COURSE NAME: INDUSTRIAL PIPING SYSTEM

LECTURE III-WEEK III: TYPES OF PIPE FITTING AND THEIR APPLICATIONS

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OBJECTIVES

By the end of this session the learner/student will be able to:

- ✓ Identify the types of pipe fittings in piping system
- ✓Describe the application of pipe fittings

III.1. Introduction

Pipe fittings are components used to join pipe sections together with other fluid control products like valves and pumps to create pipelines. The common connotation for the term fittings is associated with the ones used for metal and plastic pipes which carry fluids.

Introduction Cont'd

There are also other forms of pipe fittings that can be used to connect pipes for handrails and other architectural elements, where providing a leak-proof connection is not a requirement. Pipe fittings may be welded or threaded, mechanically joined, or chemically adhered, to name the most common mechanisms, depending on the material of the pipe.

III.2. Pipe Fitting Materials and Manufacturing process

a. Steel and steel alloys

Steel pipe fittings are often extruded or drawn over a mandrel from welded or seamless pipe. In smaller sizes they are often threaded to match threads on the ends of pipe. As sizes and pressures increase, they are often welded in place by either butt-weld or socket-weld methods. Socket fittings are welded into place with fillet welds, which makes them weaker than butt- welded fittings, but still preferable to threaded fittings for high-end work. The need for an expansion gap in the fitting precludes their use in high-pressure food applications.

Pipe fittings and pipe lengths joined by butt welds require end preparation to ensure the integrity of the final welded joints as it is shown on the figure below:

Source: *https://www.thomasnet.com/articles/hardware/understanding-pipe-fittings/*

b. Stainless steel pipe fittings

Stainless steel pipe fittings can be used for sanitary applications such as food and dairy processing, and are commonly fitted with quick-connect clamps to enable dismantling of the line for internal cleaning. The flanges for these clamping systems are available as weld-on entities or in many instances available as wyes, tees, etc. with the flange integral to the fitting.

c. Aluminum fittings

Aluminum fittings are available in all the same forms or shapes as steel fittings. Aluminum threaded fittings such as caps or nipples are available, as are fittings that feature a combination of threaded and butt weld connection styles. Socket weld options also exist. Welding of aluminum fittings usually requires a MIG or TIG process.

d. Concrete

Concrete pipe fittings are available in a variety of styles suitable to their application in large civil projects such as storm-water control. Aside from the typical wye connections, specialized fittings include utility hole portals and various styles of vaults. Typical connections use shouldered ends on the fittings which mate with counterparts on the receiving pipes. A rubber gasket provides for a leak-proof joint.

e. Plastic Fittings

Plastic pipe fittings are available in both socket weld (sometimes called solvent weld) and threaded styles, with the former the most common. Socket weld fittings are designed to be welded in place chemically, thereby making installation quick and straightforward to complete. Plastic pipes are usually dry fitted, then marked, as the solvent used to connect them is especially fast-acting. Couplings are typically used to connect and join straight lengths of pipe together.

Source: *https://www.thomasnet.com/articles/hardware/understanding-pipe-fittings/*

Plastic Fittings Cont'd

Common PVC pipe fittings include reducers, elbows, caps, tees, wyes, couplings, unions, and crosses, to name a few. The standard cross-sectional profile for most PVC pipe fittings is circular, but there are other profile shapes available, such as square PVC fittings. However, these alternative fitting profiles are usually associated with PVC pipe that is designated for structural use, such as fences, railings, or furniture grade use, and are not associated with PVC pipe that is fluid handling applications.

f. Glass Pipe fittings

In some specialized industrial fluid process settings, glass pipe and fittings are employed. Borosilicate glass offers several key advantages over alternative forms of piping systems. The material has high purity, so it will not contaminate process fluids. The natural transparency of glass permits the inspection of the process as needed, while the smooth surface prevents the development of scale or other residues on the interior surface of the pipe. Laboratory applications may also frequently employ glass tubing and glass profile fittings.

Source: *https://www.flexachem.com/glass-lined-pipes-and-fittings/*

III.3. Fitting shapes and styles

Most fitting shapes are self-explanatory by their name. The commonly available ones include:

- Caps
- Plugs
- Nipples
- Elbows
- Tees
- Wyes
- Crosses
- Unions
- Bushings
- Reducers
- Adapters

The figure below illustrates some of the types of pipe fittings:

Source: *https://id.images.search.yahoo.com/images/view;_ylt=AwrtkJYsKCBkpd4wFZ0eHYpQ*

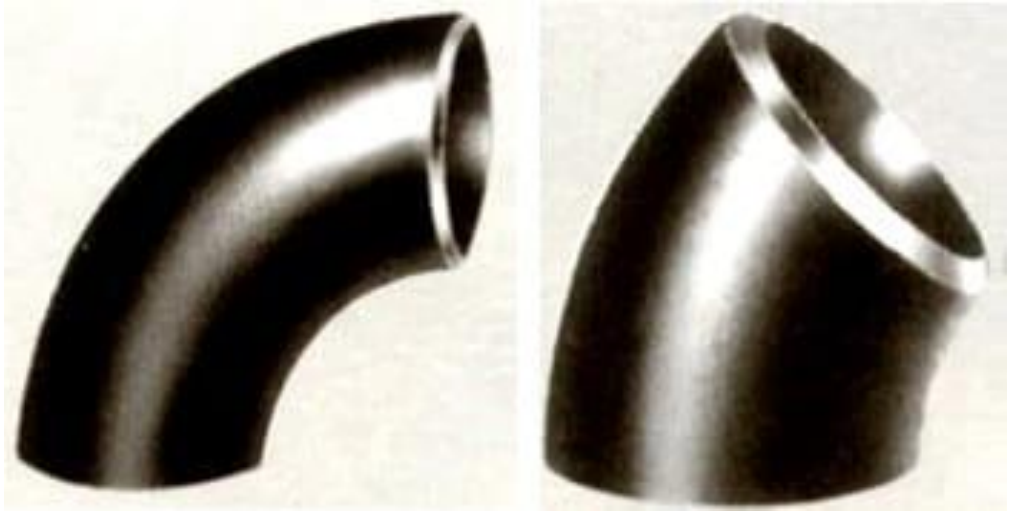
a. Pipe plugs or caps

Pipe plugs or caps can be used to seal off the ends of pipe. Some forms of high-pressure plugs are used to temporarily seal off pipe ends to facilitate pressure testing in pipelines and pressure vessels while eliminating the need to perform conventional welding operations in order to perform these tests. They exist either as metallic and non-metallic

Source: *https://products.swagelok.com/en/all-products/fittings/pipe-fittings/caps-plugs/c/144?clp=true*

b. Pipe Elbow fitting

The Elbow is used more than any other pipe fittings. It provides flexibility to change the pipe direction. Elbow is mainly available in two standard types 90° and 45°. However, it Can be cut to any other degree. Elbows are available in two radius types, Short radius (1D) and Long Radius (1.5D).



Source: *https://hardhatengineer.com/wp-content/uploads/2016/12/Elbow-Short-vs-Long-1.jpg*

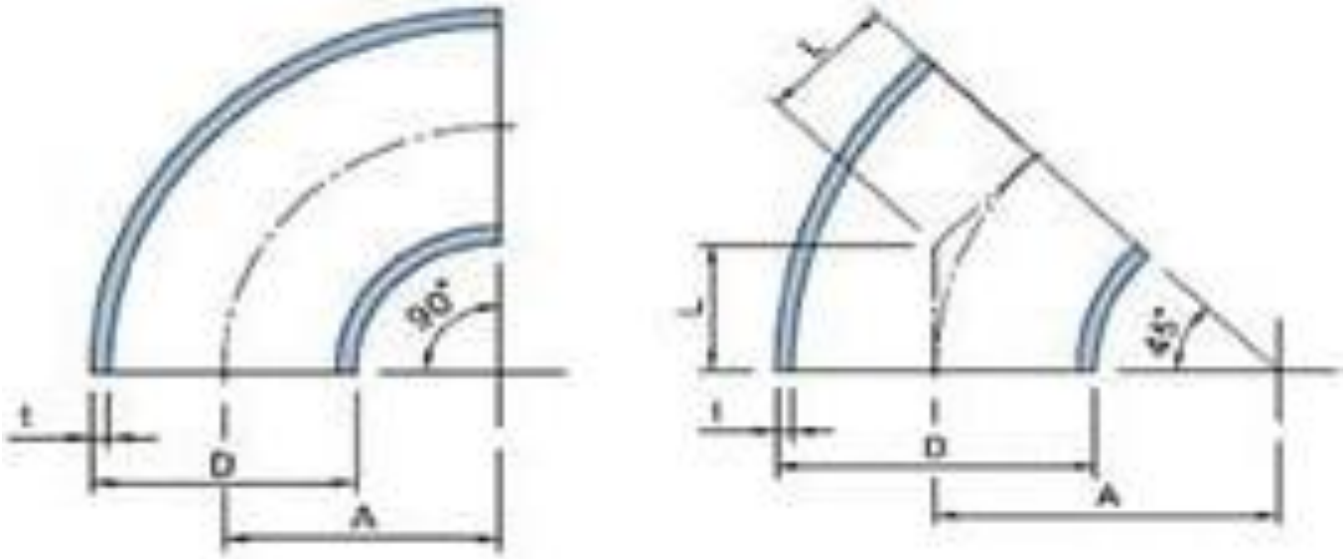
Pipe Elbow fitting Cont'd

i. 90 Degree Elbow

90 Degree elbow is installed between the pipe to change the direction of the pipe by 90 Degree. Available in long and short radius form.

ii. 45 Degree Elbow

45 Degree elbow is installed between the pipe to change the direction of the pipe by 45 Degree.

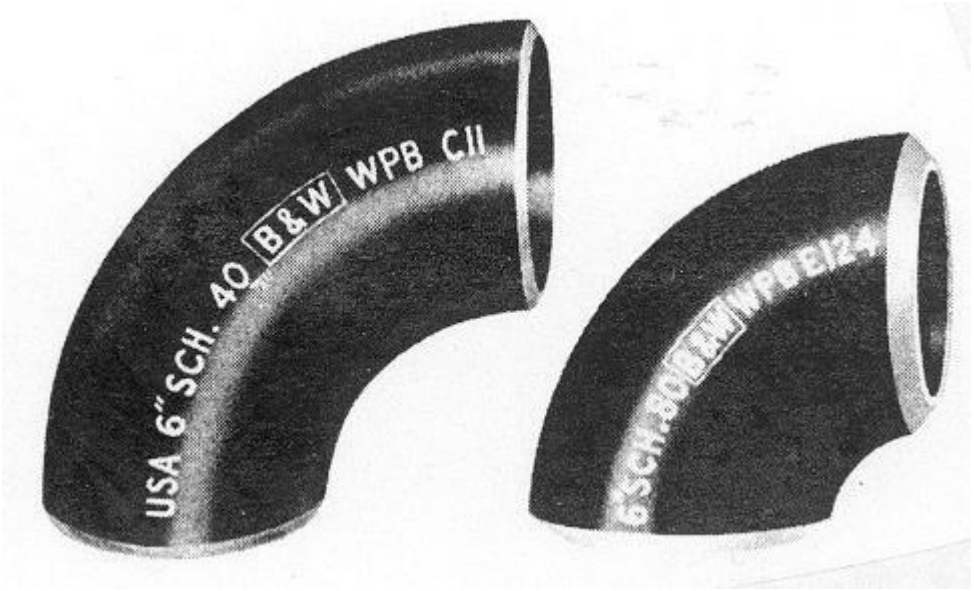


Source: *https://hardhatengineer.com/pipe-fittings/*

Pipe Elbow fitting Cont'd

iii. Long Radius Elbow

In a long radius elbow, the centreline radius is 1.5 times the nominal size of the pipe or you can say 1.5 times the diameter of the pipe. Normally long radius elbows are used in piping as pressure loss is less as compared to short radius elbows. It required more space than a short radius elbow.

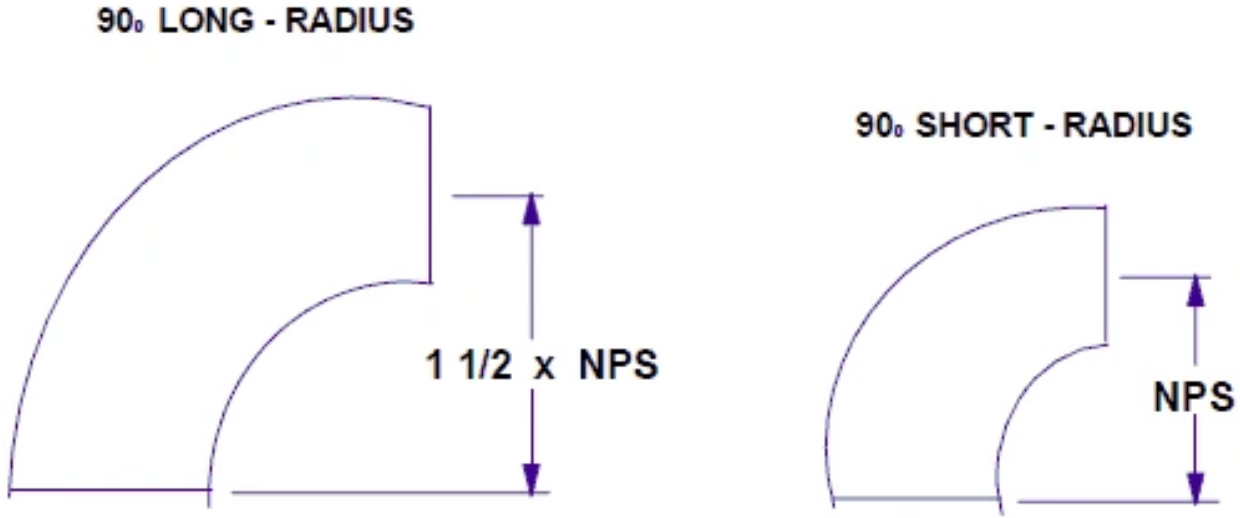


***Source**:*
https://hardhatengineer.com/pipe-fittings/

Pipe Elbow fitting Cont'd

iv. Short Radius Elbow

In a short radius elbow, the centreline radius is the same as the nominal size of the pipe, or you can say one times the diameter of the pipe. Short radius elbows are used under limited space applications. However, it has a high-pressure drop due to a sudden change in the direction of flow.



Source: *https://hardhatengineer.com/wp-content/uploads/2017/12/LR-SR-Elbow-example.png*

Pipe Elbow fitting Cont'd

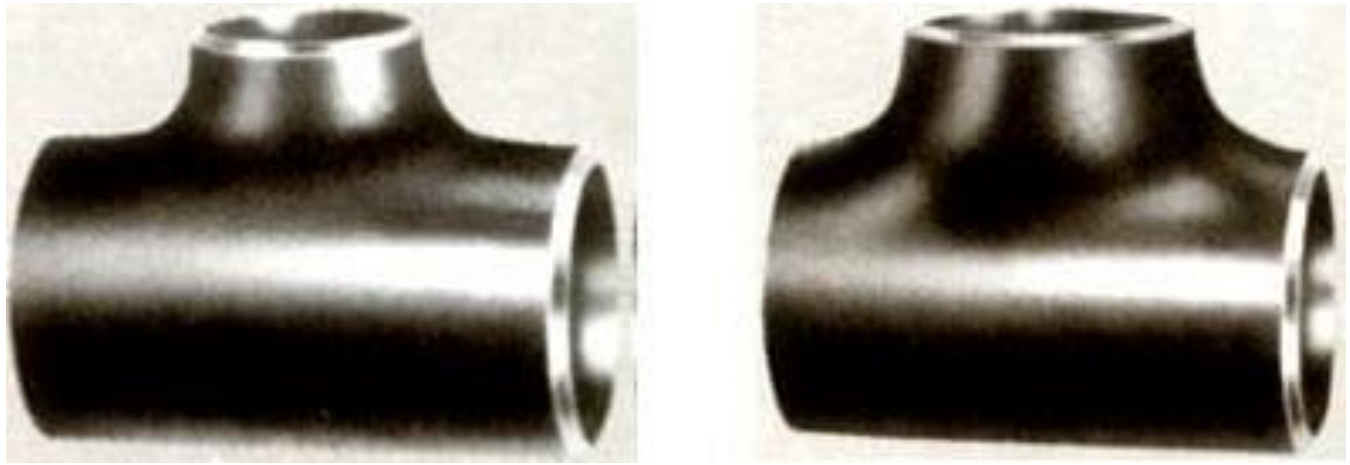
v. Reducing Elbow

The 90 reducing elbows is designed to change direction and reduce the pipe size within a piping system. The reducing elbow eliminates one pipe fitting and reduces the welding by more than one-third. Also, the gradual reduction in diameter throughout the arc of the reducing elbow provides lower resistance to flow and reduces the effect of stream turbulence and potential internal erosion. These features prevent sizeable pressure drops in the line.

Source: *https://hardhatengineer.com/wp-content/uploads/2016/12/Reducing-Elbow.jpg*

c. Pipe Tee Fitting

A Tee fitting is used for distributing or collecting the fluid from the run pipe. It is a short piece of pipe with a 90-degree branch at the center. Two types of Tee are used in piping: Equal / Straight Tee and Reducing / Unequal Tee.



Source: *https://hardhatengineer.com/wp-content/uploads/2016/12/Pipe-Tee.jpg*

Pipe Tee Fitting Cont'd

i. Straight Tee:

In straight tee, the diameter of the branch is the same as the diameter of the Run (Header) Pipe.

Source: *https://www.wermac.org/fittings/dim_tees_eq.html*

Pipe Tee Fitting Cont'd

ii. Reducing Tee

In reducing tee, the diameter of the branch size is smaller than the diameter of the Run (Header) Pipe.

Source: *https://www.octalpipefittings.com/steel-tee-equal-and-reducing-tee/*

Pipe Tee Fitting Cont'd

iii. Barred Tee

A barred tee, also known as a scrapper tee, is used in pigged pipelines. The tee branch has a restriction bar welded internally to prevent the pig or scrapper from entering the branch. The bars are welded in the branch in a way that it will allow restriction-free passage of the pig from the run pipe.

Source: *https://hardhatengineer.com/wp-content/uploads/2017/12/Barred-Tee.png*

Pipe Tee Fitting Cont'd

iv. Wye Tee / Lateral

It is a type of Tee that has a branch at a 45° angle or an angle other than 90°. Wye tee allows one pipe to be joined to another at a 45° angle. This type of tee reduces friction and turbulence that could hamper the flow. Wye tee is also known as a lateral.

Source: *https://hardhatengineer.com/wp-content/uploads/2017/12/why-lateral-tee.png*

Pipe Tee Fitting Cont'd

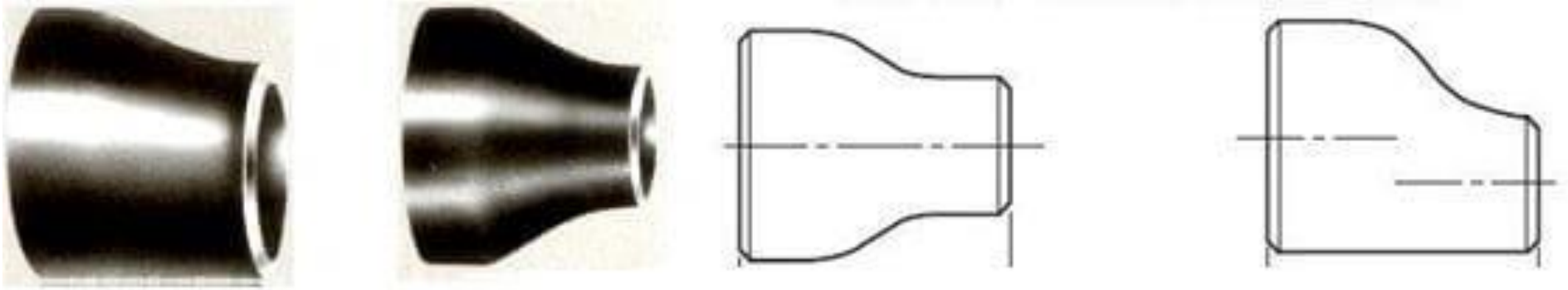
v. Cross

Cross is also known as four-way pipe fitting. A cross has one inlet and three outlets (or vice versa). Generally, crosses are not used in process piping to transport fluid. But forged crosses are common in the firewater sprinkler line.

***Source**: https://hardhatengineer.com/wp-content/uploads/2016/12/Cross.jpg*

d. Pipe Reducers

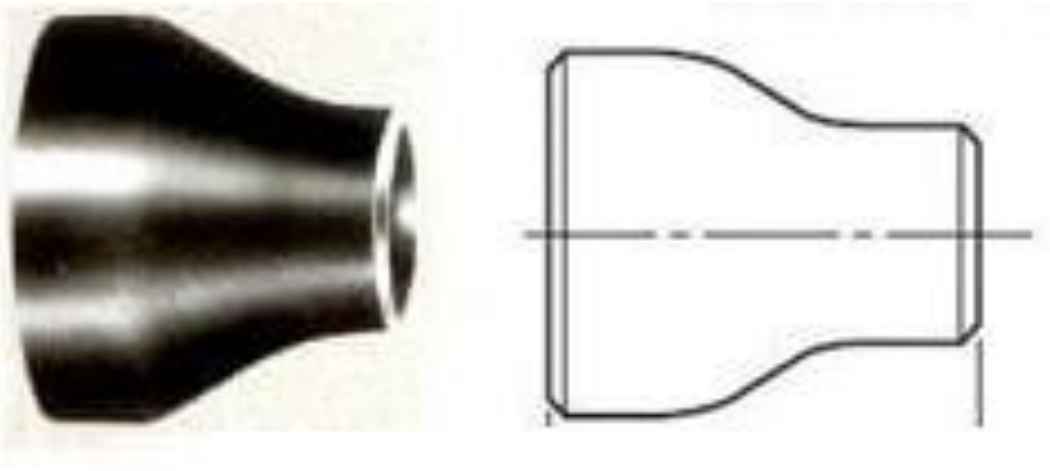
A pipe reducer changes the size of the pipe. There are two types of reducers used in piping Concentric & Eccentric.



Source: *https://hardhatengineer.com/wp-content/uploads/2016/12/Pipe-Reducer.jpg*

i. Concentric Pipe Reducer or Conical Reducer

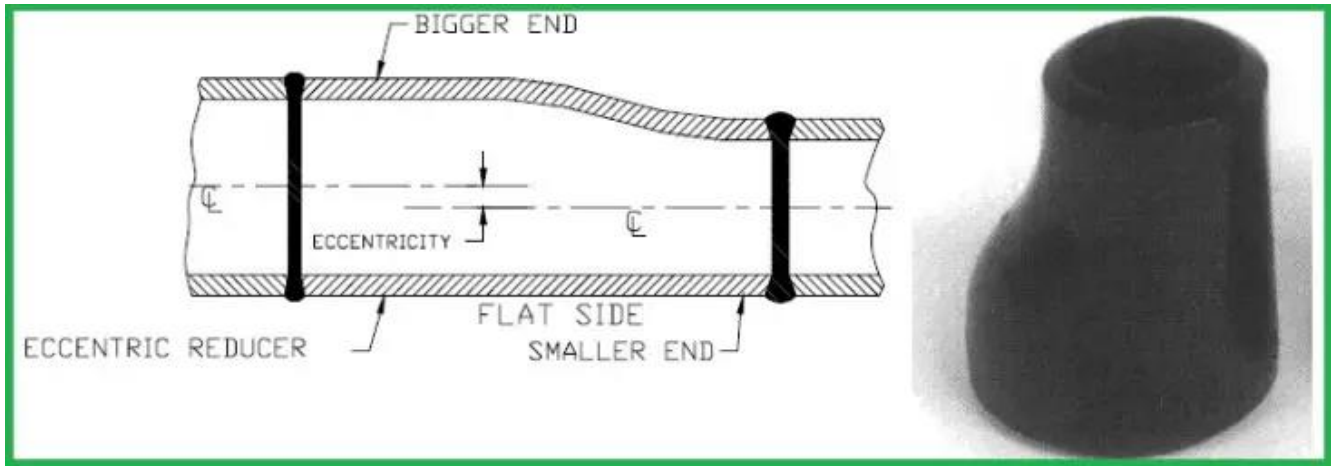
In a Concentric reducer, also known as a conical reducer, the center of both ends is on the same axis. It maintains the centerline elevation of the pipeline. When the center lines of the larger and smaller pipe are to be maintained the same, concentric reducers are used. Reducers are reversible and can be used in any direction.



Source: *https://hardhatengineer.com/wp-content/uploads/2016/12/Pipe-Reducer.jpg*

ii. Eccentric Reducer

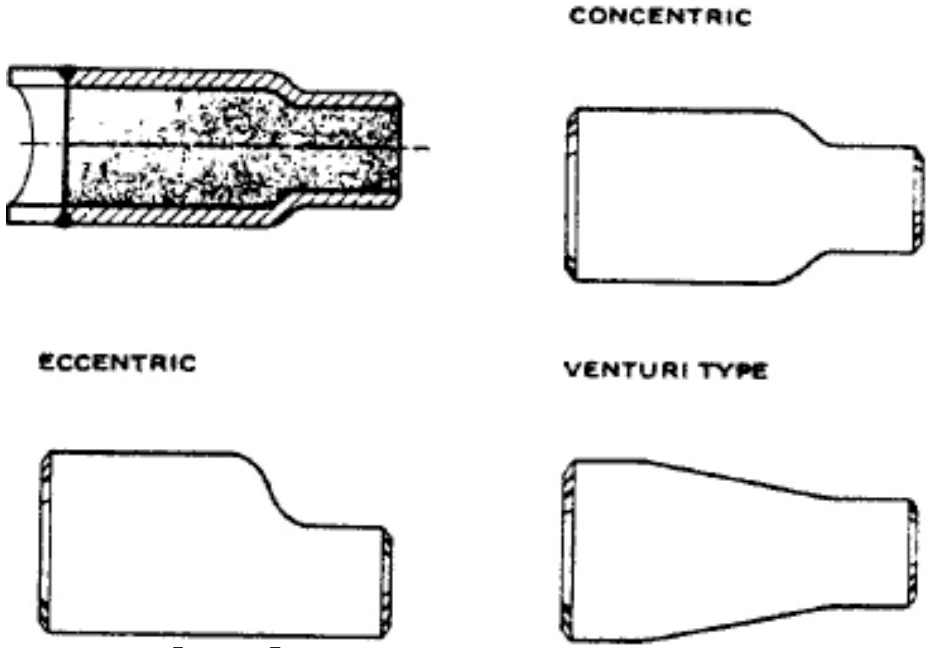
In eccentric reducer there is an offset in between the center lines of the bigger end and the centerline of the smaller end. This offset or eccentricity will maintain a flat side either on top or on the bottom side. the reduction in the pipe size is achieved at a constant rate but maintains one side of the fitting horizontally. The use of eccentric reducers is also reversible and can be used as eccentric expanders. Eccentric reducers are not symmetrical about their centerlines.



Source: *https://whatispiping.com/pipe-reducers/*

Swage Reducer

The swage is like reducers but small in size and used to connect pipes to smaller screwed or socket welded pipes. Like reducers, they are also available in concentric & eccentric types. Swages are available in different end types. Such as both plain ends or one plain and one threaded end.



Source: *https://hardhatengineer.com/wp-content/uploads/2017/12/pipe-swage.png*

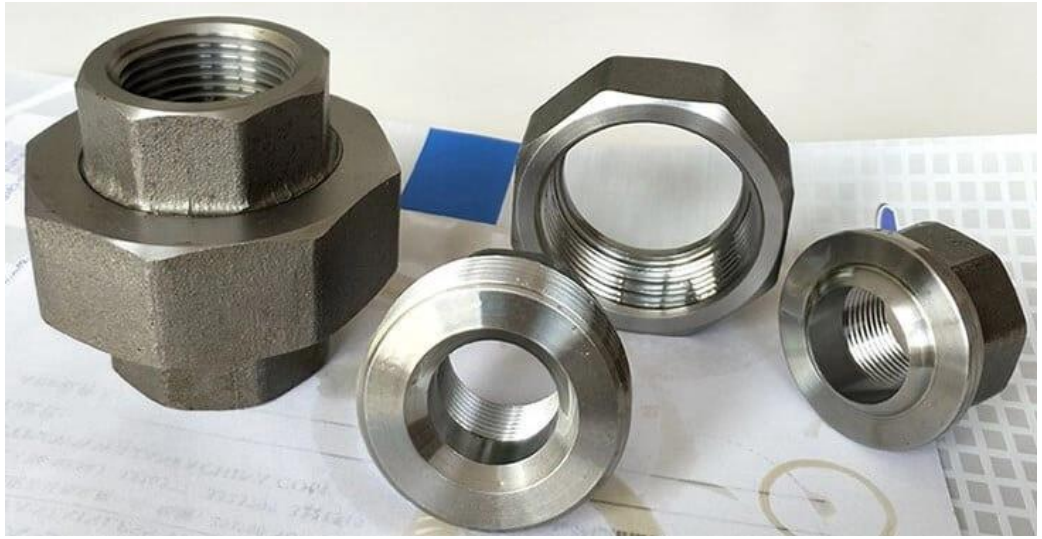
e. Returns – 180 Degree Elbow

Returning elbows are used to make a 180º change in direction. Available in short & long patterns. Returns are used in the heating coil, heat exchanger, tank vent, etc.

Source: *https://hardhatengineer.com/wp-content/uploads/2016/12/Returns-180-degree-bend.jpg*

f. Piping Union

Unions are used as an alternative to flanges connection in low-pressure small bore piping where the dismantling of the pipe is required more often. Unions can be threaded ends, or socket weld ends. There are three pieces in a union, a nut, a female end, and a male end. When the female and male ends are joined, the nuts provide the necessary pressure to seal the joint.



Source:
https://hardhatengineer.com/wp-content/uploads/2017/12/Pipe-union.jpg

g. Pipe Nipple

The nipple is a short pipe stub with a male pipe thread at each end or at one end. It is used for connecting two other fittings. Nipples are used for connecting pipes, hoses, and valves. Pipe nipples are used in low-pressure piping.

Source: *https://hardhatengineer.com/wp-content/uploads/2017/12/pipe-Nipple-weld.jpg*

h. Pipe Coupling

There are three types of coupling available;

- ✓Full Coupling
- ✓Half Coupling
- ✓Reducing Coupling

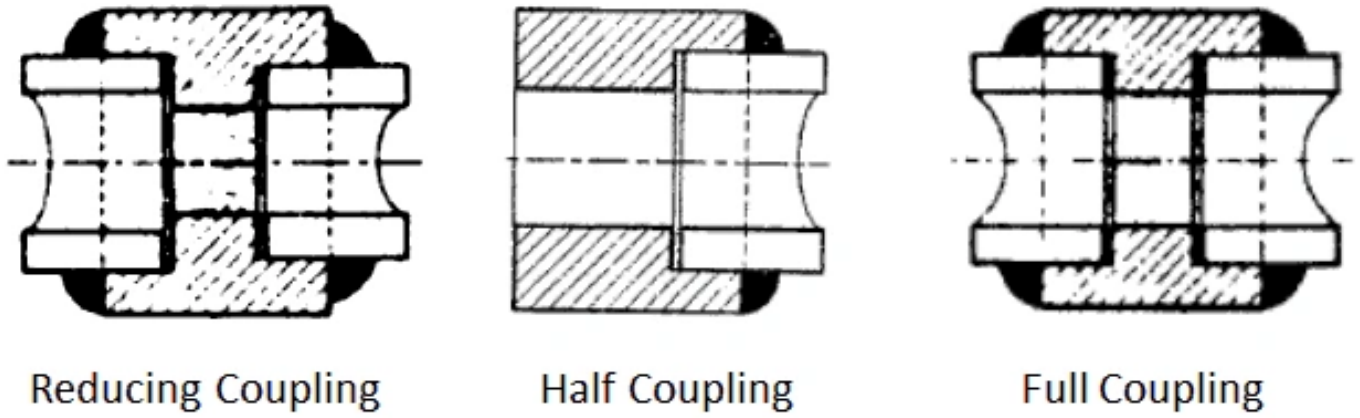
Source: *https://hardhatengineer.com/wp-content/uploads/2016/12/Half-Coupling.jpg*

Pipe Coupling Cont'd

Reducing coupling is used to connect two different sizes of pipe. It is like a concentric reducer that maintains a centerline of the pipe but is small in size.

Half Coupling is used for small bore branching from a vessel or large pipe. It can be threaded or socket type. It has a socket or thread end on only one side.

Full Coupling is used for connecting small bore pipes. It is used to connect pipe to pipe or pipe to swage or nipple. It can be threaded or socket ends



Reducing Coupling Half Coupling Full Coupling

Source: *https://hardhatengineer.com/wp-content/uploads/2017/12/reducing-half-and-full-coupling.png*

III.4. Conclusion

Pipe fittings are many, the aforementioned ones here are like samples. Pipe fitting component is used according to the purpose: connecting piping system components, changing direction in piping system, controlling the flow and changing the size.

References

1. ASPE, (2010). Plumbing Engineering Design Handbook: A Plumbing Engineer's Guide to System Design and Specifications (Vol 2). River Road. Retrieved www.pdfdrive.com.
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