Elbow vs Pipe Bend

Thursday, May 12, 2016
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Piping Elbows and Bends are very important pipe fitting which are used very frequently for changing direction in piping system. Piping Elbow and Piping bend are not the same, even though sometimes these two terms are interchangeably used.

A BEND is simply a generic term in piping for an “offset” – a change in direction of the piping. It signifies that there is a “bend” i.e, a change in direction of the piping (usually for some specific reason) – but it lacks specific, engineering definition as to direction and degree. Bends are usually made by using a bending machine (hot bending and cold bending) on site and suited for a specific need. Use of bends are economic as it reduces number of expensive fittings.

An ELBOW, on the other hand, is a specific, standard, engineered bend pre-fabricated as a spool piece (based on ASME B 16.9) and designed to either be screwed, flanged, or welded to the piping it is associated with. An elbow can be 45 degree or 90 degree. There can also be custom-designed elbows, although most are categorized as either “short radius” or long radius”.

The difference between them is as follows:

1. Bend is a generic term for any offset or change of direction in the piping. It is a vague term that also includes elbows.
2. An elbow is an engineering term and they are classified as 90 deg or 45 deg, short or long radius.
3. Elbows have industrial standards and have limitations to size, bend radius and angle. The angles are usually 45 deg or 90 degrees. All others offsets are classified as pipe bends.
4. Bends are generally made or fabricated as per the need of the piping; however elbows are pre fabricated and standard, and are available off the shelf.
5. Bends are never sharp corners but elbows are. Pipe bending techniques have constraint as to how much material thinning can be allowed to safely contain the pressure of the fluid to be contained. As elbows are pre fabricated, cast or butt welded, they can be sharp like right angles and return elbows which are 180 degrees.
6. Elbow is a standard fitting but bends are custom fabricated.
7. In bends as the pipe is bent and there is no welding involved, there is less pipe friction and flow is smoother. In elbows, the welding can create some friction.
8. All elbows are bends but all bends are not elbows.
9. Bend has a larger radius then elbows.
10. Generally the most basic difference is the radius of curvature. Elbows generally have radius of curvature between one to twice the diameter of the pipe. Bends have a radius of curvature more than twice the diameter.

Whenever the term elbow is used, it must also carry the qualifiers of type (45 or 90 degree) and radius (short or long) – besides the nominal size.

Elbows can change direction to any angle as per requirement. An elbow angle can be defined as the angle by which the flow direction deviates from its original flowing direction (See Fig.1 below).Even though An elbow angle can be anything greater than 0 but less or equal to 90°But still a change in direction greater than 90° at a single point is not desirable. Normally, a 45° and a 90° elbow combined used while making piping layouts for such situations.

Elbows or bends are available in various radii for a smooth change in direction which are expressed in terms of pipe nominal size expressed in inches. Elbows or bends are available in three radii,

- Long radius elbows (Radius = 1.5D): used most frequently where there is a need to keep the frictional fluid pressure loss down to a minimum, there is ample space and volume to allow for a wider turn and generate less pressure drop.
- Long radius elbows (Radius > 1.5D): Used sometimes for specific applications for transporting high viscous fluids likes slurry, low polymer etc. For radius more than 1.5D pipe bends are usually used and these can be made to any radius. However, 3D & 5D pipe bends are most commonly used
- Short radius elbows (Radius = 1.0D): to be used only in locations where space does not permit use of long radius elbows and there is a need to reduce the cost of elbows. In jacketed piping the short radius elbow is used for the core pipe

Here D is nominal pipe size in inches.

There are three major parameters which dictates the radius selection for elbow:

- Space availability,
- Cost, and
- Pressure drop.

Pipe bends are preferred where pressure drop is of a major consideration.