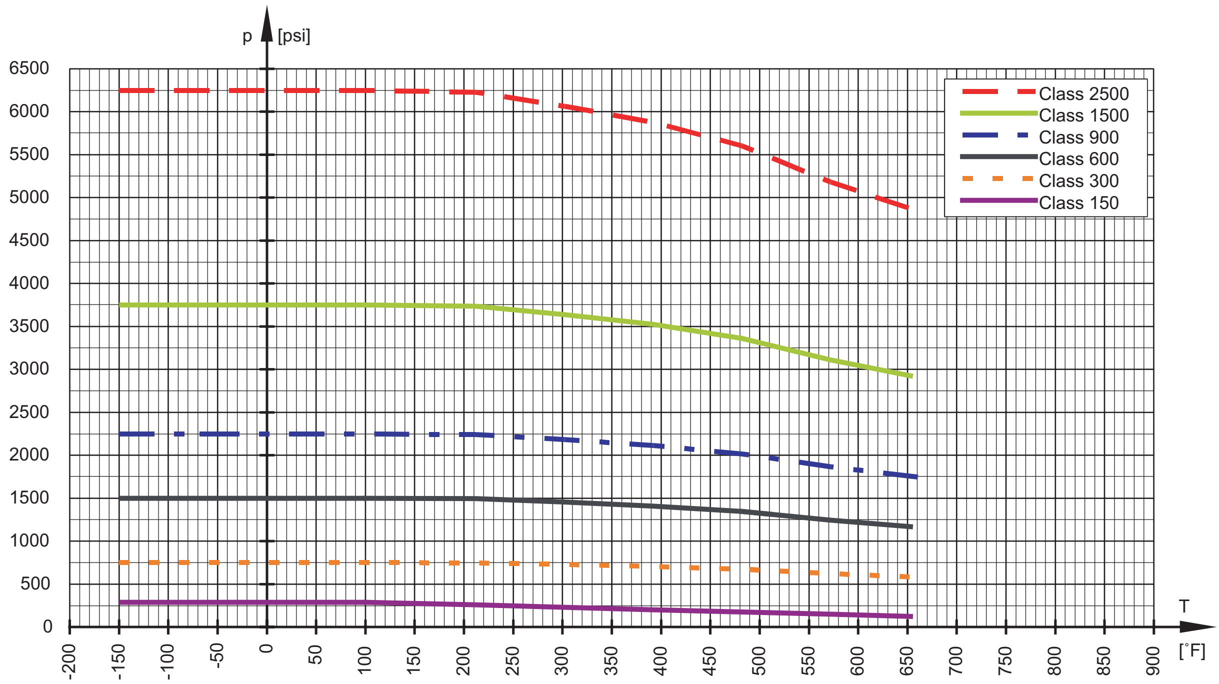

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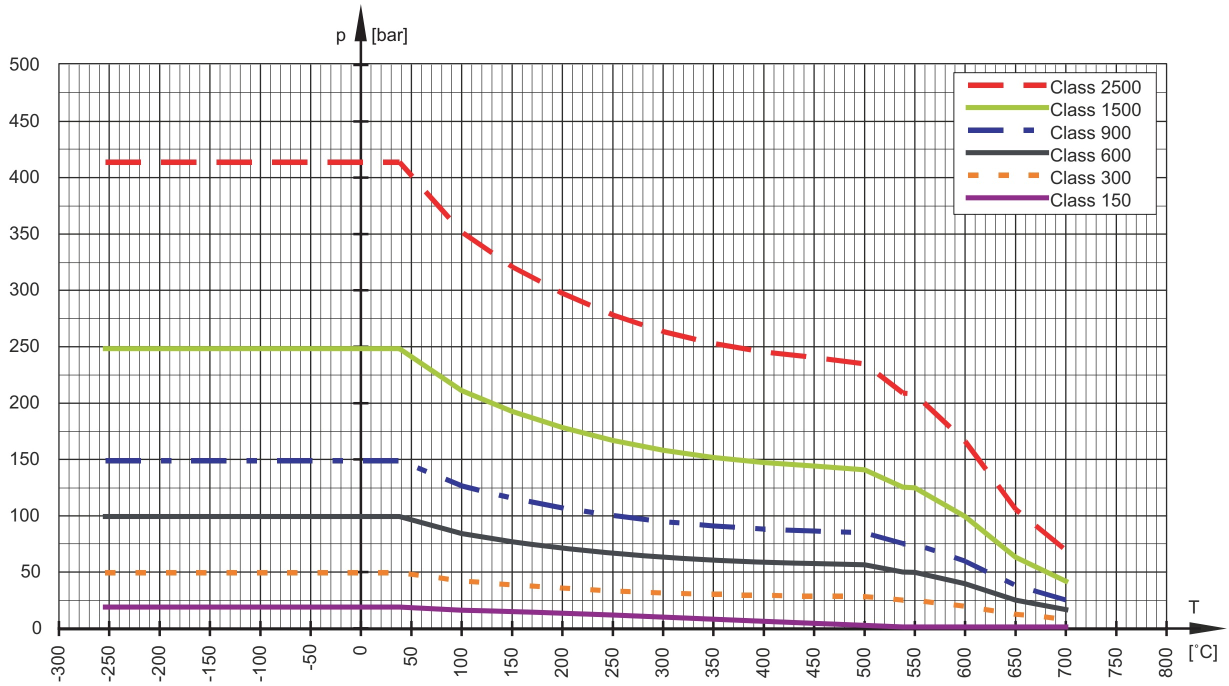

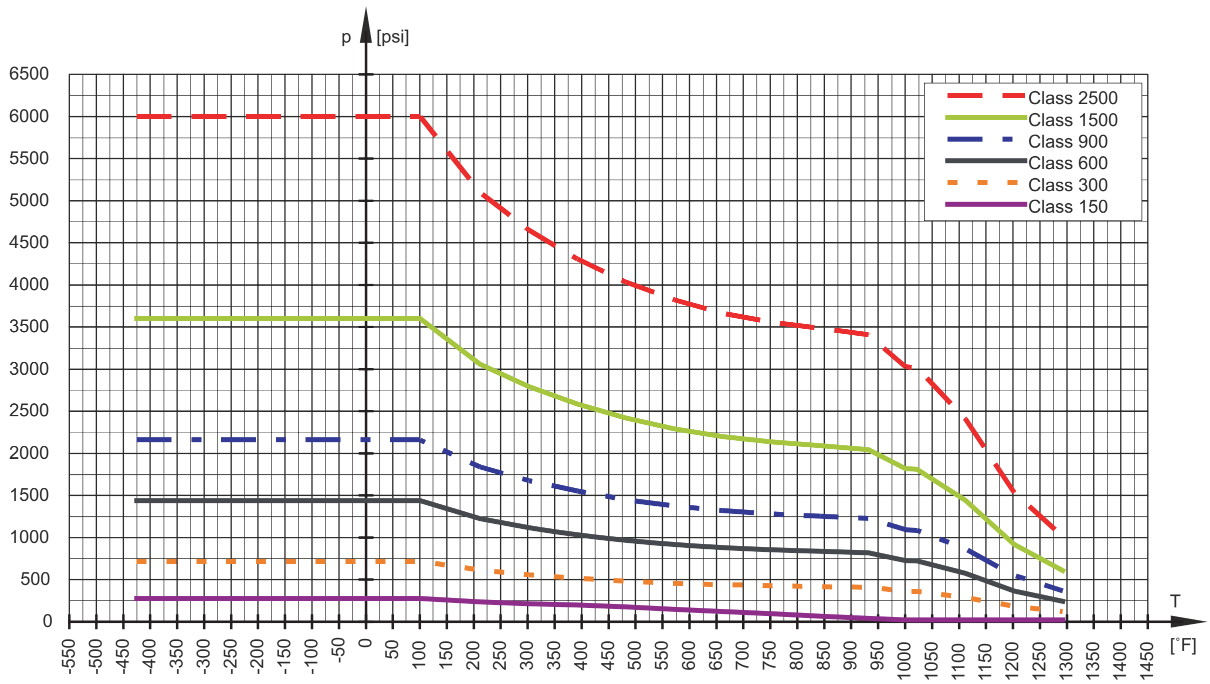

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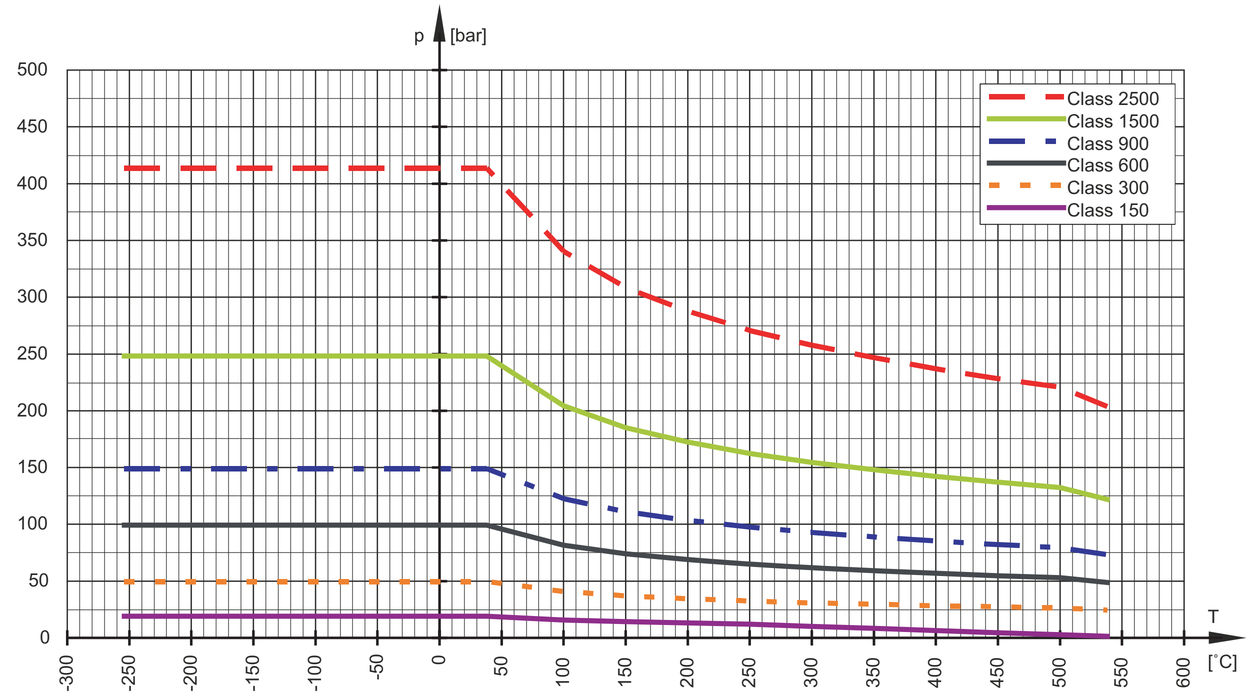

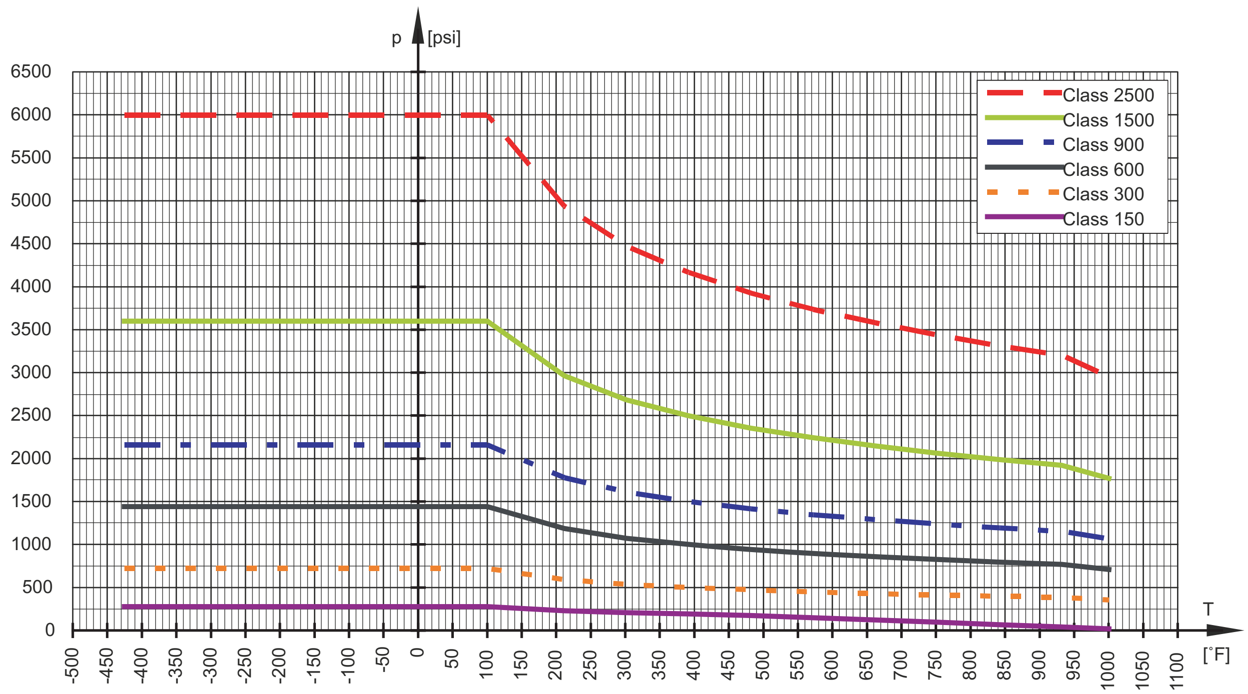

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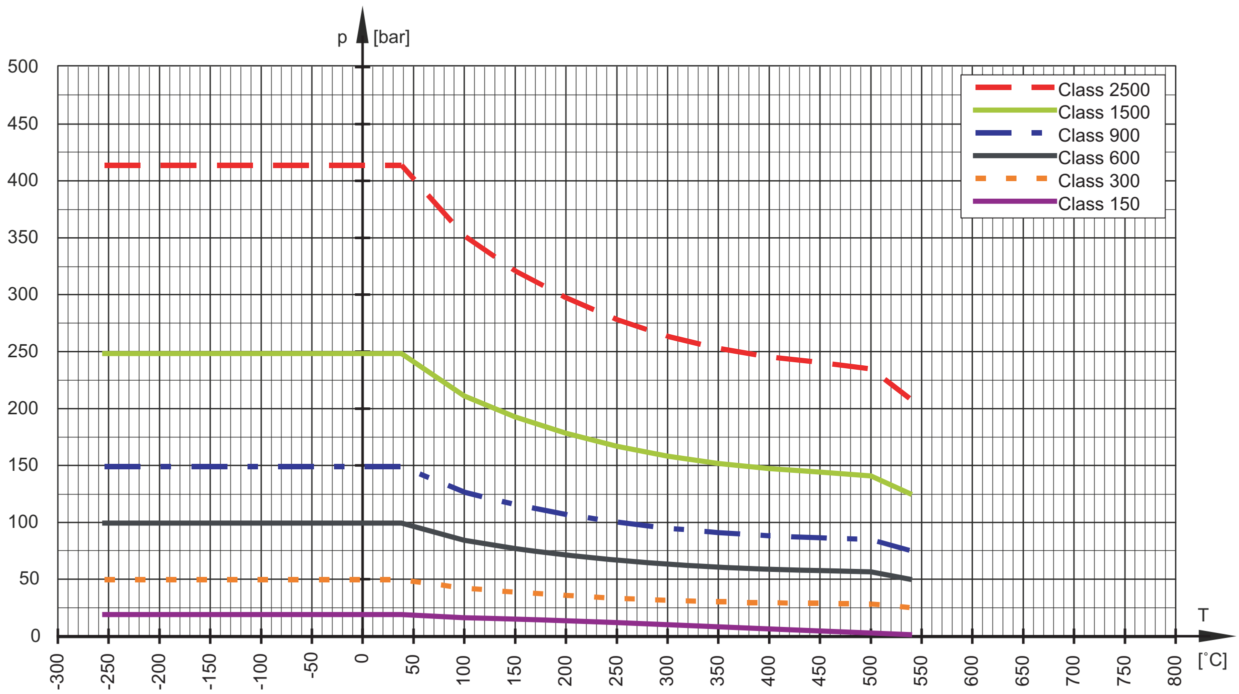

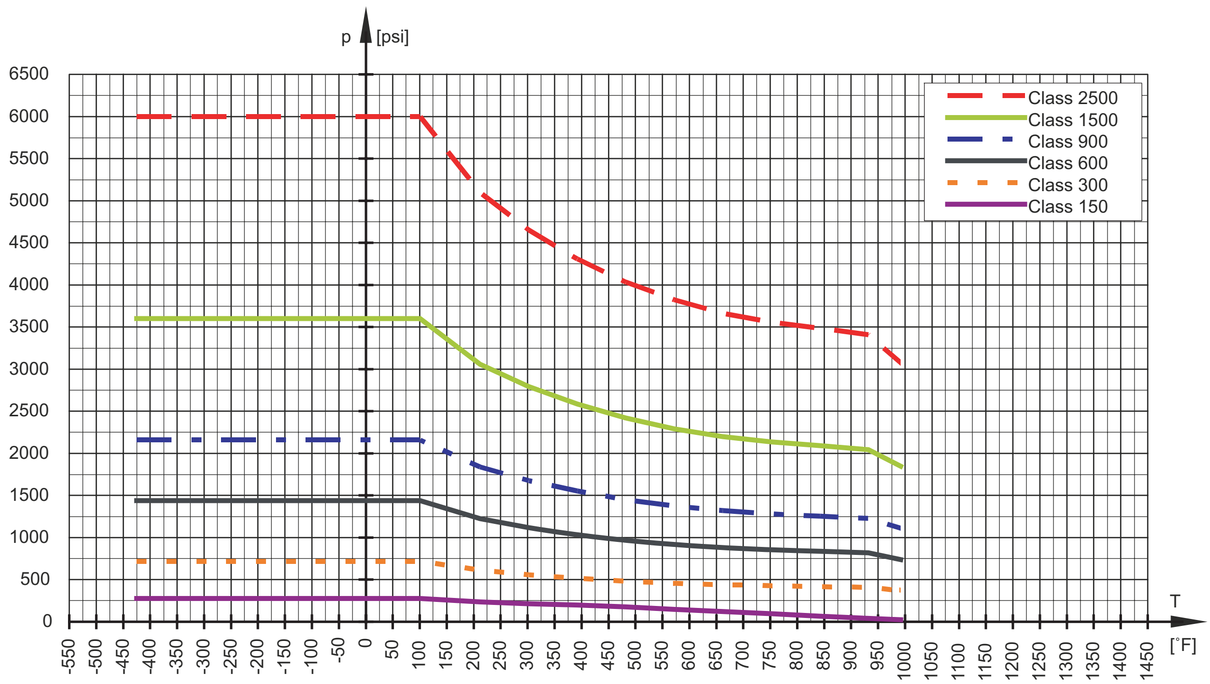

Note

Spraytech®
Systems (India) Pvt. Ltd.
The Flow Technologists

Companies Location Map

Regd. Office (Thane)

Rabale Plant (Navi Mumbai)

Indapur Plant (Pune)

Regd. Office :
20 KMS from Mumbai International Airport

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Systems (India) Pvt. Ltd.
The Flow Technologists

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sales@spraytechindia.com
sales1@spraytechindia.com

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Tal. - Indapur,
Dist. - Pune. 413103

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