ASME B16.5 Metric Values - A Philosophy

Introduction

The 2003 Edition of ASME B16.5, Pipe Flanges and Flanged Fittings NPS ½ through NPS 24 Metric/Inch Standard, contains millimeter dimensions and pressure-temperature ratings expressed in bar, with US Customary units in either parenthetical or separate forms. The purpose of this paper is to offer an explanation about why some of the conversions were made the way they were.

The cognizant committee had two primary goals during the development of the metric values shown in the 2003 Edition:

- The dimensions in mm should reflect the needed precision as much as possible.
- Flanges manufactured using existing forging dyes and machinery settings based on the inch dimensions should be able to meet the requirements for the metric dimensions.

Conversion from the Original Fraction

ASME B16.5 dimensions before 1977 were expressed mostly in fractional inches instead of decimal inches. For example, 1/8 in. was shown as 0.12 in. or 0.125 in., depending on the intended precision of the dimension, starting in the 1977 edition.

Millimeter dimensions were converted from the original fractional inch dimensions rather than the decimal inch dimensions. For example, 1/16 in., when converted from the fraction, converts to 1.6 mm. The decimal "equivalent" (0.06 in.) converts to 1.5 mm. Some of the conversions shown in the tables will appear to be incorrect when converted from the decimal inch dimensions.

1/16 in. was sometimes converted to nearest 0.1 mm, sometimes converted to the nearest 0.5 mm, and at other times converted to the nearest 1 mm. The conversion depended on the needed precision of the measurement. So the millimeter equivalent for 0.06 in. is sometimes 1.6 mm, sometimes 1.5 mm and at other times 2 mm.

Toleranced Dimensions

Dimensions that have tolerances are those that are considered to be needed for adequate fit-up and those important for integrity of the pressurized flanged joint. These dimensions were converted such that the metric dimensions are essentially the same as the US Customary dimensions, and the tolerances were selected such that the permitted deviations from the tabulated dimensions were nearly identical to those permitted by the US Customary dimensions.

Bolt circle diameter converted to nearest 0.1 mm. The committee believes this level of precision is needed to minimize problems with fit-up to other flanges, even though the tolerance on the dimension is 1.5 mm. Converting with less precision was expected to cause additional problems with centering metal gaskets as well.
Length through hub converted to nearest 1 mm. This dimension needs to be consistent in order to maintain overall dimensions for fabricated spools. The committee believes that maintaining this dimension to the nearest whole millimeter provides the needed precision.

Un-toleranced Dimensions

Dimensions that have no tolerances are those that need not have precision for fit-up and don't contribute significantly to the integrity of the pressurized flanged joint. Examples of those dimensions and the philosophy used to create the millimeter dimensions are:

1/16" raised face converted to 2 mm instead of 1.6 mm. Raised faces measuring something different than 2 mm meet the requirements of the standard. Conversion to the nearest mm reflects the intended precision of the dimension.

Outside diameter of flanges converted to nearest 5 mm. For example, NPS ¾ Class 600 Flange outside diameter. The 4-5/8" was converted to the nearest 5 mm (115) instead of the nearest whole mm (117) or tenth mm (117.5). Outside diameters measuring other than 115 mm meet the requirements of the standard. Conversion to the nearest 5 mm reflects the intended precision of the dimension.

Bolt hole diameters expressed in fractional inches. Inch dimension bolt holes were retained for flanges manufactured to metric dimensions. Inch bolts are recommended for use with these flanges. Extensive dimensional compatibility studies exploring the possibility of using metric as well as inch dimensioned bolting with ASME B16.5 flanges were conducted. The studies revealed that providing dimensions that allowed for the use of metric as well as inch dimensioned bolts, especially when combined with metal gaskets, was impossible. This conclusion was supported by experience with some flanges manufactured to ISO 7005-1, Metallic flanges – Part 1: Steel flanges.

In Summary

The cognizant subcommittee did not intentionally change any of the requirements for dimensions in the 2003 Edition of ASME B16.5. The dimensions in mm reflect the needed precision as much as possible.

Flanges manufactured using existing forging dyes and machinery settings based on the inch dimensions should be able to meet the requirements for the metric dimensions. While acceptable dimension ranges are not precisely the same for the two units of measure, there is a significant amount of overlap. Still it is possible for a flange to meet the requirements in one system of units and not in the other.