ASME B16.25-2022

(Revision of ASME B16.25-2017)

Buttwelding Ends

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

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The American Society of Mechanical Engineers
Two Park Avenue • New York, NY • 10016 USA

Date of Issuance: August 31, 2023

The next edition of this Standard is scheduled for publication in 2027.

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FOREWORD

In July 1953, the American Welding Society presented a proposal on Welding End Preparation to Sectional Committee B16 of the American Standards Association (ASA), with the recommendation that it be considered as a candidate for an American Standard. The proposal was expanded to include welding preparation for flanges and valves covered by ASA B16.5, Steel Pipe Flanges and Flanged Fittings, and for fittings covered by ASA B16.9, Buttwelding Fittings. Consideration was also given to Pipe Fabrication Institute Standard ES-1.

The third draft reviewed by Subcommittee 3, Subgroup 6 (now Subcommittee F), of the B16 Sectional Committee was forwarded to the Committee, cosponsor organizations, and then ASA for approval. Final approval was given on September 14, 1955, with the designation ASA B16.25-1955.

Revisions were developed as a need for clarification and improvements became known and were approved as ASA B16.25-1958 and ASA B16.25-1964. After ASA reorganized as the American National Standards Institute (ANSI) and the Sectional Committee became American National Standards Committee B16, a further revision was approved as ANSI B16.25-1972.

Subcommittee F immediately began work on a major expansion and updating of the Standard, adding illustrations and requirements for welding end configurations applicable to a number of specific circumstances, including cast steel and alloy valves. When a draft had been developed that overcame the many problems and conflicting demands, the Standards Committee, cosecretariat organizations, and ANSI concurred in approval of ANSI B16.25-1979 on July 18, 1979.

In 1982, American National Standards Committee B16 was reorganized as a committee of The American Society of Mechanical Engineers (ASME) operating under procedures accredited by ANSI. In the 1986 edition, inch dimensions were established as the standard, and numerous changes in text and format were made. Notes for illustrations were also clarified. Following approval by the Standards Committee and ASME, approval as an American National Standard was given by ANSI on October 8, 1986, with the new designation ASME/ANSI B16.25-1986.

In 1992, the subcommittee revised the requirements for the preparation of the inside diameter of welding end. The references in Annex B were also updated. After public review and approval by ASME, this edition was approved by ANSI on October 26, 1992, with the new designation ASME B16.25-1992.

In the 1997 edition, metric dimensions were added as an independent but equal standard to the inch units. An Annex was also added to reference quality system requirements. Following approval by the Standards Committee and ASME, this revision to the 1992 edition of B16.25 was approved as an American National Standard by ANSI on April 17, 1997, with the new designation ASME B16.25-1997.

In the 2003 edition, the reference standard dates were updated. There were clarifications to text made to address inquiries. Tolerances on bevel angles were modified slightly. Following approval by the Standards Committee and ASME, this revision to the 1997 edition of B16.25 was approved as an American National Standard by ANSI on December 17, 2003, with the new designation ASME B16.25-2003.

In the 2007 edition, buttwelding end data were extended to cover requirements for sizes up to NPS 48 (DN 1200). The reference data were updated, and the interpretation section was removed from the Standard.

In the 2012 edition, the references in Mandatory Appendix II were updated, and notes were updated in the included tables.

In the 2017 edition, provisions were made to update verbiage and readings. Following the approval by the ASME B16 Standards Committee, approval as an American National Standard was given by ANSI on September 7, 2017.

In ASME B16.25-2022, the U.S. Customary table in former Mandatory Appendix I has been merged with the SI table in the main text. The tables and figures have been redesignated, former Mandatory Appendix I has been deleted, and the subsequent Mandatory Appendix has been redesignated. Cross-references have been updated accordingly. Also, in this edition, the references in Mandatory Appendix I (formerly Mandatory Appendix II) have been updated and reformatted. Following approval by the ASME B16 Standards Committee, ASME B16.25-2022 was approved by ANSI on November 28, 2022.

ASME B16 COMMITTEE
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(The following is the roster of the committee at the time of approval of this Standard.)

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Revisions and Errata. The committee processes revisions to this Standard on a continuous basis to incorporate changes that appear necessary or desirable as demonstrated by the experience gained from the application of the Standard. Approved revisions will be published in the next edition of the Standard.

In addition, the committee may post errata on the committee web page. Errata become effective on the date posted. Users can register on the committee web page to receive e-mail notifications of posted errata.

This Standard is always open for comment, and the committee welcomes proposals for revisions. Such proposals should be as specific as possible, citing the paragraph number(s), the proposed wording, and a detailed description of the reasons for the proposal, including any pertinent background information and supporting documentation.

Cases

(a) The most common applications for cases are

(1) to permit early implementation of a revision based on an urgent need

(2) to provide alternative requirements

(3) to allow users to gain experience with alternative or potential additional requirements prior to incorporation directly into the Standard

(4) to permit the use of a new material or process

(b) Users are cautioned that not all jurisdictions or owners automatically accept cases. Cases are not to be considered as approving, recommending, certifying, or endorsing any proprietary or specific design, or as limiting in any way the freedom of manufacturers, constructors, or owners to choose any method of design or any form of construction that conforms to the Standard.

(c) A proposed case shall be written as a question and reply in the same format as existing cases. The proposal shall also include the following information:

(1) a statement of need and background information

(2) the urgency of the case (e.g., the case concerns a project that is underway or imminent)

(3) the Standard and the paragraph, figure, or table number(s)

(4) the edition(s) of the Standard to which the proposed case applies

(d) A case is effective for use when the public review process has been completed and it is approved by the cognizant supervisory board. Approved cases are posted on the committee web page.

Interpretations. Upon request, the committee will issue an interpretation of any requirement of this Standard. An interpretation can be issued only in response to a request submitted through the online Interpretation Submittal Form at https://go.asme.org/InterpretationRequest. Upon submitting the form, the inquirer will receive an automatic e-mail confirming receipt.

ASME does not act as a consultant for specific engineering problems or for the general application or understanding of the Standard requirements. If, based on the information submitted, it is the opinion of the committee that the inquirer should seek assistance, the request will be returned with the recommendation that such assistance be obtained. Inquirers can track the status of their requests at https://go.asme.org/Interpretations.

ASME procedures provide for reconsideration of any interpretation when or if additional information that might affect an interpretation is available. Further, persons aggrieved by an interpretation may appeal to the cognizant ASME committee or subcommittee. ASME does not "approve," "certify," "rate," or "endorse" any item, construction, proprietary device, or activity.

Interpretations are published in the ASME Interpretations Database at https://go.asme.org/Interpretations as they are issued.

Committee Meetings. The B16 Standards Committee regularly holds meetings that are open to the public. Persons wishing to attend any meeting should contact the secretary of the committee. Information on future committee meetings can be found on the committee web page at https://go.asme.org/B16committee.

ASME B16.25-2022
SUMMARY OF CHANGES

Following approval by the ASME B16 Standards Committee and ASME, and after public review, ASME B16.25-2022 was approved by the American National Standards Institute on November 28, 2022.

In ASME B16.25-2022, the U.S. Customary table in former Mandatory Appendix I has been merged with the SI table in the main text. The table and figures have been redesignated, former Mandatory Appendix I has been deleted, and the subsequent Mandatory Appendix has been redesignated. Cross-references have been updated accordingly. In addition, this edition includes the following change identified by a margin note, (22). The Record Number listed below is explained in more detail in the "List of Changes in Record Number Order" following this Summary of Changes.

Page	*Location*	*Change (Record Number)*
16	Mandatory Appendix I	Updated *(22-812)*

LIST OF CHANGES IN RECORD NUMBER ORDER

Record Number	Change
22-812	Updated references in Mandatory Appendix I (former Mandatory Appendix II).

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BUTTWELDING ENDS

1 SCOPE

1.1 General

This Standard covers the preparation of buttwelding ends of piping components to be joined into a piping system by welding. It includes requirements for welding bevels, for external and internal shaping of heavy-wall components, and for preparation of internal ends (including dimensions and tolerances). Coverage includes preparation for joints with the following:

(a) no backing rings
(b) split or noncontinuous backing rings
(c) solid or continuous backing rings
(d) consumable insert rings
(e) gas tungsten arc welding (GTAW) of the root pass

Details of preparation for any backing ring must be specified when ordering the component.

1.2 Application

This Standard applies to any metallic materials for which a welding procedure can be satisfactorily qualified but does not prescribe specific welding processes or procedures. Unless otherwise specified by the purchaser, it does not apply to welding ends conforming to ASME B16.5, ASME B16.9, or ASME B16.47.

1.3 Relevant Units

This Standard states values in both SI (Metric) and U.S. Customary units. These systems of units are to be regarded separately as standard. Within the text, the U.S. Customary units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, it is required that each system of units be used independently of the other. Combining values from the two systems constitutes nonconformance with the Standard.

1.4 Size

Nominal pipe size (NPS), followed by a dimensionless number, is the designation for nominal fitting size. NPS is related to the reference nominal diameter (DN) used in international standards. The relationship is typically as follows:

NPS	DN
½	15
¾	20
1	25
1¼	32
1½	40
2	50
2½	65
3	80
4	100

For NPS ≥ 4, the related DN = 25 × NPS.

1.5 Referenced Standards

Standards and specifications adopted by reference in this Standard are shown in Mandatory Appendix I. It is not considered practical to identify the specific edition of each standard and specification in the individual references. Instead, the specific edition reference is identified in Mandatory Appendix I. A product made in conformance with a prior edition of referenced standards will be considered to be in conformance, even though the edition reference may be changed in a subsequent revision of the standard.

1.6 Quality Systems

Nonmandatory requirements relating to the manufacturer's quality system program are described in Nonmandatory Appendix A.

1.7 Convention

For determining conformance with this Standard, the convention for fixing significant digits where limits (maximum and minimum values) are specified shall be as defined in ASTM E29. This requires that an observed or calculated value be rounded off to the nearest unit in the last right-hand digit used for expressing the limit. Decimal values and tolerances do not imply a particular method of measurement.

2 TRANSITION CONTOURS

Figure 2-1 delineates the maximum envelope in which transitions from welding bevel to the outer surface of the component and from the root face to the inner surface of the component must lie. Except as specified in Figure 2-1,

Note (5), and as otherwise specified by the purchaser, the exact contour within this envelope is the manufacturer's option, provided it maintains the specified minimum wall thickness, has no slopes steeper than those indicated for the respective regions, and includes the proper surface for backing rings if specified.

3 WELDING BEVEL DESIGN

3.1 Bevels for Other Than GTAW Root Pass

(a) Components having nominal wall thicknesses of 3 mm (0.12 in.) and less shall have ends cut square or slightly chamfered.

(b) Components having nominal wall thicknesses over 3 mm to 22 mm (0.12 in. to 0.88 in.) inclusive shall have single angle bevels as illustrated in Figure 3.1-1.

(c) Components having nominal wall thicknesses greater than 22 mm (0.88 in.) shall have compound angle bevels as illustrated in Figure 3.1-2.

3.2 Bevels for GTAW Root Pass

(a) Components having nominal wall thicknesses of 3 mm (0.12 in.) and less shall have ends cut square or slightly chamfered.

(b) Components having nominal wall thicknesses over 3 mm to 10 mm (0.12 in. to 0.38 in.) inclusive shall have 37½ deg ± 2½ deg bevels or slightly concave bevels (see Figure 3.2-1).

(c) Components having nominal wall thicknesses over 10 mm to 25 mm (0.38 in. to 1.0 in.) inclusive shall have bevels as shown in Figure 3.2-2.

(d) Components having nominal wall thicknesses greater than 25 mm (1.0 in.) shall have bevels as shown in Figure 3.2-3.

3.3 Outside Diameter at Welding Ends

Dimension A shall be either that specified in the applicable component standard or that specified in the purchaser's component specification. In the absence of a requirement for dimension A in a component standard or a purchaser's specification, the values for dimension A in Table 3.3-1 may be used.

4 PREPARATION OF INSIDE DIAMETER OF WELDING END

4.1 General

Preparation of the inside diameter (I.D.) at the end of a component shall be in accordance with one of the following, as specified by the purchaser:

(a) Components to be welded without backing rings shall meet the requirements of the standard or specification for the component.

(b) Components to be welded using split or noncontinuous backing rings shall be contoured with a cylindrical surface at the end as shown in Figure 3.1-1, illustration (b) and Figure 3.1-2, illustration (b). If the backing ring contour is other than rectangular, details must be furnished by the purchaser.

(c) Components to be welded using solid or continuous backing rings shall be contoured with a cylindrical or tapered surface at the end as specified by the purchaser. End preparation is illustrated in Figure 3.1-1, illustration (c) and Figure 3.1-2, illustration (c) for rectangular ends and in Figure 3.1-1, illustration (d) and Figure 3.1-2, illustration (d) for tapered ends.

(d) Components to be welded using consumable insert rings or GTAW root pass shall be contoured with a cylindrical surface at the end as shown in Figures 3.2-1 through 3.2-3.

4.2 Dimension *C*

Values for dimension C shown in Figure 3.1-1, illustrations (c) and (d); Figure 3.1-2, illustrations (c) and (d); and Figures 3.2-2 and 3.2-3 can be determined by the following equations:

(SI Units)

$$C = A - \text{O.D. tolerance} - 2 \times t_{\min} - 0.25 \quad (1)$$

(U.S. Customary Units)

$$C = A - \text{O.D. tolerance} - 2 \times t_{\min} - 0.010 \quad (2)$$

where

A = specified outside pipe diameter at welding end (see para. 3.3)

O.D. tolerance = undertolerance on the pipe outside diameter (O.D.) from the applicable piping specification

$t_{\min}$ = t − manufacturing tolerance for pipe wall thickness per applicable pipe specification, mm (in.)

t = nominal wall thickness of pipe, mm (in.)

0.25 (0.010) = plus machining tolerance on bore C, mm (in.)

Based on tolerances specific to ASTM A106 [50 ≤ DN ≤ 1 200 (2 ≤ NPS ≤ 48)] and A335 [50 ≤ DN ≤ 300 (2 ≤ NPS ≤ 12)] pipe, including an undertolerance on wall thickness of 12.5%, eqs. (1) and (2) can be defined as follows:

(SI Units)

$$C = A - 0.79 - 2 \times 0.875t - 0.25$$

(U.S. Customary Units)

$$C = A - 0.031 - 2 \times 0.875t - 0.010$$

Table 3.3-1 lists the *C* values for pipe with an undertolerance on *A* of 0.79 mm (0.031 in.) and 12.5% on wall thickness for DN 50 to DN 1500 (NPS 2 to NPS 60) pipe. An undertolerance on *A* of 0.4 mm (0.015 in.) and wall thickness of 12.5% was used for DN 40 (NPS $1^1/_2$) and smaller pipe. For pipe with an *A* or pipe wall thickness undertolerance other than the above, do not use the *C* data from Table 3.3-1 [see para. 4.3(a)].

4.3 Exceptions

(a) For pipe or tubing varying from the ASTM A106 and ASTM A335 types, having different wall thickness or O.D. tolerances (such as forged and bored pipe), or both, the foregoing equations may be inapplicable. Equations (1) and (2) may be used to determine *C* for these applications. The purchaser shall specify the *C* dimension when Table 3.3-1 data do not apply.

(b) For components in smaller sizes and lower schedule numbers, it may be necessary to deposit weld metal on the I.D. or use thicker wall materials in order to machine the backing ring while maintaining required wall thickness. This condition may also arise when using material whose nominal dimensions indicate sufficient metal but whose actual I.D., considering tolerances, is large enough to require additional metal.

5 TOLERANCES

See Figures 3.1-1 through 3.2-3.

5.1 Dimension *B*

Values for the I.D. at the welding end [see dimension *B*, Figure 3.1-1, illustrations (a) and (b) and Figure 3.1-2, illustrations (a) and (b)] shall be as specified in the applicable standard or specification for the component.

5.2 Welding Bevels, Root Face, and Dimension *C*

Values of welding bevels, root face, and dimension *C* shall be as indicated in Figures 3.1-1 through 3.2-3.

Large diameter pipe and fittings with a relatively thin wall have a tendency to spring out-of-round after removal from the machining fixture. For this reason, the measured diameters may vary with orientation. A tolerance of +0.25 mm (+0.010 in.) applies to the average *C* diameter in Figures 3.1-1 and 3.2-3, illustrations (c) and (d). A tolerance of +0.25 mm, −1.02 mm (+0.010 in., −0.040 in.) applies to the average *C* diameter for Figures 3.2-2 and 3.2-3.

5.3 Dimension *A*

Unless otherwise specified, the tolerances for dimension *A* shall be as follows:

Size	Tolerance
DN ≤ 40 (NPS ≤ $1^1/_2$)	±0.4 mm (±0.015 in.)
50 ≤ DN ≤ 125 (2 ≤ NPS ≤ 5)	+2.5 mm, −0.79 mm (+0.10 in., −0.031 in.)
DN ≥ 150 (NPS ≥ 6)	+4.0 mm, −0.79 mm (+0.16 in., −0.031 in.)

5.4 Wall Thickness

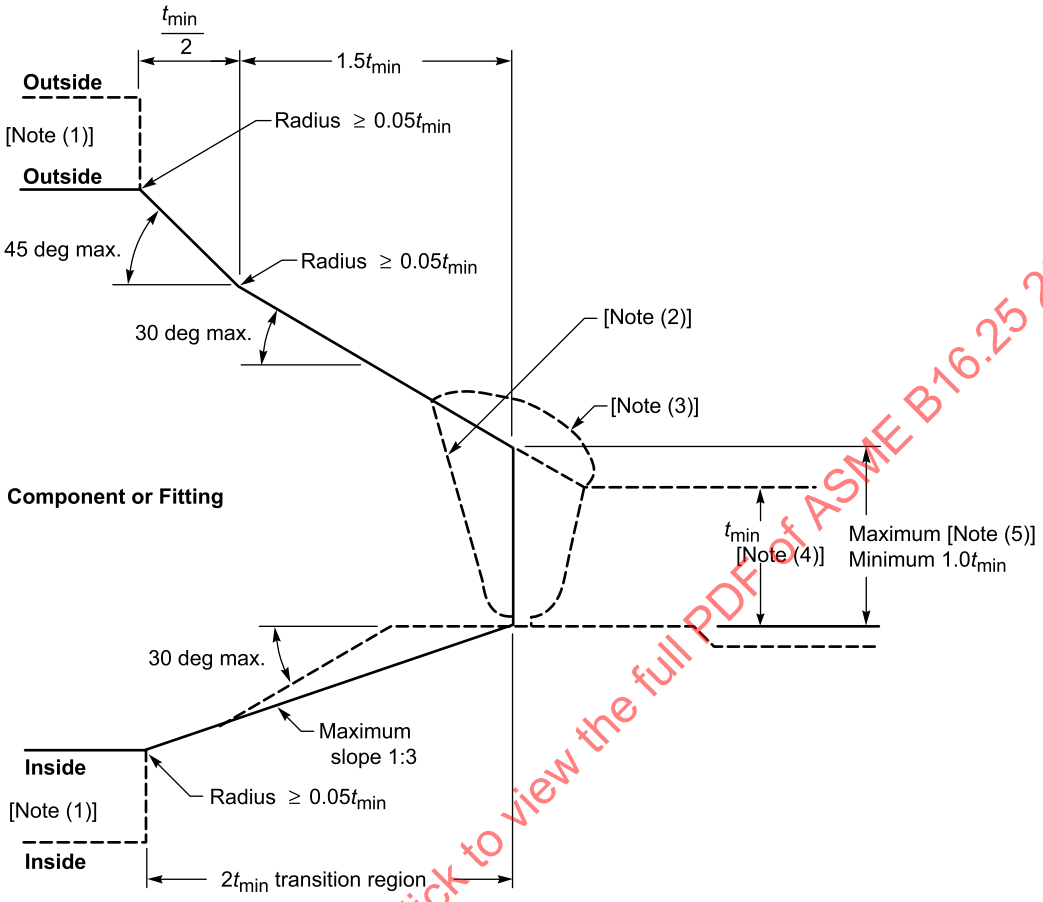
The maximum thickness at the end of the component is the

(a) greater of t_{min} + 4 mm (0.16 in.) or 1.15t_{min} when ordered on a minimum wall basis.

(b) greater of t_{min} + 4 mm (0.16 in.) or 1.10 times the nominal wall thickness when ordered on a nominal wall basis. See ASME B36.10M and ASME B36.19M for a tabulation of nominal wall thicknesses.

The minimum thickness, t_{min}, shall be as specified in the applicable standard or specification for the component (see Figure 2-1).

Figure 2-1
Maximum Envelope for Welding End Transitions



NOTES:

(1) Where transitions using maximum slope do not intersect inside or outside surface, as shown by broken lines, maximum slopes shown or alternate radii shall be used.

(2) Weld bevel shown is for illustration only.

(3) The weld reinforcement permitted by applicable code may lie outside the maximum envelope.

(4) The value of t_{min} is whichever of the following is applicable:

(a) the minimum ordered wall thickness of the pipe to include pipe that is purchased to a nominal wall thickness with an undertolerance other than 12.5%

(b) 0.875 times the nominal wall thickness of pipe ordered to a pipe schedule wall thickness that has an undertolerance of 12.5%

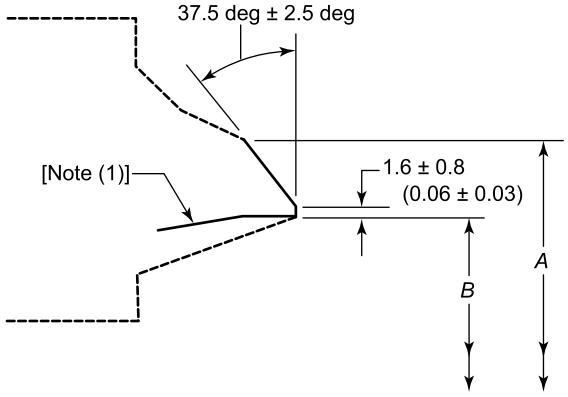
(c) the minimum ordered wall thickness of the cylindrical welding end of a component or fitting (or the thinner of the two) when the joint is between two components

(5) The maximum thickness at the end of the components is

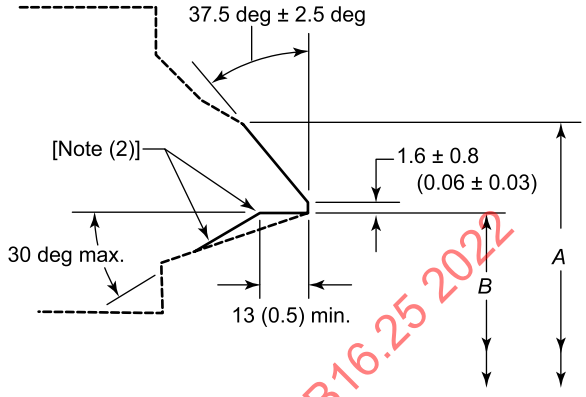
(a) the greater of t_{min} + 4 mm (0.16 in.) or $1.15t_{min}$ when ordered on a minimum wall basis

(b) the greater of t_{min} + 4 mm (0.16 in.) or 1.10 times the nominal wall thickness when ordered on a nominal basis (see ASME B36.10 and ASME B36.19 for a tabulation of nominal wall thicknesses)

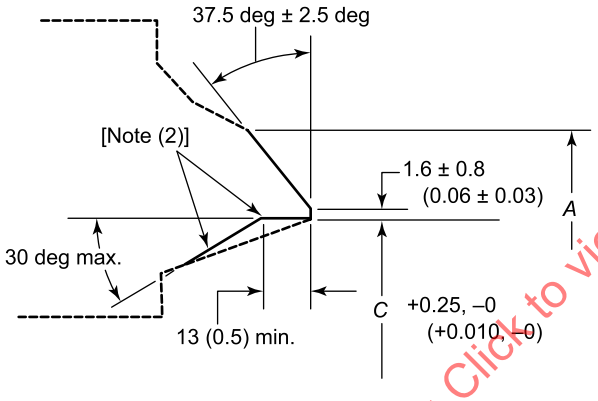
Figure 3.1-1
Bevels for Wall Thickness Over 3 mm to 22 mm (0.12 in. to 0.88 in.), Inclusive



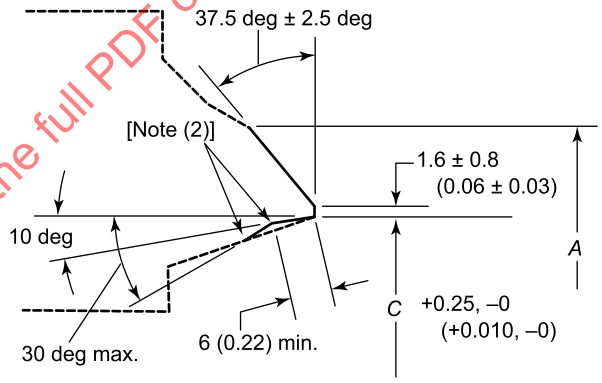
(a) Welding End Detail for Joint Without Backing Ring



(b) Welding End Detail for Joint Using Split Rectangular Backing Ring



(c) Welding End Detail for Joint Using Continuous Rectangular Backing Ring

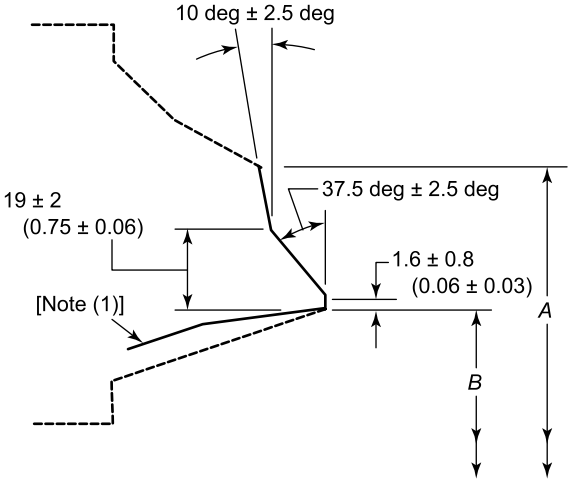


(d) Welding End Detail for Joint Using Continuous Tapered Backing Ring

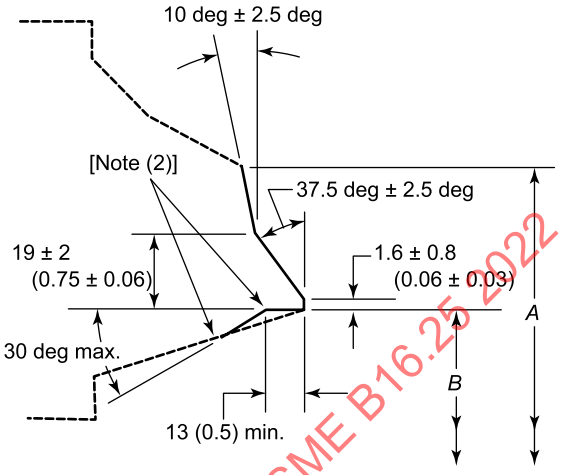
GENERAL NOTES:
(a) Broken lines denote maximum envelope for transitions from welding bevel and root face into body of component. See Figure 2-1 for details.
(b) See section 5 for tolerances other than those given in these illustrations.
(c) Purchase order must specify contour of any backing ring to be used.
(d) Linear dimensions are in millimeters with inch values in parentheses.

NOTES:
(1) Internal surface may be as-formed or machined for dimension *B* at root face. Contour within the envelope shall be in accordance with section 2.
(2) Intersections should be slightly rounded.

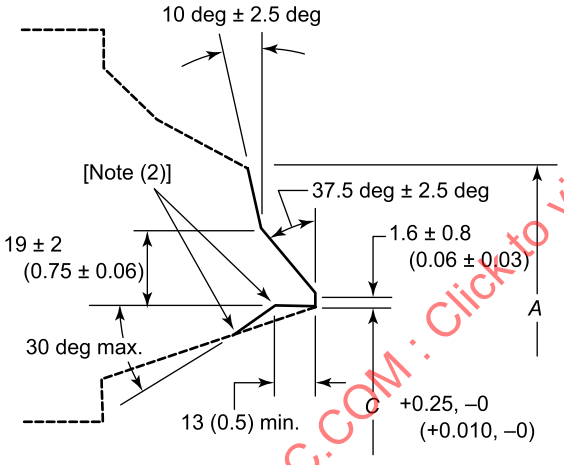
Figure 3.1-2
Weld Bevel Details for Wall Thickness Over 22 mm (0.88 in.)



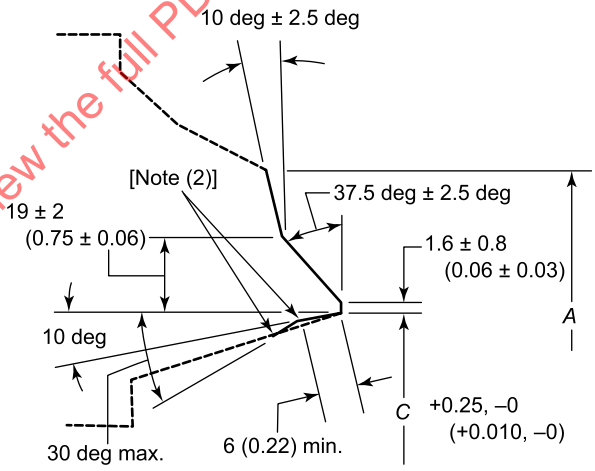
(a) Welding End Detail for Joint Without Backing Ring



(b) Welding End Detail for Joint Using Split Rectangular Backing Ring



(c) Welding End Detail for Joint Using Continuous Rectangular Backing Ring

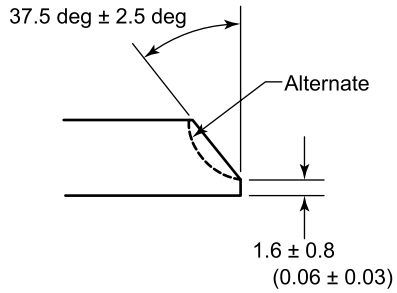


(d) Welding End Detail for Joint Using Continuous Tapered Backing Ring

GENERAL NOTES:
(a) Broken lines denote maximum envelope for transitions from welding bevel and root face into body of component. See Figure 2-1 for details.
(b) See section 5 for tolerances other than those given in these illustrations.
(c) Purchase order must specify contour of any backing ring to be used.
(d) Linear dimensions are in millimeters with inch values in parentheses.

NOTES:
(1) Internal surface may be as-formed or machined for dimension *B* at root face. Contour within the envelope shall be in accordance with section 2.
(2) Intersections should be slightly rounded.

Figure 3.2-1
Weld Bevel Details for GTAW Root Pass [Wall Thickness Over 3 mm to 10 mm (0.12 in. to 0.38 in.), Inclusive]

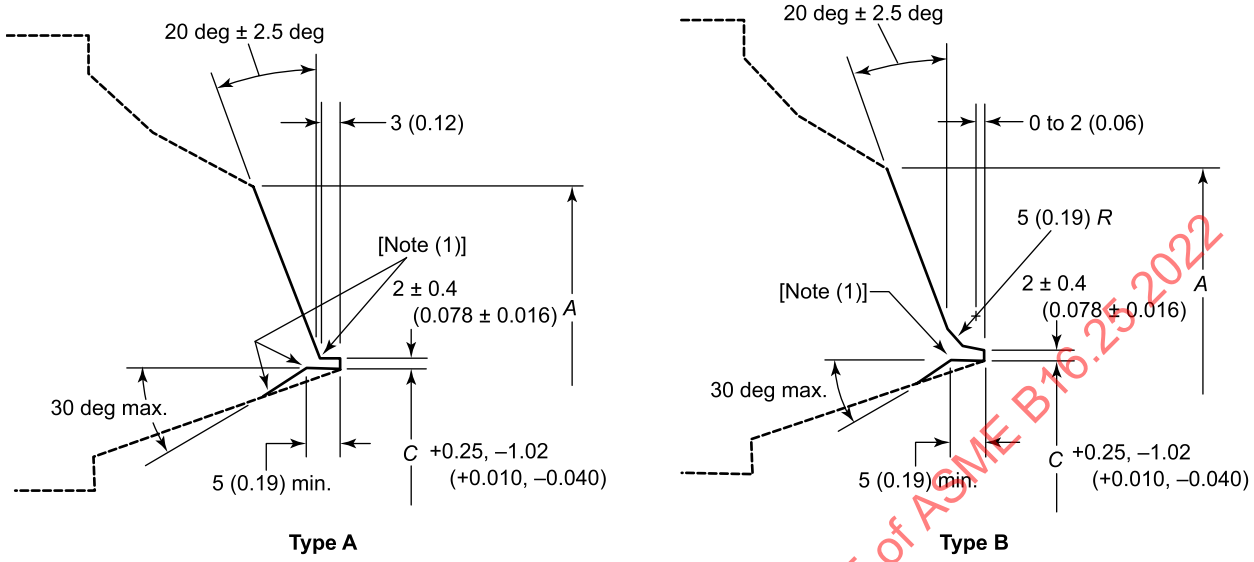


GENERAL NOTES:

(a) This detail applies for gas tungsten arc welding (GTAW) of the root pass where nominal wall thickness is over 3 mm (0.12 in.) to 10 mm (0.38 in.), inclusive.

(b) Linear dimensions are in millimeters with inch values in parentheses.

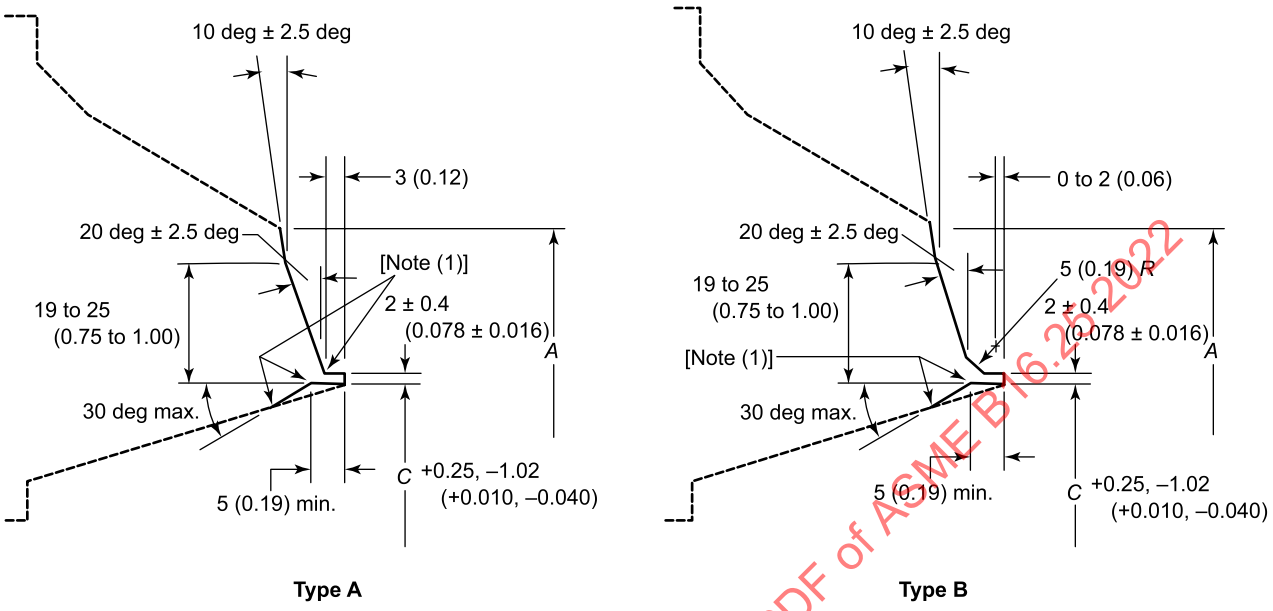
Figure 3.2-2
Weld Bevel Details for GTAW Root Pass [Wall Thickness Over 10 mm to 25 mm (0.38 in. to 1.0 in.), Inclusive]



GENERAL NOTES:
(a) This detail applies for gas tungsten arc welding (GTAW) of the root pass where nominal wall thickness is over 10 mm (0.38 in.) to 25 mm (1.0 in.), inclusive.
(b) Broken lines denote maximum envelope for transitions from welding groove and land into body of component. See Figure 2-1 for details.
(c) See section 5 for tolerances other than those given in these illustrations.
(d) Linear dimensions are in millimeters with inch values in parentheses.

NOTE: (1) Inside corners should be slightly rounded.

Figure 3.2-3
Weld Bevel Details for GTAW Root Pass [Wall Thickness Over 25 mm (1.0 in.)]



GENERAL NOTES:
(a) This detail applies for gas tungsten arc welding (GTAW) of the root pass where nominal wall thickness is greater than 25 mm (1.0 in.).
(b) Broken lines denote maximum envelope for transitions from welding groove and land into body of component. See Figure 2-1 for details.
(c) See section 5 for tolerances other than those given in these illustrations.
(d) Linear dimensions are in millimeters with inch values in parentheses.

NOTE: (1) Inside corners should be slightly rounded.

Table 3.3-1
Dimensions of Welding Ends (See Figures 2-1 Through 3.2-3)

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends, *A*		*B*	*C* [Note (3)]	*t*
		Wrought or Fabricated Components [Notes (1), (2)]	Cast Components [Note (2)]			
½	80, 80S	21.3 (0.840)	23 (0.90)	13.84 (0.546)	14.12 (0.558)	3.73 (0.147)
	160	21.3 (0.840)	23 (0.90)	11.74 (0.464)	12.28 (0.486)	4.78 (0.188)
	XXS	21.3 (0.840)	23 (0.90)	6.36 (0.252)	7.58 (0.300)	7.47 (0.294)
¾	80, 80S	26.7 (1.050)	28 (1.11)	18.88 (0.742)	19.21 (0.756)	3.91 (0.154)
	160	26.7 (1.050)	28 (1.11)	15.58 (0.612)	16.32 (0.642)	5.56 (0.219)
	XXS	26.7 (1.050)	28 (1.11)	11.06 (0.434)	12.36 (0.486)	7.82 (0.308)
1	40, 40S	33.4 (1.315)	35 (1.37)	26.64 (1.049)	26.84 (1.057)	3.38 (0.133)
	80, 80S	33.4 (1.315)	35 (1.37)	24.30 (0.957)	24.79 (0.977)	4.55 (0.179)
	160	33.4 (1.315	35 (1.37)	20.70 (0.815)	21.64 (0.852)	6.35 (0.250)
	XXS	33.4 (1.315)	35 (1.37)	15.22 (0.599)	16.84 (0.664)	9.09 (0.358)
1¼	40, 40S	42.2 (1.660)	44 (1.74)	35.08 (1.380)	35.32 (1.390)	3.56 (0.140)
	80, 80S	42.2 (1.660)	44 (1.74)	32.50 (1.278)	33.06 (1.301)	4.85 (1.191)
	160	42.2 (1.660)	44 (1.74)	29.50 (1.160)	30.44 (1.198)	6.35 (0.250)
	XXS	42.2 (1.660)	44 (1.74)	22.80 (0.896)	24.58 (0.966)	9.70 (0.382)
1½	40, 40S	48.3 (1.900)	50 (1.98)	40.94 (1.610)	41.21 (1.621)	3.68 (0.145)
	80, 80S	48.3 (1.900)	50 (1.98)	38.14 (1.500)	38.76 (1.525)	5.08 (0.200)
	160	48.3 (1.900)	50 (1.98)	34.02 (1.338)	35.16 (1.383)	7.14 (0.281)
	XXS	48.3 (1.900)	50 (1.98)	28.00 (1.100)	29.89 (1.175)	10.15 (0.400)
2	40, 40S	60.3 (2.375)	62 (2.46)	52.48 (2.067)	53.35 (2.064)	3.91 (0.154)
	80, 80S	60.3 (2.375)	62 (2.46)	49.22 (1.939)	50.50 (1.952)	5.54 (0.218)
	160	60.3 (2.375)	62 (2.46)	42.82 (1.687)	44.90 (1.732)	8.74 (0.344)
	XXS	60.3 (2.375)	62 (2.46)	38.16 (1.503)	40.82 (1.571)	11.07 (0.436)
2½	30	73.0 (2.875)	75 (2.96)	63.50 (2.499)	63.60 (2.505)	4.78 (0.188)
	40, 40S	73.0 (2.875)	75 (2.96)	62.50 (2.469)	62.93 (2.479)	5.16 (0.203)
	80, 80S	73.0 (2.875)	75 (2.96)	59.00 (2.323)	59.69 (2.351)	7.01 (0.276)
	160	73.0 (2.875)	75 (2.96)	54.00 (2.125)	55.28 (2.178)	9.53 (0.375)
	XXS	73.0 (2.875)	75 (2.96)	45.00 (1.771)	47.43 (1.868)	14.02 (0.552)
3	30	88.9 (3.500)	91 (3.59)	79.50 (3.124)	79.50 (3.130)	4.78 (0.188)
	40, 40S	88.9 (3.500)	91 (3.59)	78.00 (3.068)	78.25 (3.081)	5.49 (0.216)
	80, 80S	88.9 (3.500)	91 (3.59)	73.50 (2.900)	74.53 (2.934)	7.62 (0.300)
	160	88.9 (3.500)	91 (3.59)	66.50 (2.624)	68.38 (2.692)	11.13 (0.438)
	XXS	88.9 (3.500)	91 (3.59)	58.50 (2.300)	61.19 (2.409)	15.24 (0.600)
3½	30	101.6 (4.000)	105 (4.12)	92.00 (3.624)	92.20 (3.630)	4.78 (0.188)
	40, 40S	101.6 (4.000)	105 (4.12)	90.00 (3.548)	90.52 (3.564)	5.74 (0.226)
	80, 80S	101.6 (4.000)	105 (4.12)	85.50 (3.364)	86.42 (3.402)	8.08 (0.318)

Table 3.3-1
Dimensions of Welding Ends (See Figures 2-1 Through 3.2-3) (Cont'd)

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends, *A*		*B*	*C* [Note (3)]	*t*
		Wrought or Fabricated Components [Notes (1), (2)]	Cast Components [Note (2)]			
4	30	114.3 (4.500)	117 (4.62)	104.50 (4.124)	104.90 (4.130)	4.78 (0.188)
	40, 40S	114.3 (4.500)	117 (4.62)	102.00 (4.026)	102.73 (4.044)	6.02 (0.237)
	80, 80S	114.3 (4.500)	117 (4.62)	97.00 (3.826)	98.28 (3.869)	8.56 (0.337)
	120	114.3 (4.500)	117 (4.62)	92.00 (3.624)	93.78 (3.692)	11.13 (0.438)
	160	114.3 (4.500)	117 (4.62)	87.50 (3.438)	89.65 (3.530)	13.49 (0.531)
	XXS	114.3 (4.500)	117 (4.62)	80.00 (3.152)	83.30 (3.279)	17.12 (0.674)
5	40, 40S	141.3 (5.563)	144 (5.69)	128.00 (5.047)	128.80 (5.070)	6.55 (0.258)
	80, 80S	141.3 (5.563)	144 (5.69)	122.00 (4.813)	123.58 (4.866)	9.53 (0.375)
	120	141.3 (5.563)	144 (5.69)	116.00 (4.563)	118.04 (4.647)	12.70 (0.500)
	160	141.3 (5.563)	144 (5.69)	109.50 (4.313)	112.47 (4.428)	15.88 (0.625)
	XXS	141.3 (5.563)	144 (5.69)	103.00 (4.063)	106.92 (4.209)	19.05 (0.750)
6	40, 40S	168.3 (6.625)	172 (6.78)	154.00 (6.065)	154.82 (6.094)	7.11 (0.280)
	80, 80S	168.3 (6.625)	172 (6.78)	146.50 (5.761)	148.06 (5.828)	10.97 (0.432)
	120	168.3 (6.625)	172 (6.78)	140.00 (5.501)	142.29 (5.600)	14.27 (0.562)
	160	168.3 (6.625)	172 (6.78)	132.00 (5.187)	135.31 (5.326)	18.26 (0.719)
	XXS	168.3 (6.625)	172 (6.78)	124.50 (4.897)	128.85 (5.072)	21.95 (0.864)
8	20	219.1 (8.625)	223 (8.78)	206.50 (8.125)	206.95 (8.146)	6.35 (0.250)
	30	219.1 (8.625)	223 (8.78)	205.00 (8.071)	205.74 (8.099)	7.04 (0.277)
	40, 40S	219.1 (8.625)	223 (8.78)	203.00 (7.981)	203.75 (8.020)	8.18 (0.322)
	60	219.1 (8.625)	223 (8.78)	198.50 (7.813)	200.02 (7.873)	10.31 (0.406)
	80, 80S	219.1 (8.625)	223 (8.78)	193.50 (7.625)	195.84 (7.709)	12.70 (0.500)
	100	219.1 (8.625)	223 (8.78)	189.00 (7.437)	191.65 (7.544)	15.09 (0.594)
	120	219.1 (8.625)	223 (8.78)	182.50 (7.187)	186.11 (7.326)	18.26 (0.719)
	140	219.1 (8.625)	223 (8.78)	178.00 (7.001)	181.98 (7.163)	20.62 (0.812)
	XXS	219.1 (8.625)	223 (8.78)	174.50 (6.875)	179.16 (7.053)	22.23 (0.875)
	160	219.1 (8.625)	223 (8.78)	173.00 (6.813)	177.79 (6.998)	23.01 (0.906)
10	20	273.0 (10.750)	278 (10.94)	260.50 (10.250)	260.85 (10.272)	6.35 (0.250)
	30	273.0 (10.750)	278 (10.94)	257.50 (10.136)	258.31 (10.172)	7.80 (0.307)
	40, 40S	273.0 (10.750)	278 (10.94)	254.50 (10.020)	255.74 (10.070)	9.27 (0.365)
	60, 80S	273.0 (10.750)	278 (10.94)	247.50 (9.750)	249.74 (9.834)	12.70 (0.500)
	80	273.0 (10.750)	278 (10.94)	243.00 (9.562)	245.55 (9.670)	15.09 (0.594)
	100	273.0 (10.750)	278 (10.94)	236.50 (9.312)	240.01 (9.451)	18.26 (0.719)
	120	273.0 (10.750)	278 (10.94)	230.00 (9.062)	234.44 (9.232)	21.44 (0.844)
	140	273.0 (10.750)	278 (10.94)	222.00 (8.750)	227.51 (8.959)	25.40 (1.000)
	160	273.0 (10.750)	278 (10.94)	216.00 (8.500)	221.95 (8.740)	28.58 (1.125)
12	20	323.8 (12.750)	329 (12.97)	311.00 (12.250)	311.65 (12.272)	6.35 (0.250)
	30	323.8 (12.750)	329 (12.97)	307.00 (12.090)	308.10 (12.132)	8.38 (0.330)
	STD, 40S	323.8 (12.750)	329 (12.97)	305.00 (12.000)	306.08 (12.055)	9.53 (0.375)
	40	323.8 (12.750)	329 (12.97)	303.00 (11.938)	304.72 (11.999)	10.31 (0.406)
	XS, 80S	323.8 (12.750)	329 (12.97)	298.50 (11.750)	300.54 (11.834)	12.70 (0.500)

Table 3.3-1
Dimensions of Welding Ends (See Figures 2-1 Through 3.2-3) (Cont'd)

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends, *A*		*B*	*C* [Note (3)]	*t*
		Wrought or Fabricated Components [Notes (1), (2)]	Cast Components [Note (2)]			
12 (Cont'd)	60	323.8 (12.750)	329 (12.97)	295.00 (11.626)	297.79 (11.725)	14.27 (0.562)
	80	323.8 (12.750)	329 (12.97)	289.00 (11.374)	292.17 (11.505)	17.48 (0.688)
	100	323.8 (12.750)	329 (12.97)	281.00 (11.062)	285.24 (11.232)	21.44 (0.844)
	120	323.8 (12.750)	329 (12.97)	273.00 (10.750)	278.31 (10.959)	25.40 (1.000)
	140	323.8 (12.750)	329 (12.97)	266.50 (10.500)	272.75 (10.740)	28.58 (1.125)
	160	323.8 (12.750)	329 (12.97)	257.00 (10.126)	264.45 (10.413)	33.32 (1.312)
14	20	355.6 (14.000)	362 (14.25)	340.00 (13.376)	340.70 (13.413)	7.92 (0.312)
	STD, 40S	355.6 (14.000)	362 (14.25)	336.50 (13.250)	337.88 (13.303)	9.53 (0.375)
	40	355.6 (14.000)	362 (14.25)	333.50 (13.124)	335.08 (13.192)	11.13 (0.438)
	XS, 80S	355.6 (14.000)	362 (14.25)	330.00 (13.000)	332.34 (13.084)	12.70 (0.500)
	60	355.6 (14.000)	362 (14.25)	325.50 (12.812)	328.15 (12.920)	15.09 (0.594)
	80	355.6 (14.000)	362 (14.25)	317.50 (12.500)	321.22 (12.646)	19.05 (0.750)
	100	355.6 (14.000)	362 (14.25)	308.00 (12.124)	312.86 (12.318)	23.83 (0.938)
	120	355.6 (14.000)	362 (14.25)	300.00 (11.812)	305.93 (12.044)	27.79 (1.094)
	140	355.6 (14.000)	362 (14.25)	292.00 (11.500)	299.00 (11.771)	31.75 (1.250)
	160	355.6 (14.000)	362 (14.25)	284.00 (11.188)	292.07 (11.498)	35.71 (1.406)
16	20	406.4 (16.000)	413 (16.25)	390.50 (15.376)	391.50 (15.413)	7.92 (0.312)
	STD, 40S	406.4 (16.000)	413 (16.25)	387.50 (15.250)	388.68 (15.303)	9.53 (0.375)
	40, 80S	406.4 (16.000)	413 (16.25)	381.00 (15.000)	383.14 (15.084)	12.70 (0.500)
	60	406.4 (16.000)	413 (16.25)	373.00 (14.688)	376.21 (14.811)	16.66 (0.656)
	80	406.4 (16.000)	413 (16.25)	363.50 (14.312)	367.84 (14.482)	21.44 (0.844)
	100	406.4 (16.000)	413 (16.25)	354.00 (13.938)	359.53 (14.155)	26.19 (1.031)
	120	406.4 (16.000)	413 (16.25)	344.50 (13.562)	351.18 (13.826)	30.96 (1.219)
	140	406.4 (16.000)	413 (16.25)	333.50 (13.124)	341.43 (13.442)	36.53 (1.438)
	160	406.4 (16.000)	413 (16.25)	325.50 (12.812)	334.50 (13.170)	40.49 (1.594)
18	20	457.2 (18.000)	464 (18.28)	441.50 (17.376)	442.30 (17.413)	7.92 (0.312)
	30	457.2 (18.000)	464 (18.28)	435.00 (17.124)	436.68 (17.192)	11.13 (0.438)
	STD, 40S	457.2 (18.000)	464 (18.28)	438.00 (17.250)	439.48 (17.303)	9.53 (0.375)
	XS, 80S	457.2 (18.000)	464 (18.28)	432.00 (17.000)	433.94 (17.084)	12.70 (0.500)
	40	457.2 (18.000)	464 (18.28)	428.50 (16.876)	431.19 (16.975)	14.27 (0.562)
	60	457.2 (18.000)	464 (18.28)	419.00 (16.500)	422.82 (16.646)	19.05 (0.750)
	80	457.2 (18.000)	464 (18.28)	409.50 (16.124)	414.46 (16.318)	23.83 (0.938)
	100	457.2 (18.000)	464 (18.28)	398.50 (15.688)	404.78 (15.936)	29.36 (1.156)
	120	457.2 (18.000)	464 (18.28)	387.50 (15.250)	395.03 (15.553)	34.93 (1.375)
	140	457.2 (18.000)	464 (18.28)	378.00 (14.876)	386.77 (15.225)	39.67 (1.562)
	160	457.2 (18.000)	464 (18.28)	366.50 (14.438)	376.99 (14.842)	45.24 (1.781)
20	STD, 40S	508.0 (20.000)	516 (20.31)	489.00 (19.250)	490.28 (19.303)	9.53 (0.375)
	XS, 80S	508.0 (20.000)	516 (20.31)	482.50 (19.000)	484.74 (19.084)	12.70 (0.500)
	40	508.0 (20.000)	516 (20.31)	478.00 (18.812)	480.55 (18.920)	15.09 (0.594)
	60	508.0 (20.000)	516 (20.31)	467.00 (18.376)	470.88 (18.538)	20.62 (0.812)
	80	508.0 (20.000)	516 (20.31)	455.50 (17.938)	461.13 (18.155)	26.19 (1.031)

Table 3.3-1
Dimensions of Welding Ends (See Figures 2-1 Through 3.2-3) (Cont'd)

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends, *A*		*B*	*C* [Note (3)]	*t*
		Wrought or Fabricated Components [Notes (1), (2)]	Cast Components [Note (2)]			
20 (Cont'd)	100	508.0 (20.000)	516 (20.31)	443.00 (17.438)	450.02 (17.717)	32.54 (1.281)
	120	508.0 (20.000)	516 (20.31)	432.00 (17.000)	440.29 (17.334)	38.10 (1.500)
	140	508.0 (20.000)	516 (20.31)	419.00 (16.500)	429.17 (16.896)	44.45 (1.500)
	160	508.0 (20.000)	516 (20.31)	408.00 (16.062)	419.44 (16.513)	50.01 (1.969)
22	STD	558.8 (22.000)	567 (22.34)	539.00 (21.250)	541.08 (21.303)	9.53 (0.375)
	XS	558.8 (22.000)	567 (22.34)	533.00 (21.000)	535.54 (21.084)	12.70 (0.500)
	60	558.8 (22.000)	567 (22.34)	514.00 (20.250)	518.86 (20.428)	22.23 (0.875)
	80	558.8 (22.000)	567 (22.34)	501.00 (19.750)	507.75 (19.990)	28.58 (1.125)
	100	558.8 (22.000)	567 (22.34)	488.50 (19.250)	496.63 (19.553)	34.93 (1.375)
	120	558.8 (22.000)	567 (22.34)	476.00 (18.750)	485.52 (19.115)	41.28 (1.625)
	140	558.8 (22.000)	567 (22.34)	463.00 (18.250)	474.41 (18.678)	47.63 (1.875)
	160	558.8 (22.000)	567 (22.34)	450.50 (17.750)	463.30 (18.240)	53.98 (2.125)
24	STD, 40S	609.6 (24.000)	619 (24.38)	590.50 (23.250)	591.88 (23.303)	9.53 (0.375)
	XS, 80S	609.6 (24.000)	619 (24.38)	584.00 (23.000)	586.34 (23.084)	12.70 (0.500)
	30	609.6 (24.000)	619 (24.38)	581.00 (22.876)	583.59 (22.975)	14.27 (0.562)
	40	609.6 (24.000)	619 (24.38)	574.50 (22.624)	577.97 (22.755)	17.48 (0.688)
	60	609.6 (24.000)	619 (24.38)	560.50 (22.062)	565.49 (22.263)	24.61 (0.969)
	80	609.6 (24.000)	619 (24.38)	547.50 (21.562)	554.38 (21.826)	30.96 (1.219)
	100	609.6 (24.000)	619 (24.38)	532.00 (20.938)	540.49 (21.280)	38.89 (1.531)
	120	609.6 (24.000)	619 (24.38)	517.50 (20.376)	528.03 (20.788)	46.02 (1.812)
	140	609.6 (24.000)	619 (24.38)	505.00 (19.876)	516.91 (20.350)	52.37 (2.062)
	160	609.6 (24.000)	619 (24.38)	490.50 (19.312)	504.37 (19.857)	59.54 (2.344)
26	10	660.4 (26.000)	670 (26.38)	645.50 (25.376)	645.50 (25.413)	7.92 (0.312)
	STD	660.4 (26.000)	670 (26.38)	641.34 (25.250)	642.68 (25.303)	9.53 (0.375)
	20	660.4 (26.000)	670 (26.38)	635.00 (25.000)	637.14 (25.084)	12.70 (0.500)
28	10	711.2 (28.000)	721 (28.38)	695.50 (27.376)	696.30 (27.413)	7.92 (0.312)
	STD	711.2 (28.000)	721 (28.38)	692.14 (27.250)	693.48 (27.303)	9.53 (0.375)
	20	711.2 (28.000)	721 (28.38)	686.00 (27.000)	687.94 (27.084)	12.70 (0.500)
	30	711.2 (28.000)	721 (28.38)	679.50 (26.750)	682.37 (26.865)	15.88 (0.625)
30	10	762.0 (30.000)	772 (30.38)	746.00 (29.376)	747.10 (29.413)	7.92 (0.312)
	STD	762.0 (30.000)	772 (30.38)	742.94 (29.250)	744.28 (29.303)	9.53 (0.375)
	20	762.0 (30.000)	772 (30.38)	736.50 (29.000)	738.74 (29.084)	12.70 (0.500)
	30	762.0 (30.000)	772 (30.38)	730.00 (28.750)	733.17 (28.865)	15.88 (0.625)
32	10	812.8 (32.000)	825 (32.50)	797.00 (31.376)	797.90 (31.413)	7.92 (0.312)
	STD	812.8 (32.000)	825 (32.50)	793.74 (31.250)	795.08 (31.303)	9.53 (0.375)
	20	812.8 (32.000)	825 (32.50)	787.50 (31.000)	789.54 (31.084)	12.70 (0.500)
	30	812.8 (32.000)	825 (32.50)	781.00 (30.750)	783.97 (30.865)	15.88 (0.625)
	40	812.8 (32.000)	825 (32.50)	778.00 (30.624)	781.17 (30.755)	17.48 (0.688)

Table 3.3-1
Dimensions of Welding Ends (See Figures 2-1 Through 3.2-3) (Cont'd)

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends, *A*		*B*	*C* [Note (3)]	*t*
		Wrought or Fabricated Components [Notes (1), (2)]	Cast Components [Note (2)]			
34	10	863.6 (34.000)	876 (34.50)	848.00 (33.376)	848.70 (33.413)	7.92 (0.312)
	STD	863.6 (34.000)	876 (34.50)	844.54 (33.250)	845.88 (33.303)	9.53 (0.375)
	20	863.6 (34.000)	876 (34.50)	838.00 (33.000)	840.34 (33.084)	12.70 (0.500)
	30	863.6 (34.000)	876 (34.50)	832.00 (32.750)	834.77 (32.865)	15.88 (0.625)
	40	863.6 (34.000)	876 (34.50)	828.50 (32.624)	831.97 (32.755)	17.48 (0.688)
36	10	914.4 (36.000)	927 (36.50)	898.50 (35.376)	899.50 (35.413)	7.92 (0.312)
	STD	914.4 (36.000)	927 (36.50)	895.34 (35.250)	896.68 (35.303)	9.53 (0.375)
	20	914.4 (36.000)	927 (36.50)	889.00 (35.000)	891.14 (35.084)	12.70 (0.500)
	30	914.4 (36.000)	927 (36.50)	882.50 (34.750)	885.57 (34.865)	15.88 (0.625)
	40	914.4 (36.000)	927 (36.50)	876.50 (34.500)	880.02 (34.646)	19.05 (0.750)
38	STD	965.2 (38.000)	978 (38.50)	946.00 (37.250)	947.48 (37.303)	9.53 (0.375)
	XS	965.2 (38.000)	978 (38.50)	940.00 (37.000)	941.94 (37.084)	12.70 (0.500)
40	STD	1 016.0 (40.000)	1 029 (40.50)	997.00 (39.250)	998.28 (39.303)	9.53 (0.375)
	XS	1 016.0 (40.000)	1 029 (40.50)	991.50 (39.000)	992.74 (39.084)	12.70 (0.500)
42	STD	1 066.8 (42.000)	1 079 (42.50)	1 047.50 (41.250)	1 049.08 (41.303)	9.53 (0.375)
	XS	1 066.8 (42.000)	1 079 (42.50)	1 041.50 (41.000)	1 043.54 (41.084)	12.70 (0.500)
44	STD	1 117.6 (44.000)	1 130 (44.50)	1 098.50 (42.250)	1 099.88 (43.303)	9.53 (0.375)
	XS	1 117.6 (44.000)	1 130 (44.50)	1 092.00 (43.000)	1 094.34 (43.084)	12.70 (0.500)
46	STD	1 168.4 (46.000)	1 181 (46.50)	1 149.50 (45.250)	1 150.68 (45.303)	9.53 (0.375)
	XS	1 168.4 (46.000)	1 181 (46.50)	1 143.00 (45.000)	1 145.14 (45.084)	12.70 (0.500)
48	STD	1 219.2 (48.000)	1 232 (48.50)	1 200.00 (47.250)	1 201.48 (47.303)	9.53 (0.375)
	XS	1 219.2 (48.000)	1 232 (48.50)	1 194.00 (47.000)	1 195.94 (47.084)	12.70 (0.500)
52	...	1 321 (52.000)	1 334 (52.50)	1 301.94 (51.250)	1 304.22 (51.303)	9.53 (0.375)
	...	1 321 (52.000)	1 334 (52.50)	1 295.60 (51.000)	1 298.67 (51.084)	12.70 (0.500)
	...	1 321 (52.000)	1 334 (52.50)	1 289.24 (50.750)	1 293.10 (50.865)	15.88 (0.625)
	...	1 321 (52.000)	1 334 (52.50)	1 282.90 (50.500)	1 287.56 (50.646)	19.05 (0.750)
	...	1 321 (52.000)	1 334 (52.50)	1 276.54 (50.250)	1 281.89 (50.428)	22.23 (0.875)
	...	1 321 (52.000)	1 334 (52.50)	1 270.20 (50.000)	1 276.44 (50.209)	25.40 (1.000)
56	...	1 422 (56.000)	1 436 (56.56)	1 402.94 (55.250)	1 405.22 (55.303)	9.53 (0.375)
	...	1 422 (56.000)	1 436 (56.56)	1 396.60 (55.000)	1 399.67 (55.084)	12.70 (0.500)
	...	1 422 (56.000)	1 436 (56.56)	1 390.24 (54.750)	1 394.10 (54.865)	15.88 (0.625)
	...	1 422 (56.000)	1 436 (56.56)	1 383.90 (54.500)	1 388.56 (54.646)	19.05 (0.750)
	...	1 422 (56.000)	1 436 (56.56)	1 377.54 (54.250)	1 382.89 (54.428)	22.23 (0.875)
	...	1 422 (56.000)	1 436 (56.56)	1 371.20 (54.000)	1 377.44 (54.209)	25.40 (1.000)