

§195.212 Bending of pipe.

- (a) Pipe must not have a wrinkle bend.
- (b) Each field bend must comply with the following:
- (1) A bend must not impair the serviceability of the pipe.
 - (2) Each bend must have a smooth contour and be free from buckling, cracks, or any other mechanical damage.
 - (3) On pipe containing a longitudinal weld, the longitudinal weld must be as near as practicable to the neutral axis of the bend unless-
 - (i) The bend is made with an internal bending mandrel; or
 - (ii) The pipe is 323.8 mm (12¾ in) or less nominal outside diameter or has a diameter to wall thickness ratio less than 70.
- (c) Each circumferential weld which is located where the stress during bending causes a permanent deformation in the pipe must be nondestructively tested either before or after the bending process.

Neutral Axis – That portion of the pipe bend or tube bend that is neither in compression or tension.

neutral axis — The line separating the regions of compression (intrados) and elongation (extrados) of the tube wall during the bending process. Because the intrados and extrados extend into the leading and trailing tangents of a bend, so does the neutral axis which widens into an inactive zone at these extremes. Contrary to common misconception, the neutral axis is not the centerline radius, which is a geometric entity. The neutral axis lies inboard of the centerline radius. The neutral axis is a narrow region, lying inside of the centerline radius, separating the zone of compression from the zone of stretching. At the neutral axis the tube wall neither compresses nor stretches.

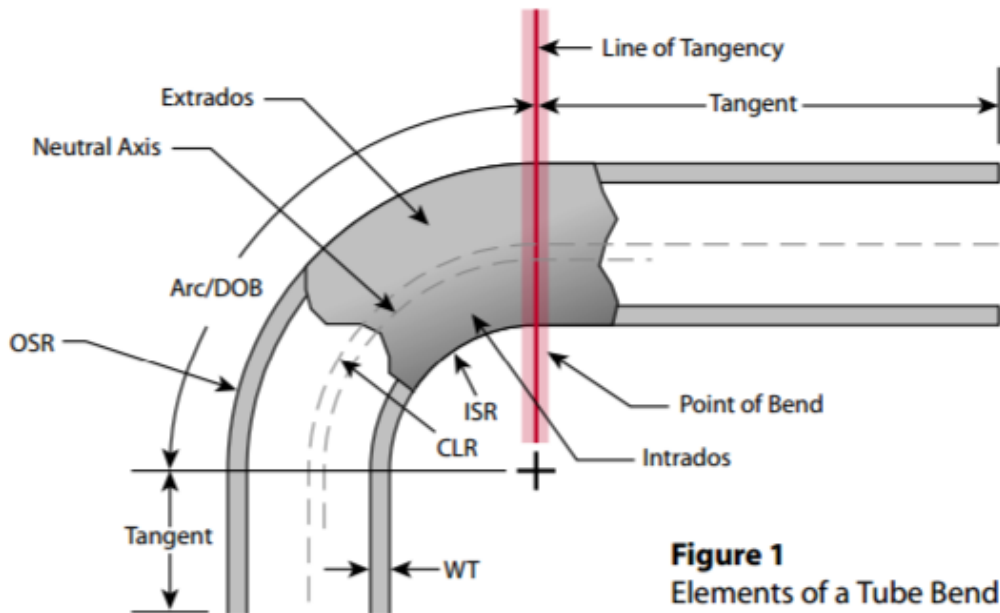


Figure 1
Elements of a Tube Bend

arc — The curved section of a bent tube, as opposed to the straight unbent sections (i.e., tangents); the bend itself; the physical manifestation of the geometry of bend radius combined with degree of bend. degree of bend — The depth of bend; the sweep of the arc.

centerline radius — The most common specification for the arc of a tube bend. Physically, it is the location of the crown of bend; geometrically, it is the continuation of the vertical centerline of the tube into the arc.

tangent — The unbent section of a bent tube, as opposed to the arc of the bend. Each bent part consists of at least two tangents and a bend. The end tangents of a bent part are those tangents at each end of the part, and the mid-tangents are the remaining tangents between the bends of the part (assuming the part has more than one bend in it). The forward or lead tangent is the tangent that lies ahead of the line of tangency during the bending process, and the back or trailing tangent is that which lies behind.

outside radius — A specification for the arc of a tube bend, most commonly used with non-round tubing. (The centerline radius, which see, is almost always used to specify the bend of a round tube.) Physically, it is the outermost edge of bend; geometrically, it is the continuation of the outboard line of the tube into the arc.

Intrados vs. inside radius. The intrados is the zone of compression, bounded by the inside radius and the neutral axis.

Extrados vs. outside radius. The extrados is the zone of stretching, bounded by the outside radius and the neutral axis.