INTERNAL MACHINING AND SOLID MACHINED BACKING RINGS FOR CIRCUMFERENTIAL BUTT WELDS

ES-01

Prepared by

Pipe Fabrication Institute Engineering Committee

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METRIC CONVERSIONS

The conversion of quantities between systems of units involves a determination of the number of significant digits to be retained. All conversions depend upon the intended precision of the original quantity and are rounded to the appropriate accuracy.

Pipe sizes together with applicable wall thicknesses are not shown with metric equivalents.

| The SI (metric) values, were included with the customary U.S. values in this Standard are the rounded equivalents of the U.S. values and are for reference only.

Metric units were derived utilizing the following conversion factor:

Conversion	Factor
inches to millimeter	25.4

1. Scope

1.1 This Standard covers the dimensioning of solid machined backing rings and the internal machining of seamless and welded piping components for use with these rings.

1.2 Piping components must be internally machined to a close tolerance to accept solid machined backing rings. For this reason, solid machined backing rings are not recommended for use with piping components having a wall thickness less than 0.562" (14mm).

2. Backing Rings

2.1 Solid machined backing rings may be of either flat or tapered design. Refer to Figures l, 2, 3, and 4 for backing ring dimensions and design.

2.2 The nominal diameter of a tapered solid machined backing ring shall be 0.010" (0.3mm) larger than the corresponding nominal internal counterbore of the piping component. The nominal diameter of a flat solid machined backing ring shall be equal to the corresponding nominal internal counterbore of the piping component. The diametrical tolerance on either a flat or tapered solid machined backing ring shall be +.000" –.010" (+0.0mm – 0.3mm).

3. End Preparation

3.1 Typical end preparations for different wall thicknesses are shown in Figures 1 through 4. Those dimensions which are marked with an asterisk (*) may be modified as appropriate for the applicable welding process and variables associated with that process. These specific dimensions shall be defined in the Welding Procedure Specification.

4. Internal Machining

4.1 The following terms define the various dimensions and tolerances required to compute the internal machining dimensions ("C" dimension) for different types of piping components.

A = specified outside pipe diameter
B = nominal inside pipe diameter
C = I.D. machining dimension
d = specified minimum inside diameter
Mo = over tolerance on C-bore
Mu = under tolerance on C-bore
Ru = under tolerance on outside diameter
So = over tolerance on inside diameter
Su = under tolerance on inside diameter
T = minimum ordered wall thickness
t = nominal wall thickness
t_m = minimum wall required by design

4.2 To assure proper fit-up of adjoining components, and to assure proper fit-up of the backing ring it is recommended that "Mo" be set at +.010" (0.3mm) and "Mu" at –.000" (–.000mm).

NOTE: It must be recognized that large diameter pipe with a relatively thin wall, has a tendency to spring back after removal from the machining fixture, so the

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tolerance (Mu or Mo) on the internal machining dimension "C" is therefore applicable to pipe ends measured in the restrained condition. This should be considered when checking the "C" dimension after removal from the machining fixture.

4.3 Pipe and companion components specified by outside diameter.

4.3.1 For pipe and companion components specified by outside diameter and minimum wall, the I.D. machining dimension is determined as:

$C = A – Ru – Mo – 2t_m + Mo – Mu$

4.3.2 For seamless and hollow forged pipe to ASTM A106, A312[1], A335, A376, or A405, "Ru = 0.031 in. Using the recommended values of "Mo" and "Mu" in paragraph 4.2, Formula 4.3.1 becomes:

$C = A – 0.041 – 2t_m + .010" – .000"$

4.3.3 For pipe specified by outside diameter and nominal wall (or schedule) where the ASTM 12 1/2% nominal to minimum wall thickness tolerance applies, Formula 4.3.1 becomes

$C = A – 0.041 – 1.75\ t + .010" – .000"$

"C" dimensions and corresponding backing ring dimensions for standard ANSI B36.10 pipe sizes, 24" and under with wall thickness 0.562" (14mm) and heavier, are published in Table 1 : "Pipe specified by outside diameter and nominal wall ". These dimensions have been calculated in accordance with Formula 4.3.3.

4.4 Pipe and companion components specified by inside diameter.

4.4.1 The formulas below may be used as a guide to determine the internal machining dimension for pipe and companion components specified by inside diameter:

a) for use of flat solid backing rings.

$C = d + So + Su – Mo + Mo – Mu$

b) for use of tapered solid backing rings where the possibility of weld buildup is to be minimized or eliminated.

$C = d + So + Mo + Mo – Mu$

NOTES:

1. Where "d" is specified as nominal instead of minimum I.D., "Su" should be dropped from the expression.

2. When using welded plate pipe, permissible variations in out-of-roundness and diameter may make procurement of pipe with sized ends desirable. In this case "So" should be set equal to the plus sizing tolerance and "Su" the minus sizing tolerance.

4.5 Where the outside and/or inside diameters of the adjacent components differ from each other by more than the nominal tolerances, the heavier component shall be tapered in accordance with ANSI B16.25, Figure l.

5. Material Ordering

5.1 In some cases, selection of internal machining dimensions may affect ordered wall thicknesses of pipe and mating components.

5.2 Seamless pipe ordered by outside diameter: Formulas 4.3.1, 4.3.2 and 4.3.3 are intended to permit minimum wall to be maintained without purchase of material having wall thickness in excess of that required to satisfy "t_m", or "T" as applicable.

When pipe and adjoining components are received with the O.D. larger than dimension "A" but within the permitted O.D. tolerance, or when internal machining for solid machined backing rings is performed, it may be necessary to perform an additional operation of depositing weld metal on the I.D. or O.D. surface at the welding end (weld buildup) to assure satisfactory contact between the internal machined surface of the piping component and the backing ring and to maintain t_m.

Industry experience indicates that use of Formulas 4.3.1, 4.3.2 and 4.3.3 to determine the internal machining dimension will result in a satisfactory seat contact of 7/32" (6mm) minimum (approximately 75% minimum length of contact) between pipe and 10° tapered backing rings. Occasionally it will be necessary to perform a weld buildup to provide sufficient material for machining for satisfactory seating.

5.3 Pipe ordered to inside diameter:
When the formulas listed in 4.4.1 are used for computing internal machining dimensions, and pipe is received with the I.D. at the minimum of the permitted tolerance range, the possibility exists that machining will encroach "t_m"

[1] under tolerance for A312 varies with pipe size. Refer to ASTM specification.

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