

Types of Pipe Fittings Used in Piping

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Types of Pipe Fittings – In pipe systems, a fitting or adapter is used to join straight lengths of pipe or tube, adapt to different sizes or forms and regulate (or measure) fluid flow among other things. These fittings are used in plumbing to control the flow of water, gas, or liquid waste in a system of pipes or tubes in a household or commercial setting.

Fittings (especially unusual varieties) take time, money, materials, and tools to install, but they're an essential aspect of piping and plumbing systems. Although valves are technically fittings, they are often treated independently.

What is Pipe Fitting?

Pipe fittings are used to join pipes together. Component of the piping system that aids in Elbows and tees change the flow direction. Reducers and reducing tees change the pipe's size. Various parts, like couplings, are used to connect and stop flows, whereas Caps are used to halt flows.

Standards

When constructing (or producing) a plumbing system, standard codes are followed. The following are some of the organizations that publish pipe standards:

- ASTM International: American Society for Testing and Materials
- ASME: American Society of Mechanical Engineers
 - 19.2 Ceramic plumbing fixtures standard
 - 19.1 Enameled cast-iron and steel plumbing fixtures standards
- API: American Petroleum Institute
- AWWA: American Water Works Association
- AWS: American Welding Society
- ANSI: American National Standards Institute
- NFPA: National Fire Protection Association
- MSS: Manufacturers Standardization Society
- CGA: Compressed Gas Association
- PCA: Plumbing Code of Australia
- EJMA: Expansion Joint Manufacturers Association

Pipes must meet the following dimensional requirements:

- ASME B36.19M: Stainless-steel pipe
- ASME B36.10M: Welded and seamless wrought-steel pipe
- ASME B31.4 XXXX: Power piping
- ASME B31.3 2008: Process piping

Chemical, pharmaceutical, textile, paper, semiconductor, and cryogenic industries, as well as related processing plants and terminals, are all covered by the B31.3 and B31.4 codes.

Materials and components, design, manufacturing, erection, assembly, inspection, examination, and pipe testing are all covered by these rules. Raw, intermediate, and finished chemicals; gas, steam, air, and water; petroleum products; fluidized solids; refrigerants, and cryogenic fluids are all covered by the codes.

Materials

The material used to make a pipe is frequently the deciding factor in pipe selection. Pipes are made from various materials, including:

- Carbon(CS) and galvanized steel
- Low-temperature carbon steel (LTCS)
- Impact-tested carbon steel (ITCS)
- Malleable iron
- Stainless steel(SS)
- Non-ferrous metals (includes inconel, copper, incoloy, and cupronickel)
- Chrome-molybdenum (alloy) steel (commonly used for high-temperature service)

- Non-metallic (includes acrylonitrile butadiene styrene(ABS), polyvinyl chloride (PVC), fibre-reinforced plastic (FRP), high-density polyethylene (HDPE), chlorinated polyvinyl chloride (CPVC), and toughened glass).

The bodies of pipe and tube fittings are often made of the same material as the pipe or tubing they connect: copper, steel, PVC, CPVC, or ABS. Any material allowed by the plumbing, health, or construction codes (as appropriate) may be used, but it must be consistent with the other materials in the systems, the fluids being conveyed, and the temperature and pressure within (as well as outside) the system. Copper pipes and plumbing systems frequently use brass or bronze fittings. The choice of pipe and fitting materials is also influenced by aspects such as fire resistance, mechanical ruggedness, earthquake resistance, theft resistance, and others.



Example of threaded cast-iron fittings (Reference: [wikipedia.org](https://www.wikipedia.org))

Gaskets

Gaskets are ring-shaped mechanical seals that seal flange joints. Gaskets are distinguished by their structure, materials, and features. Nonmetallic (ASME B 16.21), spiral-wound (ASME B 16.20), and ring-joint gaskets are commonly employed (ASME B 16.20). With flat- or raised-face flanges, non-metallic gaskets are employed. With raised-face flanges, spiral-wound gaskets are utilized, while ring-joint gaskets are used with ring-type joint (RTJ) flanges. When an RTJ gasket is fastened to a flange, stress builds between the gasket and the flange groove, causing plastic deformation of the gasket.

Gender

To make connections, piping or tubing is normally placed into fittings. Connectors are allocated a gender, which is denoted by the letters M or F. A “3/4-inch female adapter NPT,” for example, would have a matching male connector of the same thread and size standard (in this case also NPT).

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Should I Use PVC or CPVC Pipe

Different Types of Pipe Fittings

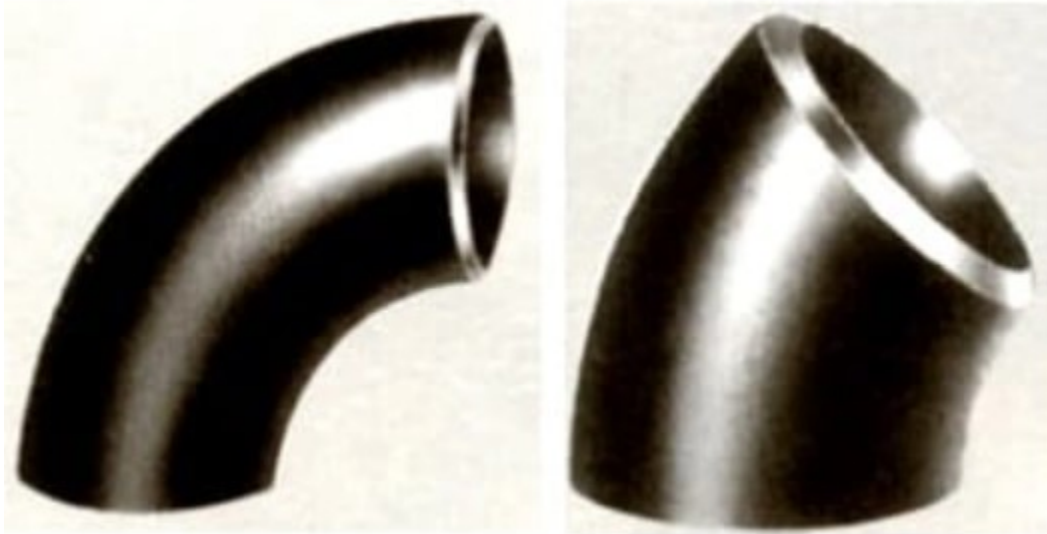
Pipe fittings come in various shapes and sizes. The following is a list of pipe fittings that are commonly used in piping projects.

- **Elbow**
- **Reducer**
- **Tee**
- **Coupling**
- **Adapters**
- **Union**
- **Valve**
- **Cross**
- **Olet**

- **Cap**
- **Plug**
- **Swage Nipple**
- **Expansion Joint**
- **Bush**
- **Long Radius Bend**
- **Steam Traps**
- **Flanges**

Pipe Elbow

Elbows are used more frequently than any other pipe fitting. It allows you to modify the pipe's direction with ease. The two most common kinds of the elbow are 90° and 45°. It can, however, be trimmed to any degree. Elbows come in two different radius types: short radius (1D) and long radius (1.5D).



Pipe Elbow (Reference: hardhatengineer.com)

90 Degree Elbow

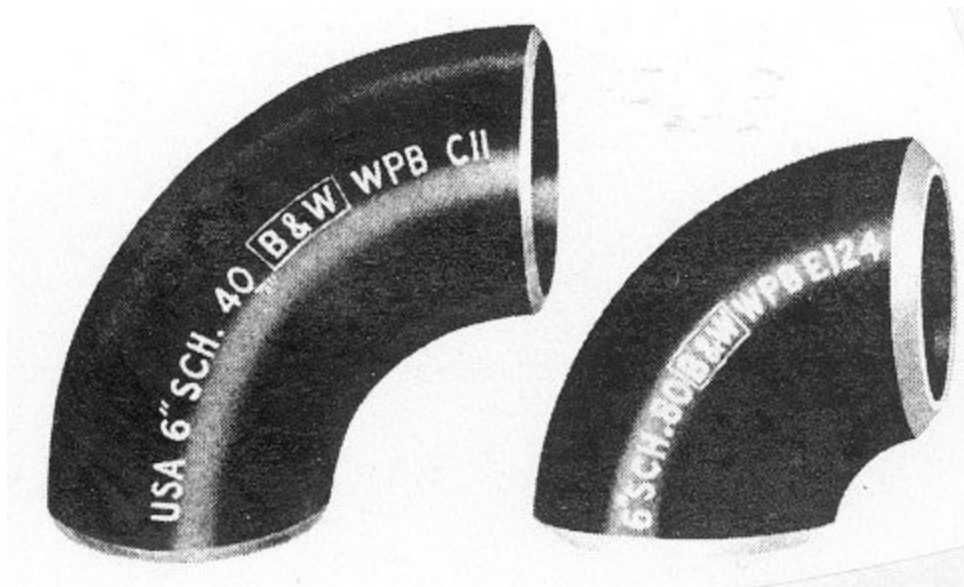
To shift the direction of the pipe by 90 degrees, a 90 degree elbow is put between the pipes. Long and short radius options are available.

45 Degree Elbow

To shift the direction of the pipe by 45 degrees, a 45 degree elbow is inserted between the pipes.

Long Radius Elbow

The centerline radius of a long radius elbow is 1.5 times the nominal size of the pipe or 1.5 times the diameter of the pipe. Long radius elbows are commonly used in pipes because they have less pressure loss than short radius elbows. It took up more room than a short radius elbow would.



Long Radius Elbow (Reference: hardhatengineer.com)

Short Radius Elbow

The centerline radius of a short radius elbow is the same as the pipe's nominal size, or one time the pipe's diameter. In applications where space is limited, short radius elbows are used. However, due to a quick shift in the flow direction, it exhibits a high-pressure drop.

Reducing Elbow

The 90 reducing elbows are used to alter the direction of a pipe while also lowering its size in a piping system. The reducing elbow replaces one pipe fitting and cuts welding time by more than a third. In addition, the decreasing elbow's steady decline in diameter over its arc minimizes flow resistance and lessens the influence of stream turbulence and probable internal erosion. These features prevent the line from experiencing significant pressure drops.



Reducing Elbow
(Reference: hardhatengineer.com)

Pipe Bend

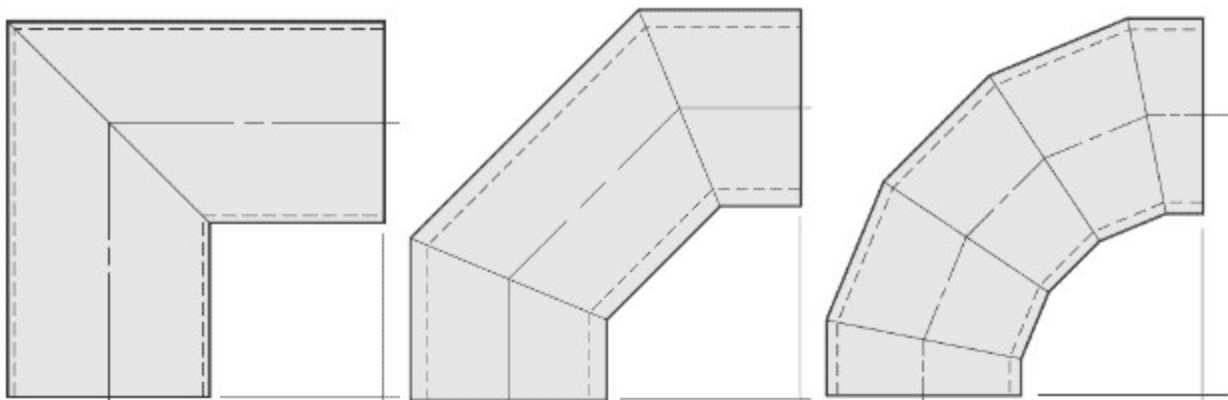
In fluid transportation lines that require pigging, long radius pipeline bends are used. The pipe bend has a minimal pressure drop because of its long radius and seamless change of direction, allowing for a smooth flow of fluid and pig. Three-dimensional (3D) and five-dimensional (5D) pipe bends are widespread. D denotes the pipe diameter.



Pipe Bend (Reference: hardhatengineer.com)

Miter Bend

Miter bends are made from pipes and are not normal pipe fittings. Because large size elbows are pricey, they are usually recommended for sizes 10" and up. Miter bends are only allowed on low-pressure water lines. Miter bends can be made in two, three, or five parts.



Miter Bend (Reference: hardhatengineer.com)

Returns – 180 Degree Elbow

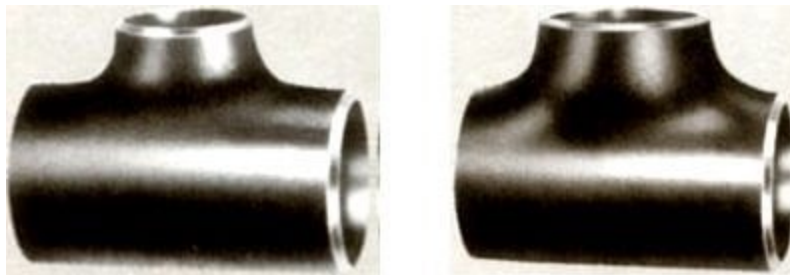
To make a 180° change in direction, return elbows are used. The design is available in two lengths: short and long. The heating coil, heat exchanger, tank vent, and other components all use returns.



Returns – 180 Degree Elbow
(Reference:
hardhatengineer.com)

Pipe Tee

The fluid from the run pipe is distributed or collected using a pipe tee. It's a short section of pipe with a central 90-degree branch. Equal / Straight Tee and Reducing / Unequal Tee are the two types of Tee used in pipes.



Pipe Tee (Reference: hardhatengineer.com)

Straight Tee

The diameter of the branch in a straight tee is the same as the diameter of the Run (Header) Pipe.

Reducing Tee

The diameter of the branch in a reducing tee is smaller than the diameter of the Run (Header) Pipe.

Barred Tee

In piggable pipelines, a barred tee, also known as a scrapper tee, is employed. A restriction bar is welded internally to the branch of the tee to prevent the pig or scrapper from entering the branch. The bars are welded into the branch in such a way that the pig can flow freely through the run pipe.



Barred Tee (Reference: hardhatengineer.com)

Wye Tee / Lateral

It's a sort of Tee with a branch that's at a 45° angle, or a different angle than 90°. The Wye tee is used to connect two pipes at a 45° angle. This form of tee lowers turbulence and friction, which can obstruct the flow. A lateral is another name for a Wye tee.



Wye Tee / Lateral (Reference: hardhatengineer.com)

Cross

Four-way pipe fitting is another name for a cross. One inlet and three exits make up a cross (or vice versa). In most cases, crosses are not used to transfer fluid in process pipes. Forged crosses, on the other hand, are typical in the firewater sprinkler system.



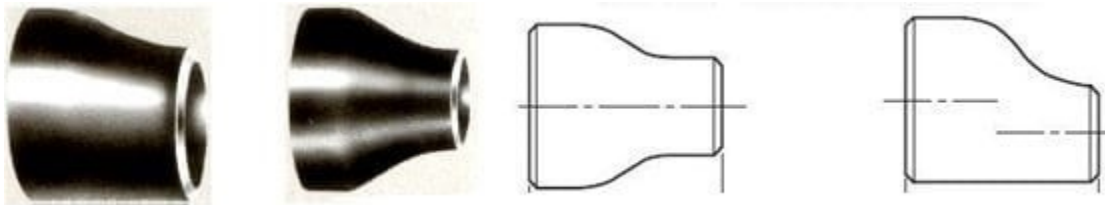
Cross (Reference: hardhatengineer.com)

Pipe Reducers

A pipe reducer reduces the pipe's diameter. In pipes, there are two types of reducers: concentric and eccentric.

Concentric Pipe Reducer or Conical Reducer

The center of both ends of a concentric reducer, also known as a conical reducer, is on the same axis. It maintains the pipeline's centerline elevation. Concentric reducers are employed when the center lines of the bigger and smaller pipes must be kept the same.



Concentric Pipe Reducer or Conical Reducer (Reference: hardhatengineer.com)

Eccentric Reducer

The center of both ends of the Eccentric reducer is on a separate axis, as illustrated in the illustration. It keeps the pipeline's BOP (bottom of pipe) height constant. Eccentric reducers are required when one of the pipeline's exterior surfaces must be kept the same.

$$\text{Offset} = (\text{Larger ID} - \text{Smaller ID}) / 2$$

Swage Reducer

Swages are similar to reducers, but they're smaller, and they're used to link larger screwed, or socket welded pipes to smaller screwed or socket welded pipes. They come in concentric and eccentric varieties, just like reducers. Swages come in a variety of end kinds. Both plain

ends or one plain and one threaded end, for example.



Swage Reducer (Reference: hardhatengineer.com)

Pipe Caps

A pipe's end is covered by the cap. Pipe caps are utilized at the piping system's dead end. It's also utilized for future connections in pipe headers.



Pipe Caps (Reference: hardhatengineer.com)

Stub Ends

With a lap joint flange, stub ends are used. The stub is butt-welded to the pipe in this form of a flange, but the flange can freely travel over the stub end. It is essentially a flange part, but it is covered by ASME B16.9, which is why it is referred to as pipe fittings.



Stub Ends (Reference: hardhatengineer.com)

Piping Union

In low-pressure small bore pipes where pipe dismantling is required more frequently, unions are utilized as an alternative to flange connections. Threaded or socket weld ends are available for unions. A union is made up of three parts: a nut, a female end, and a male end. The nuts also provide the necessary pressure to seal the connection when the female and male ends are linked.



Piping Union (Reference:
hardhatengineer.com)

Pipe Coupling

There are three different sorts of couplings:

- Full Coupling
- Half Coupling
- Reducing Coupling



Pipe Coupling
(Reference:
hardhatengineer.com)

Full Coupling

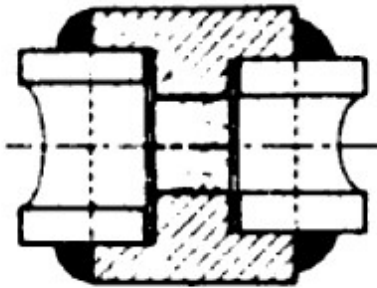
For connecting tiny bore pipes, a full coupling is employed. It was once used to join two pipes or a pipe to a swage or a nipple. Threaded or socket ends are available.

Half Coupling

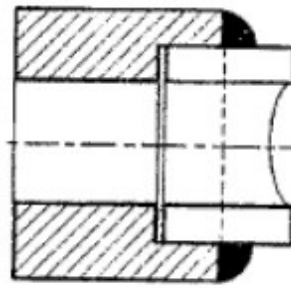
Small-bore branching from a vessel or large pipe is done with a half coupling. It can be either threaded or socketed. Only one side has a socket or thread end.

Reducing Coupling

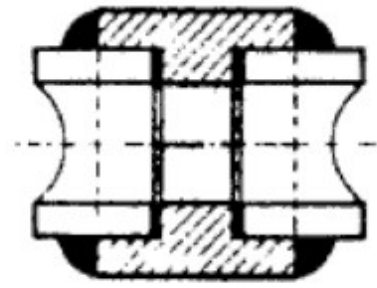
A reducing coupling is used to join two pipes of different diameters. It's similar to a concentric reducer in that it keeps the pipe's centerline but is much smaller.



Reducing Coupling



Half Coupling



Full Coupling

Pipe Coupling types (Reference: hardhatengineer.com)

Pipe Nipple

A nipple is a short stub of pipe with a male pipe thread on both ends or just one. It's used to join two other fittings together. Pipe, hoses, and valves are all connected with nipples. Low-pressure piping employs pipe nipples.



Pipe Nipple (Reference: hardhatengineer.com)

Socket weld and Threaded Pipe Fittings

Socket weld and Threaded Pipe Fittings are both forged products with different pressure-temperature ratings. They come in sizes ranging from 1/8" to 4" NPS. There are four pressure-temperature rating classes available for these fittings.

- 2000 class fittings are produced in only in threaded type.
- 3000 and 6000 class fittings are produced in both Threaded and Socket Weld types.
- 9000 class fittings are produced in only the socket weld type.

Small bore and low-pressure pipework require these fittings.

Socket Weld Elbow



Socket Weld Elbow (Reference: hardhatengineer.com)

Tee and Cross Socket Weld Type



Tee and Cross Socket Weld Type (Reference: hardhatengineer.com)

Threaded Pipe Fittings



Threaded Pipe Fittings (Reference: hardhatengineer.com)