PIPING AND PIPING COMPONENTS

Part I-*Piping*

Part II -*Piping Componants*

Part III - *Valves & Gaskets*

Part I-*Piping*

Piping is divided into three major categories:

1) Large bore pipe: Generally includes piping greater than two inches in diameter.

2)Small bore pipe: Generally includes piping which is two inches and smaller in diameter.

3)Tubing: Tubing is supplied in sizes up to four inches in diameter but has a wall thickness less than that of either large bore or small piping.

Part I - Nominal Pipe Size

The term diameter for piping sizes is identified by nominal size.

The manufacture of nominal sizes of 1/8 inches through 12 inches inclusive is based on a standardized outside diameter (OD).

The 14 inch and larger sizes have the OD equal to the nominal pipe size.

Tubing however is sized to the outside diameter for all applications.

Pipe Sizes 3/8" , 1 1/4" , 3 1/2" , 4 1/2' and 5 inches are considered as non-standard and should not be used except to connect to equipment having these sizes. In this case the line is increased to a standard size as soon as it leaves the equipment.

Part I - Schedule Number

Pipes are manufactured in a multitude of wall thickness. These wall thickness have been standardized so that a series of specific thickness applies to each size of piping. Each thickness is designated by a schedule number rather than the actual wall thickness.

The original thickness were referred to as standard (STD), extra strong (XS) and double extra strong (XXS). These designation or weight classes have now either been replaced or supplemented by SCHEDULE NUMBERS in most cases.

Schedules begin with 5 and 5s followed by 10 and 10S, then progress in increments of ten through Schedule 40 and then finally by increments of twenty to Schedule 160.

Wall thickness for Schedule 40 and STD are the same for sizes 1/8" to 10". Schedule 80 and XS also have the same wall thickness for 1/8" through 8" dia pipe.

Schedules 5 and 10 are generally used for stainless steel piping.

Part I - Pipe Length

Pipe is usually supplied in random lengths. The shortest, longest and average length may vary for piping of different materials, sizes and wall thickness schedules. Typically an average length of 20 feet is used for carbon steel pipe, but double random lengths are available from most suppliers and is generally preferred especially for rack installations.

Part I - Pipe Ends

1) Plain end
2) Bevelled end
3) Threaded ends

Plain ends (PE) are cut square and reamed to remove burrs. This type of end is used for mechnical couplings , socket weld fittings or slip on flanges.

Bevelled ends (BE) are required for most butt-weld applications.

Threaded ends (TE) are used for screwed joints. Pipe order is placed as threaded both ends (TBE) or threaded one end (TOE)

Part I - Standard Piping Materials

Carbon Steel is one of the most commonly used pipe materials.
The specifications that cover most of the pipe used are published by the ASTM (American Society for Testing of Materials) and ASME (American Society Of Mechanical Engineers)
e.g.
A106 is a Carbon Steel material specification and is available in grades A,B and C.
The grades refer the tensile strength.

Stainless Steel pipe is virtually non-magnetic. There are eighteen different grades and type 304 L is the most widely used. L denotes low carbon content and is best suited for welding.

Part I - Standard Piping Materials

Chromium- Molybdenum Alloy pipe is commonly referred to as " chrome- moly ". There are ten grades of this type of pipe material and are covered by ASTM 335. Chrome - moly pipe is used extensively in heat exchangers. This material must be stress-relieved after being joined.

Plastic Pipe is categorized into two principal groups :

1) Thermoplastic pipe available in compositions eg Polyvinyl chloride (PVC) , Polyethylene (PE) , Polypropylene (PP)

2) Thermosetting (Fiberglass) pipe

Part II - Flanges

Flanges :

Flanges are divided by classes which is normally rated by working pressure in pounds per square inch. They are available in a variety of primary pressure ratings from 25psi to 2500 psi.

Selection of the proper flange facing depends on the combination of many factors:

a) Flange material
b) Gasket material
c) Bolt Strength
d) Operating Pressure and Temperature
e) Fluid Properties Contained.

Part II - Flanges

Flange Facing:

a) Flat Face: They are used in conjunction with a full-face gasket.

B) Raised Face Facing: They are most commonly used. A facing height of 0.06 inch is customary for 150 and 300 pound flanges. A facing height of 0.25 inch is common on 400 pound and higher classes of flanges.

C) Tongue and Groove Facing has a gasket that is confined within the groove.

D) Ring Joint Facing uses a solid metal ring gasket, so the sealing surface on the flanges must be accurately machined to a very smooth finish. The ring gasket must likewise be accurately machined from solid metal. This style of facing is the most expensive, but it is most effective for high operating pressure and temperature.

Part II - Flanges

Types of Flange:

Weld neck flanges are the most common type of flanges used and preferred for the majority of service conditions. The strength of the fitting increases and stress is distributed so that this style can withstand extreme temperature. Shear, impact, bending and vibratory loading.

Socket Weld flanges are most commonly used on two inch and smaller piping.

Slip- on Flanges are sometimes preferred because of its lower installation cost and because it can accommodate slight misalignment. The calculated strength of the slip -on flange under internal pressure is approximately two thirds that of the weld neck style flanges and its life under fatigue is about one-third that of the weld-neck.

Part II - Flanges

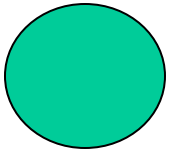
Types of Flange:

Threaded Flanges are attached by screwing the flange onto the threaded end of the pipe. As with other threaded fittings its use is restricted to systems having relatively low operating temperatures and pressures.

Lap Joint Flanges are used in piping that will be frequently dismantled. The flange is free to revolve on the pipe thus avoiding the problem of accurate alignments.

Orifice Flanges are used for instrumentation connections and are typically used in conjunction with an orifice plate and flowmeter to measure or indicate flow.

Part II - Elbows



Elbows make an angle between adjacent pipes. There are standard elbows of 90 degrees and 45 degrees. Special order elbows are also available.

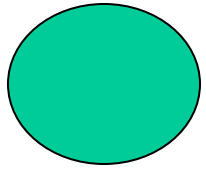
Long radius 90 deg elbow: Radius of bend = 1.5 times the nominal pipe dia

Short radius 90 deg elbow: Radius of bend = nominal diameter.

Reducing elbows are 90 deg elbows with two different size ends

180-degree return fittings are used for making 180-degree angles in piping systems.

Part II - Tees



Tees basically are of two types:

Straight Tee has three openings. Two have the same axis while the third is perpendicular to this axis for connecting a branch line.

Reducing Tee is similar to a straight tee except that the branch line connection is smaller in size.

Part II - Reducers

Reducers are used to connect different sizes of piping and can be classified as

Concentric Reducers are pipefitting with different nominal diameters on each end while maintaining the same centerline.

Eccentric Reducers are pipefitting with different nominal diameters on each end and the fitting is flat on one side with an eccentric centerline. Eccentric reducers are used for connecting different size pipes especially at centrifugal pump inlet connections for preventing air pockets which may cause the pump to cavitate.

Part II - Pipe Caps

Pipe Caps are specialised fittings that are used to close an open end.

Part II - Lateral Pipe Fittings

Lateral Pipe fittings are of two types

Straight Lateral pipe fittings have three outlets two of which have the same axis and a third on the side joined at 45 deg angle from the main axis.

Reducing Lateral fittings are similar to straight laterals except that the branch connection is smaller in size.

Part II - Weldolets

Weldolets are integral reinforcement fittings used for branch connection strength.

Part II - Full Couplings and Threaded Unions

Full Couplings are used to join a pipe segment to another pipe or pipe fitting.

Screwed Unions are basically screwed joint that can be disassembled within a completed system for subsequent maintenance.

Part II - Swage Nipple

A Swage Nipple is a reducing fitting used to join piping of different sizes. Care must be taken in matching the correct pipe schedules and end styles when ordering. Swages are available in both concentric and eccentric types.

Part II - Strainers

Strainers are used to remove solid particles from liquids. They generally have a permanent screen that can be cleaned by emptying, washing or blowdown.

Strainers are generally placed in the main line so that all of the process fluid passes through them.

Strainers are either permanent plant components designed for the life of the plant or temporary components for the removal of construction residue during initial start up.

Types of Strainers

Basket Strainers

Wye Strainers

Start-up Strainers

Part II - Steam Traps

A steam trap is really a separating trap, which separates condensate and steam.

When a steam trap discharges condensate it does so from a higher pressure to a lower pressure.

With an inlet pressure greater than the outlet pressure, condensate will be discharged and depending on the pressure differential can be made to travel quite a long way.

CLASSIFICATION OF TRAPS:

1) Mechanical
2) Thermodynamic
3) Impulse
4) Thermostatic

Part III - Valves

What is a valve ?

A Valve may be defined as a mechanical device by which the flow of liquid or gas may be started, stopped or regulated by a movable part that opens, shuts or partially obstructs one or more ports or passageways.

What does a valve do ?

A Valve may be designed to direct, start, stop, mix or regulate the flow, pressure, or temperature of a process fluid.

A Valve by nature of their design and materials can :

1)Open and Close

2)Turn on and off

3)Regulate

4)Isolate

Extremely large array of liquids and gases.

Part III - Valves

What is the range of size of valves?

A Valve may range in size from a fraction of an inch to 9mtr in diameter.

What is the range of pressure and temperature handled ?

A Valve can handle pressures ranging from vacuum to more than 140 MPA/m2 and temperatures from the cryogenic region to 815 Deg Celcius.

What are the materials used for valves ?

In most cases the required body material is the same as the pipe material which may be Carbon Steel, Stainless Steel or Chrome- Molubdenum Steel (Commonly called Chrome Moly)

Part III - Valves

Carbon Steel is the ideal material for non-corrosive fluids. It is also used for steam and condensate services.

Carbon Steel is readily available in most common general service valves and generally inexpensive. It is recommended in temperatures upto 425 Deg Celcius in continuos service or upto 535 Deg Celcius in non-continuos service.

Stainless Steel is very corrosion resistant, extremely strong and is commonly specified for high- temperature application temperatures at 535 Deg Celcius and higher.

The cost of Stainless Steel is higher than carbon steel but less than other alloy steels.

Part III - Valves

Chrome - Molybdenum steel is a good material that falls between the characteristics of carbon steel and stainless steel. It can handle higher pressure and temperatures than carbon steel making it ideal for high pressure steam or flashing condensate applications.

Special alloys are specified for special service or severe service valves e.g. Hastealloy B & C may be selected for a highly acidic fluid service or Monel or bronze body may be selected for a pure Oxygen Service.

Castings, forgings or barstock:

Valve bodies are made from Castings, forgings or barstock**.**

Castings are the least expensive choice because of the process and higher volumes run by the Manufacturer.

Forgings are required for special materials and / or higher pressure ratings , such as ANSI classes 1500, 2500 or 4500.

Part III - Gate Valves

GATE VALVE

A Gate valve is a multi turn valve in which the port is closed by a flat-faced vertical disk that slides at right angles over the seat. It is primarily designed for on-off service, where it is operated infrequently.

It can be applied to general service, oil, gas, air slurries, heavy liquids, steam, non-condensing gases and liquids, corrosive liquids.

TYPES OF GATE VALVE :

All Gate Valves are mainly of two types :

1. Parallel type 2. Wedge type

In the Parallel gate valve a flat disk is used as the closure element that fits between two parallel seats :

1 Upstream seat 2 Downstream seat

The Wedge type gate valve uses two inclined seats and a slightly mismatched inclined gate that allows for tight shutoff even against higher pressures.The inclined seats are designed 5 to 10 degrees from the vertical plane while the inclined gate is designed with a close but not exact angle.

Part III - Gate Valves

GATE VALVE INSTALLATION GUIDELINES

- Because of their linear motion gate valves have a greater height than other manual valves and this must be taken into consideration during installation.
- Large sized Gate Valves are normally installed in horizontal lines.
- Gravity tends to pull gate out of alignment with the seats in larger gate valve sizes requiring some additional mechanical support.
- User to ensure that the matching end piping flanges are aligned if the valve has flanged end connection.

Part III - Gate Valves

LIMITATIONS :

1 Gate Valves do not handle throttle operations well

2 Difficulty in opening or closing against high pressure drops.

3 Tight shut off not easily attained in some applications.

4 Cavities are formed at low pressure drop

5 Gate valves must be kept at fully open or fully closed position.

6 The throttling position often erodes the seat and disk.

Part III - Globe Valves

What is a Globe Valve?

A Globe valve is a linear motion valve and is generally used for both on-off throttling applications.

Although the globe design can handle high-pressure classes, due to the thrust limitations of the hand operator globe valves are usually applied to lower pressure applications.

Types of Globe Valves:

1.Tee-Pattern Globe Valves:

2. Wye-Pattern Globe Valves:

3. Angle Pattern:

Part III - Ball Valves

What is a Ball Valve?

The valves, which are best, used for on-off service, as well as moderate throttling situations that require minimal accuracy.

Types of Ball Valves:

They are made in three general patterns:

1. Venturi port
2. Full port
3. Reduced port

Part III - Butterfly Valves

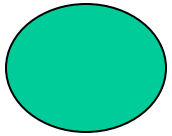
What is a Butterfly Valve?

- In a Butterfly valve the fluid moves from the inlet to the outlet, with the disk being the only obstruction to the flow.
- Unlike gate or globe valve designs, where the closure element moves out of the flow stream, the butterfly disk is located in the middle of the flow stream.
- It creates some turbulence to the flow, even in the open position.

Types of Butterfly Valves:

1. Wafer body type.
2. Flanged body type.
3. Lug-body style.
4. Slit-body style.
5. Eccentric and Cammed Butterfly valve.

Part III - Check Valves



What is a check Valve?

Check valves (also known as non-return valves) are automatic valves that prevent a return or reverse flow of the process.

The check valve operation is dependent upon the flow direction of the process, which may be created by a pump or pressure drop.

Types of Check Valves:

1.Lift Check Valves:

2. Swing Check Valves:

Part III - Plug Valves

What is a plug Valve?

It is a quarter-turn manual valve that uses a cylindrical or tapered plug to permit or prevent straight-through flow through the body.

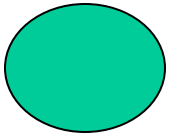
Plug valves are either lubricated or non-lubricated.

For non-lubricated valves, the plug may be inserted from the top or bottom of the valve body.

Types of plug Valves:

1. Cylindrical Plug
2. Conical Plug

Part III - Diaphragm Valves



What is a diaphragm Valve?

Diaphragm Valves consist of a rigid body formed with a weir placed in the flow path, a flexible diaphragm which forms the upper pressure boundary of the valve, a compressor which is used to force diaphragm against the weir, and the bonnet and handwheel which secure the diaphragm to the body and actuate the compressor.

They are manufactured in Variety of end connections:

Welding end socket or butt welding, flanged, screwed or threaded, clamp ends, solvent cement joint ends for thermoplastic valves and male sanitary threaded ends.

Types of Diaphragm Valves:

1.Weir type

2. Straight through type

Part III - Safety & Relief Valves

Safety Valves

- They are also known as pop safety valves.
- They are spring loaded, quick opening, full flow valves for systems containing pressurized, compressible fluids such as steam, air, or other vapors or gases.
- The set pressure is adjusted by increasing or decreasing the spring compression.
- The difference between the opening pressure and the closing pressure is called blowdown.

Relief Valves

- They are similar to safety valve but open only slightly at set pressure.
- Instead of full opening, they open wider if the pressure increase above the set pressure.
- Relief valves are normally used for liquids, such as water or oil, where release of a small volume will rapidly lower the pressure.

Part III - Gaskets

A gasket is a malleable material, which can be either soft or hard, that is inserted between two parts to prevent leakage between that joint.

Pressure is applied by bolting or using a clamp to compress the gasket firmly in place.

Gaskets are made from all different types of materials, depending on the temperature, pressure or fluid characteristics of the process.

Gaskets are used in valves for three major purposes:

- To prevent leakage around the closure mechanism
- To prevent leakage of fluid to atmosphere
- To allow the function of internal mechanisms that depend on separate fluid chambers, such as pressure balance trim