NCPWB
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The 37-1/2 Bevel

The 37-1/2° bevel is the normal bevel angle to find on pipe fittings and flanges and in many specifications and standards. Where did such a specific angle originate?

In the beginning, piping was welded using oxy-acetylene torches. Because the energy in oxy-acetylene welding is diffuse compared to that of an electric arc, the groove angle has to be wide open – a 45° bevel resulting in a groove angle of 90° as shown in Figure 1 -- so the heat from the torch can get at the base metal and melt into the groove face readily; make the groove angle smaller and incomplete fusion will become a problem.

When arc welding became popular, the pipeline guys jumped on it because it was so fast. They realized that the 90° groove angle was not necessary since the arc had no difficulty melting into the groove face and land, so they changed the bevel angle to 30°, resulting in a groove angle of 60°. That reduced the amount of weld metal that was needed to make a weld by 30%. The process piping guys were slower to adopt arc welding. Since the stresses on process piping can be more cyclic than those of pipelines, piping engineers thought their welds should be higher quality, and that a 60° groove angle was more likely to lead to incomplete fusion defects. On the other hand, they also recognized that they did not need a 90° groove angle if they were going to be using arc welding -- that was a waste of time and labor! The compromise between a 90° groove angle and a 60° groove angle was, obviously, a 75° groove angle; if you cut 75° groove angle in half, you get a 37-1/2° bevel. The ± 2-1/2° tolerance was added as an afterthought.

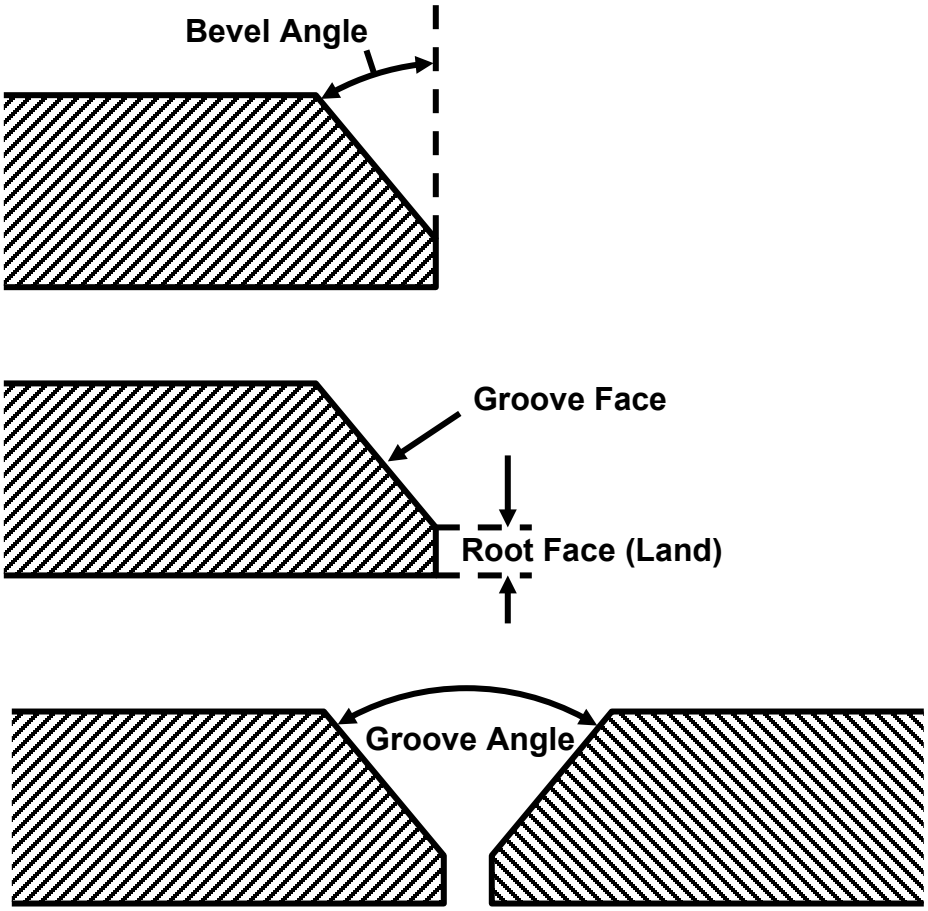
So that's the story as it was told to me by some old piping engineers who were in the Pipe Fabrication Institute when I was a young engineer. The committees that write specifications for pipe (as opposed to fittings and flanges) are dominated by pipe producers. Since one of their biggest customers is the pipeline industry, pipe from the mill has a bevel angle of 30 to 35°. Fittings and flanges, on the other hand, are produced to serve the process piping industry, and that industry has stronger representation on the B16 fittings standards committees, so fittings come with the 37-1/2° bevel as standard. Fortunately, welding fittings with a 37-1/2° bevel to pipe with a 30° bevel is not a problem.

The ± 2-1/2° bevel tolerance implies that the bevel angle is a lot more critical than it is; a bevel angle of 35 to 40° would imply less criticality, but the 37-1/2 ± 2-1/2° is established and is not likely to change.

One of the most critical aspects of groove design is the groove angle; it has to be sufficiently open that the welder can get at the root and make the root pass properly. For most arc welding processes, this means that the groove angle should be not less than 60°. There are two significant exceptions to this recommendation:

1) When welding nickel and nickel alloys, the groove angle should be more open because of the sluggish nature of the nickel alloy weld pool. A 90° groove angle is preferred to ensure good fusion into the groove face and the land.
2) When welding aluminum using GMAW, the groove angle should be more open because that allows the arc to impinge more directly on the aluminum surface and break up the surface oxide layer, ensuring good fusion. A 90° groove angle is preferred when welding aluminum using GMAW

Parts of a Weld Groove



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