

**ASME B16.25-2007**  
(Revision of ASME B16.25-2003)

# Buttwelding Ends

**AN AMERICAN NATIONAL STANDARD**



**The American Society of  
Mechanical Engineers**

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**Three Park Avenue • New York, NY 10016**

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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, to the cosponsor organizations, and then to 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 an ASME committee 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 this 2007 edition, buttwelding end data has been extended to cover requirements for sizes up to NPS 48 (DN 1200). The reference data has been updated and the interpretation section has been removed from the standard.

This revision was approved as an by American National Standards Institute on August 17, 2007.

Requests for interpretation or suggestions for revision should be sent to the Secretary, B16 Committee, The American Society of Mechanical Engineers, Three Park Avenue, New York, NY 10016-5990.

# ASME B16 COMMITTEE

## Standardization of Valves, Flanges, Fittings, and Gaskets

(The following is the roster of the Committee at the time of approval of this Standard.)

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# CORRESPONDENCE WITH THE B16 COMMITTEE

**General.** ASME Standards are developed and maintained with the intent to represent the consensus of concerned interests. As such, users of this Standard may interact with the Committee by requesting interpretations, proposing revisions, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B16 Standards Committee  
The American Society of Mechanical Engineers  
Three Park Avenue  
New York, NY 10016-5990

As an alternative, inquiries may be submitted via e-mail to: SecretaryB16@asme.org.

**Proposing Revisions.** Revisions are made periodically to the Standard 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 periodically.

The Committee welcomes proposals for revisions to this Standard. 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 documentation.

**Interpretations.** Upon request, the B16 Committee will render an interpretation of any requirement of the Standard. Interpretations can only be rendered in response to a written request sent to the Secretary of the B16 Standards Committee.

The request for interpretation should be clear and unambiguous. It is further recommended that the inquirer submit his/her request in the following format:

Subject: Cite the applicable paragraph number(s) and the topic of the inquiry.  
Edition: Cite the applicable edition of the Standard for which the interpretation is being requested.  
Question: Phrase the question as a request for an interpretation of a specific requirement suitable for general understanding and use, not as a request for an approval of a proprietary design or situation. The inquirer may also include any plans or drawings, which are necessary to explain the question; however, they should not contain proprietary names or information.

Requests that are not in this format will be rewritten in this format by the Committee prior to being answered, which may inadvertently change the intent of the original request.

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.

**Attending Committee Meetings.** The B16 Standards Committee regularly holds meetings, which are open to the public. Persons wishing to attend any meeting should contact the Secretary of the B16 Standards Committee.

# BUTTWELDING ENDS

## 1 SCOPE

### 1.1 General

This Standard covers the preparation of butt welding 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, B16.9, or B16.47.

### 1.3 Standard Units

The values stated in either metric or inch units are to be regarded separately as the standard. Within the text, the inch units are shown in parentheses. The values stated in each system are not exact equivalents; therefore, each system must be used independently of the other. Combining values from the two systems may result in nonconformance with this 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
1/2	15
3/4	20
1	25
1 1/4	32
1 1/2	40
2	50
2 1/2	65
3	80
4	100

For  $NPS \geq 4$ , the related  $DN = 25 \times NPS$ .

### 1.5 Referenced Standards

Standards and specifications adopted by reference in this Standard are shown in Mandatory Appendix II, which is part of this Standard. It is not considered practical to identify the specific edition of each standard and specification in the individual references; instead, the specific edition is identified in Mandatory Appendix II. An end preparation made in conformance to this Standard in all other respects will be considered to be in conformance to the standard even though the edition reference may be changed in a revision of this 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 the purpose of determining conformance with this Standard, the convention for fixing significant digits where limits, maximum or minimum values, are specified shall be "rounding off" as defined in ASTM Practice E 29. This requires that an observed or calculated value shall 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 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 Note (5) to Fig. 1, 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 (0.12 in.) to 22 mm (0.88 in.) inclusive shall have single angle bevels as illustrated in Fig. 2.

(c) Components having nominal wall thicknesses greater than 22 mm (0.88 in.) shall have compound angle bevels as illustrated in Fig. 3.

### 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 (0.12 in.) to 10 mm (0.38 in.) inclusive shall have  $37\frac{1}{2}$ -deg  $\pm$   $2\frac{1}{2}$ -deg bevels or slightly concave bevels. See Fig. 4.

(c) Components having nominal wall thicknesses over 10 mm (0.38 in.) to 25 mm (1.0 in.) inclusive shall have bevels as shown in Fig. 5.

(d) Components having nominal wall thicknesses greater than 25 mm (1.0 in.) shall have bevels as shown in Fig. 6.

### 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 1 or Table I-1 may be used.

## 4 PREPARATION OF INSIDE DIAMETER OF WELDING END

### 4.1 General

Preparation of the inside diameter 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 Fig. 2, illustration (b) and Fig. 3, 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 Fig. 2, illustration (c) and Fig. 3, illustration (c) for rectangular ends and in Fig. 2, illustration (d) and Fig. 3, 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 Figs. 4 through 6.

### 4.2 Dimension C

Values for dimension *C* shown in Fig. 2, illustrations (c) and (d); Fig. 3, illustrations (c) and (d); and Figs. 5 and 6 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 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 A 106 and ASTM A 335 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)

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

Tables 1 and I-1 list the *C* values for pipe with an undertolerance of 12.5% on wall thickness, including ASTM A 106 and ASTM A 335 pipe, in sizes NPS 2½ through NPS 48. For pipe with a pipe wall thickness undertolerance other than 12.5%, do not use the *C* data from Tables 1 and I-1. See para. 4.3(a).

### 4.3 Exceptions

(a) For pipe or tubing varying from the ASTM A 106 and A 335 types, having different wall thickness and/or outside diameter tolerances (such as forged and bored pipe), 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 Tables 1 and I-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 inside diameter (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 Figs. 2, 3, 5, and 6)

### 5.1 Dimension B

Values for the I.D. at the welding end [see dimension B, Fig. 2, illustrations (a) and (b); and Fig. 3, 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 Figs. 2 through 6.

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 Figs. 2 and 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 Figs. 5 and 6.

### 5.3 Dimension A

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

Size	Tolerance
NPS ≤ 5	+2.5 mm, -0.79 mm (+0.10 in., -0.031 in.)
NPS ≥ 6	+4.0 mm, -0.79 mm (+0.16 in., -0.031 in.)

### 5.4 Wall Thickness

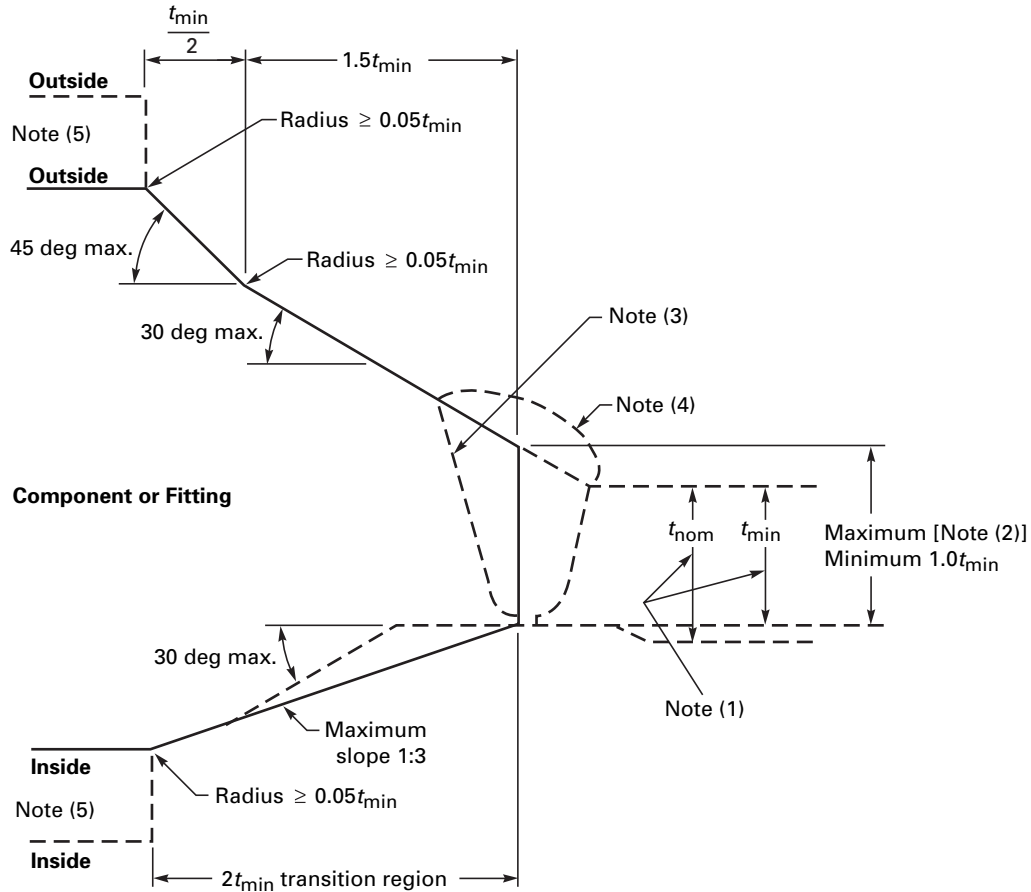
The maximum thickness,  $t_{max}$ , at the end of the component is

(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  $1.10t_{nom}$  when ordered on a nominal wall basis (see Fig. 1)

The minimum thickness,  $t_{min}$ , shall be as specified in the applicable standard or specification for the component (see Figs. 2, 3, 5, and 6).

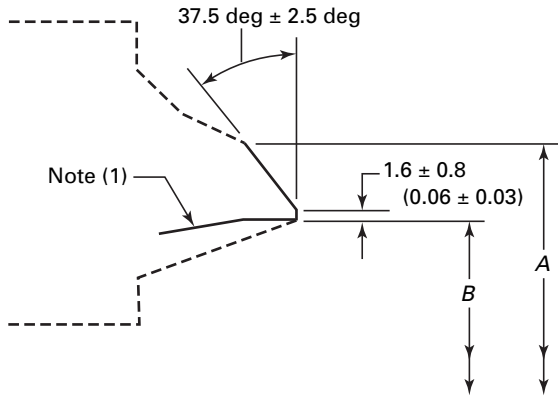
**Fig. 1 Maximum Envelope for Welding End Transitions**



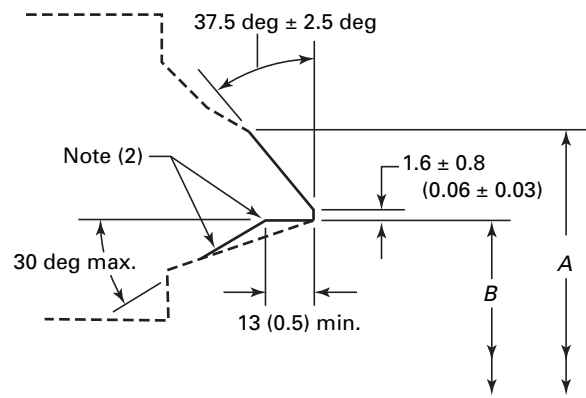
**NOTES:**

- (1) 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
- (2) The maximum thickness at the end of the components is
  - (a) the greater of  $t_{min} + 4 \text{ mm (0.16 in.)}$  or  $1.15t_{min}$  when ordered on a minimum wall basis
  - (b) the greater of  $t_{min} + 4 \text{ mm (0.16 in.)}$  or  $1.10t_{nom}$  when ordered on a nominal wall basis
- (3) Weld bevel shown is for illustration only.
- (4) The weld reinforcement permitted by applicable code may lie outside the maximum envelope.
- (5) Where transitions using maximum slope do not intersect inside or outside surface, as shown by phantom outlines, maximum slopes shown or alternate radii shall be used.

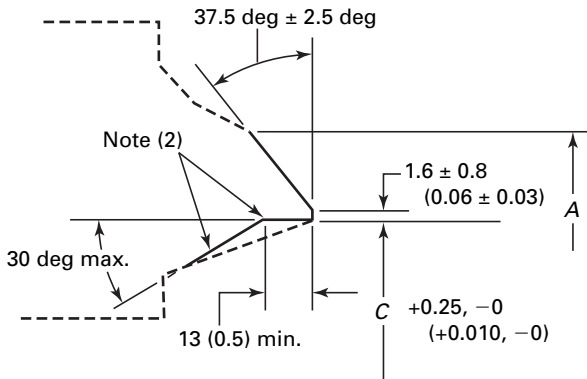
**Fig. 2 Bevels for Wall Thickness Over 3 mm (0.12 in.) to 22 mm (0.88 in.), Inclusive**



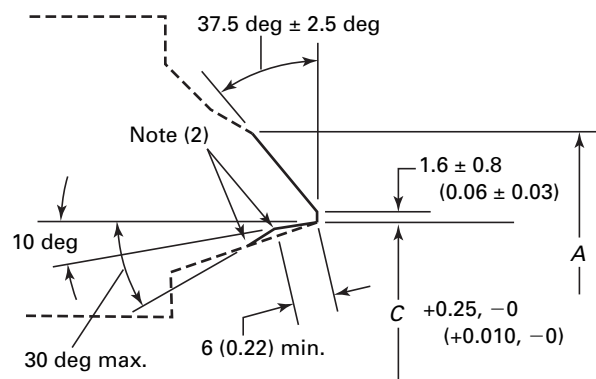
**(a) Welding End Detail for Joint Without Backing Ring**



**(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**

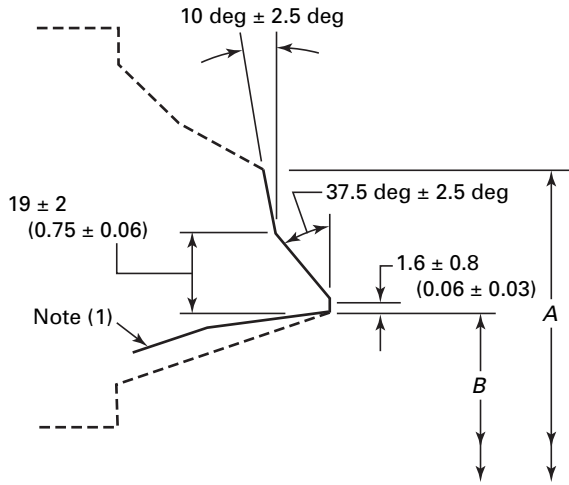
**GENERAL NOTES:**

- (a) Broken lines denote maximum envelope for transitions from welding bevel and root face into body of component. See Fig. 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.

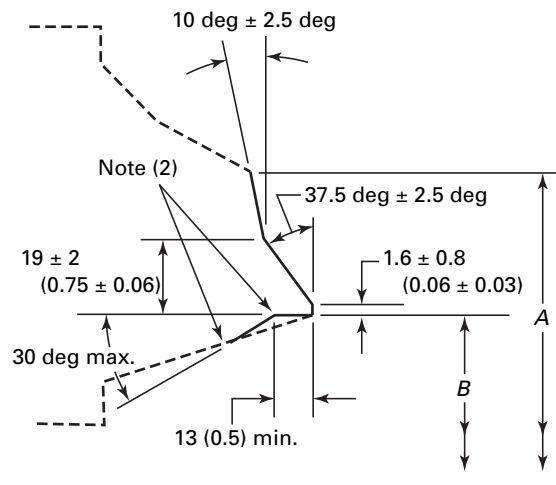
**NOTES:**

- (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.

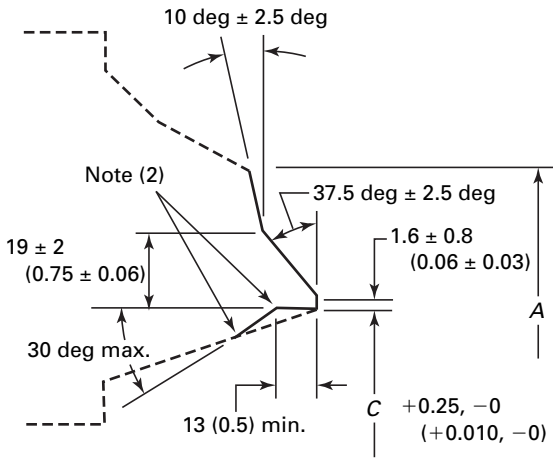
**Fig. 3 Weld Bevel Details for Wall Thickness Over 22 mm (0.88 in.)**



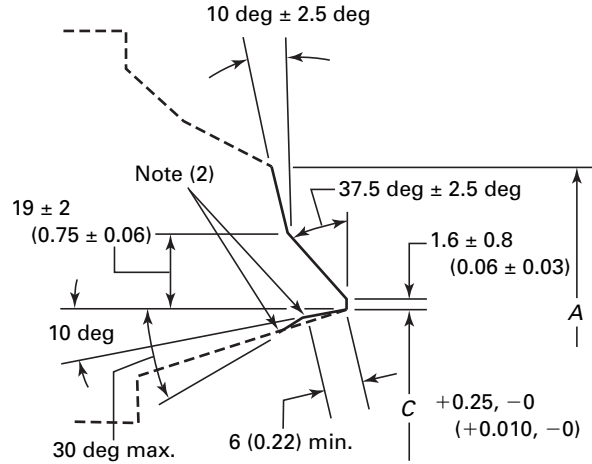
**(a) Welding End Detail for Joint Without Backing Ring**



**(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 Fig. 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.

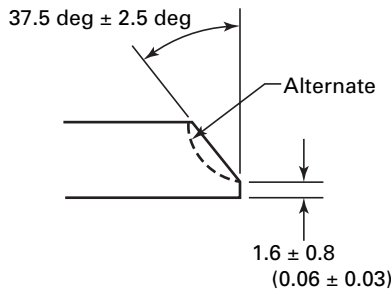
(d) Linear dimensions are in millimeters with inch values in parentheses.

**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.

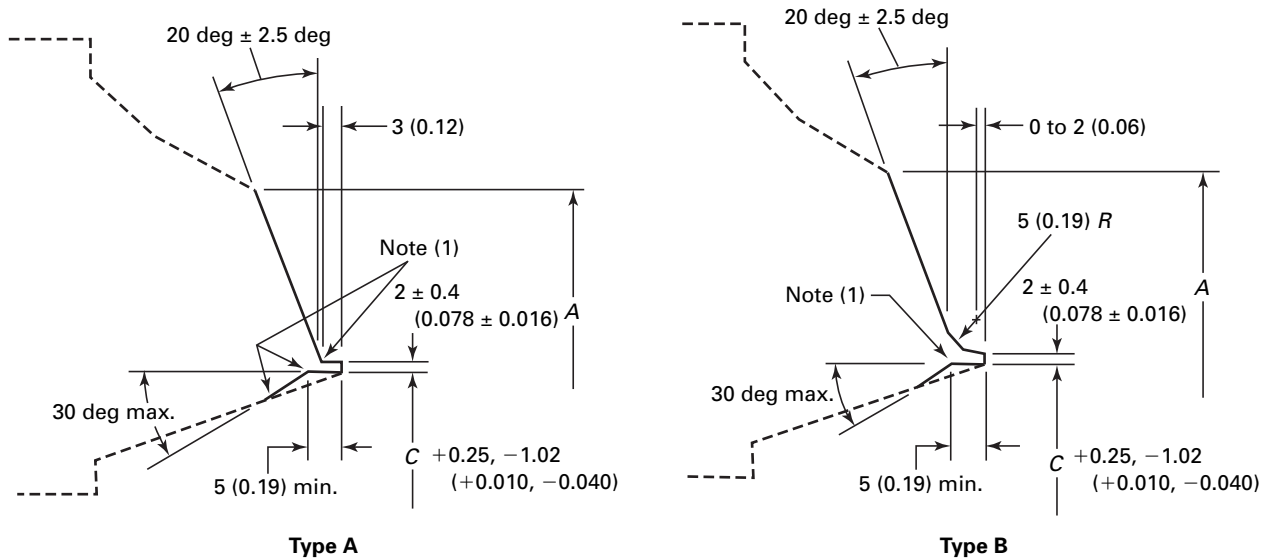
**Fig. 4 Weld Bevel Details for GTAW Root Pass  
[Wall Thickness Over 3 mm (0.12 in.) to 10 mm  
(0.38 in.), Inclusive]**



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.

**Fig. 5 Weld Bevel Details for GTAW Root Pass  
[Wall Thickness Over 10 mm (0.38 in.) to 25 mm (1.0 in.), Inclusive]**



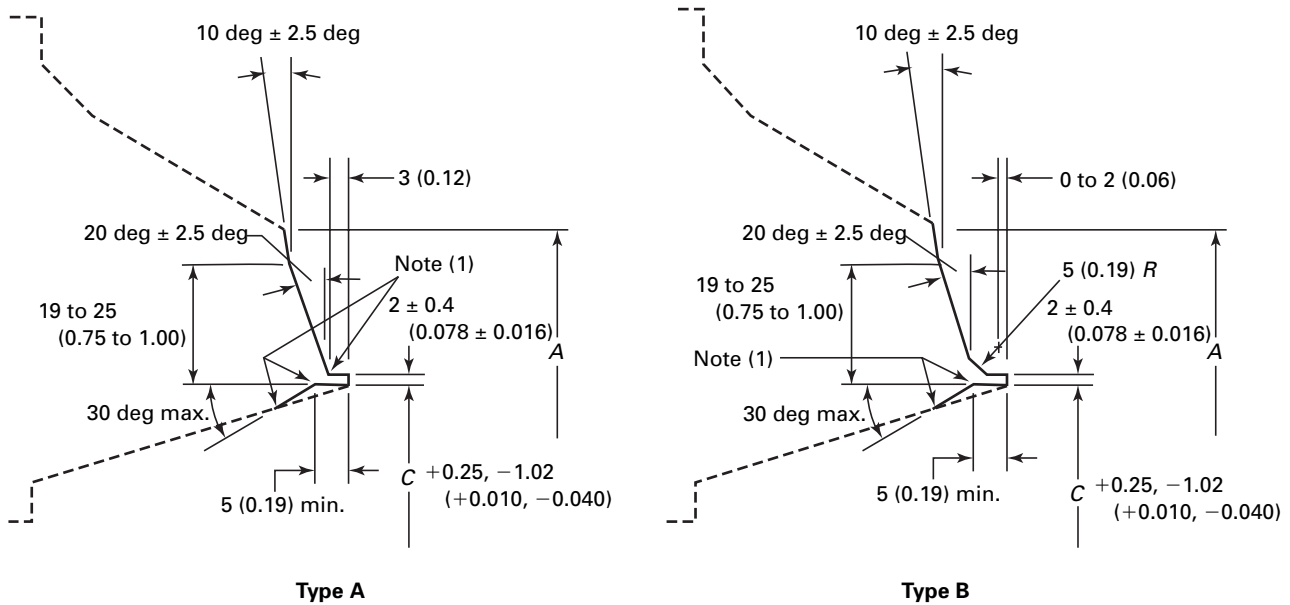
GENERAL NOTES:

- (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 Fig. 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.

**Fig. 6 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 Fig. 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 1 Dimensions of Welding Ends  
(See Figs. 1 Through 6)**

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends					<i>t</i>
		Wrought or Fabricated Components, <i>A</i> [Note (1)]		Cast Components, <i>A</i>		<i>C</i> [Note (2)]	
				<i>B</i>			
2½	30	73.0	75	63.50	63.60	4.78	
	40	73.0	75	62.50	62.93	5.16	
	80	73.0	75	59.00	59.69	7.01	
	160	73.0	75	54.00	55.28	9.53	
	XXS	73.0	75	45.00	47.43	14.02	
3	30	88.9	91	79.50	79.50	4.78	
	40	88.9	91	78.00	78.25	5.49	
	80	88.9	91	73.50	74.53	7.62	
	160	88.9	91	66.50	68.38	11.13	
	XXS	88.9	91	58.50	61.19	15.24	
3½	30	101.6	105	92.00	92.20	4.78	
	40	101.6	105	90.00	90.52	5.74	
	80	101.6	105	85.50	86.42	8.08	
4	30	114.3	117	104.50	104.90	4.78	
	40	114.3	117	102.00	102.73	6.02	
	80	114.3	117	97.00	98.28	8.56	
	120	114.3	117	92.00	93.78	11.13	
	160	114.3	117	87.50	89.65	13.49	
	XXS	114.3	117	80.00	83.30	17.12	
5	40	141.3	144	128.00	128.80	6.55	
	80	141.3	144	122.00	123.58	9.53	
	120	141.3	144	116.00	118.04	12.70	
	160	141.3	144	109.50	112.47	15.88	
	XXS	141.3	144	103.00	106.92	19.05	
6	40	168.3	172	154.00	154.82	7.11	
	80	168.3	172	146.50	148.06	10.97	
	120	168.3	172	140.00	142.29	14.27	
	160	168.3	172	132.00	135.31	18.26	
	XXS	168.3	172	124.50	128.85	21.95	
8	20	219.1	223	206.50	206.95	6.35	
	30	219.1	223	205.00	205.74	7.04	
	40	219.1	223	203.00	203.75	8.18	
	60	219.1	223	198.50	200.02	10.31	
	80	219.1	223	193.50	195.84	12.70	
	100	219.1	223	189.00	191.65	15.09	
	120	219.1	223	182.50	186.11	18.26	
	140	219.1	223	178.00	181.98	20.62	
	XXS	219.1	223	174.50	179.16	22.23	
	160	219.1	223	173.00	177.79	23.01	
10	20	273.0	278	260.50	260.85	6.35	
	30	273.0	278	257.50	258.31	7.80	
	40	273.0	278	254.50	255.74	9.27	
	60	273.0	278	247.50	249.74	12.70	
	80	273.0	278	243.00	245.55	15.09	
	100	273.0	278	236.50	240.01	18.26	



**Table 1 Dimensions of Welding Ends (Cont'd)**  
**(See Figs. 1 Through 6)**

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends					
		Wrought or Fabricated Components, A [Note (1)]	Cast Components, A	B	C [Note (2)]	t	
10 (Cont'd)	120	273.0	278	230.00	234.44	21.44	
	140	273.0	278	222.00	227.51	25.40	
	160	273.0	278	216.00	221.95	28.58	
12	20	323.8	329	311.00	311.65	6.35	
	30	323.8	329	307.00	308.10	8.38	
	STD	323.8	329	305.00	306.08	9.53	
	40	323.8	329	303.00	304.72	10.31	
	XS	323.8	329	298.50	300.54	12.70	
	60	323.8	329	295.00	297.79	14.27	
	80	323.8	329	289.00	292.17	17.48	
	100	323.8	329	281.00	285.24	21.44	
	120	323.8	329	273.00	278.31	25.40	
	140	323.8	329	266.50	272.75	28.58	
	160	323.8	329	257.00	264.45	33.32	
	14	20	355.6	362	340.00	340.70	7.92
STD		355.6	362	336.50	337.88	9.53	
40		355.6	362	333.50	335.08	11.13	
XS		355.6	362	330.00	332.34	12.70	
60		355.6	362	325.50	328.15	15.09	
80		355.6	362	317.50	321.22	19.05	
100		355.6	362	308.00	312.86	23.83	
120		355.6	362	300.00	305.93	27.79	
140		355.6	362	292.00	299.00	31.75	
160		355.6	362	284.00	292.07	35.71	
16	20	406.4	413	390.50	391.50	7.92	
	STD	406.4	413	387.50	388.68	9.53	
	40	406.4	413	381.00	383.14	12.70	
	60	406.4	413	373.00	376.21	16.66	
	80	406.4	413	363.50	367.84	21.44	
	100	406.4	413	354.00	359.53	26.19	
	120	406.4	413	344.50	351.18	30.96	
	140	406.4	413	333.50	341.43	36.53	
	160	406.4	413	325.50	334.50	40.49	
18	20	457.2	464	441.50	442.30	7.92	
	30	457.2	464	435.00	436.68	11.13	
	STD	457.2	464	438.00	439.48	9.53	
	XS	457.2	464	432.00	433.94	12.70	
	40	457.2	464	428.50	431.19	14.27	
	60	457.2	464	419.00	422.82	19.05	
	80	457.2	464	409.50	414.46	23.83	
	100	457.2	464	398.50	404.78	29.36	
	120	457.2	464	387.50	395.03	34.93	
	140	457.2	464	378.00	386.77	39.67	
	160	457.2	464	366.50	376.99	45.24	
	20	STD	508.0	516	489.00	490.28	9.53
		XS	508.0	516	482.50	484.74	12.70
40		508.0	516	478.00	480.55	15.09	

**Table 1 Dimensions of Welding Ends (Cont'd)**  
**(See Figs. 1 Through 6)**

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends					<i>t</i>
		Wrought or Fabricated Components, <i>A</i> [Note (1)]	Cast Components,		<i>C</i> [Note (2)]		
			<i>A</i>	<i>B</i>			
20 (Cont'd)	60	508.0	516	467.00	470.88	20.62	
	80	508.0	516	455.50	461.13	26.19	
	100	508.0	516	443.00	450.02	32.54	
	120	508.0	516	432.00	440.29	38.10	
	140	508.0	516	419.00	429.17	44.45	
	160	508.0	516	408.00	419.44	50.01	
22	STD	558.8	567	539.00	541.08	9.53	
	XS	558.8	567	533.00	535.54	12.70	
	60	558.8	567	514.00	518.86	22.23	
	80	558.8	567	501.00	507.75	28.58	
	100	558.8	567	488.50	496.63	34.93	
	120	558.8	567	476.00	485.52	41.28	
	140	558.8	567	463.00	474.41	47.63	
	160	558.8	567	450.50	463.30	53.98	
24	STD	609.6	619	590.50	591.88	9.53	
	XS	609.6	619	584.00	586.34	12.70	
	30	609.6	619	581.00	583.59	14.27	
	40	609.6	619	574.50	577.97	17.48	
	60	609.6	619	560.50	565.49	24.61	
	80	609.6	619	547.50	554.38	30.96	
	100	609.6	619	532.00	540.49	38.89	
	120	609.6	619	517.50	528.03	46.02	
	140	609.6	619	505.00	516.91	52.37	
	160	609.6	619	490.50	504.37	59.54	
	26	10	660.4	670	645.50	645.50	7.92
		STD	660.4	670	641.34	642.68	9.53
20		660.4	670	635.00	637.14	12.70	
28	10	711.2	721	695.50	696.30	7.92	
	STD	711.2	721	692.14	693.48	9.53	
	20	711.2	721	686.00	687.94	12.70	
	30	711.2	721	679.50	682.37	15.88	
30	10	762.0	772	746.00	747.10	7.92	
	STD	762.0	772	742.94	744.28	9.53	
	20	762.0	772	736.50	738.74	12.70	
	30	762.0	772	730.00	733.17	15.88	
32	10	812.8	825	797.00	797.90	7.92	
	STD	812.8	825	793.74	795.08	9.53	
	20	812.8	825	787.50	789.54	12.70	
	30	812.8	825	781.00	783.97	15.88	
	40	812.8	825	778.00	781.17	17.48	
34	10	863.6	876	848.00	848.70	7.92	
	STD	863.6	876	844.54	845.88	9.53	
	20	863.6	876	838.00	840.34	12.70	
	30	863.6	876	832.00	834.77	15.88	
	40	863.6	876	828.50	831.97	17.48	

**Table 1 Dimensions of Welding Ends (Cont'd)**  
**(See Figs. 1 Through 6)**

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends				
		Wrought or Fabricated Components, A [Note (1)]	Cast Components, A	B	C [Note (2)]	t
36	10	914.4	927	898.50	899.50	7.92
	STD	914.4	927	895.34	896.68	9.53
	20	914.4	927	889.00	891.14	12.70
	30	914.4	927	882.50	885.57	15.88
	40	914.4	927	876.50	880.02	19.05
38	STD	965.2	978	946.00	947.48	9.53
	XS	965.2	978	940.00	941.94	12.70
40	STD	1016.0	1029	997.00	998.28	9.53
	XS	1016.0	1029	990.50	992.74	12.70
42	STD	1066.8	1079	1047.50	1049.08	9.53
	XS	1066.8	1079	1041.50	1043.54	12.70
44	STD	1117.6	1130	1098.50	1099.88	9.53
	XS	1117.6	1130	1092.00	1094.34	12.70
46	STD	1168.4	1181	1149.50	1150.68	9.53
	XS	1168.4	1181	1143.00	1145.14	12.70
48	STD	1219.2	1232	1200.00	1201.48	9.53
	XS	1219.2	1232	1194.00	1195.94	12.70

## GENERAL NOTES:

- (a) Dimensions are in millimeters.  
 (b) See section 5 for tolerances.

## NOTES:

- (1) Data are from ASME B36.10M or a more precise rounding of the inch dimensions from Table I-1. Data in the table are also applicable to ASME B36.19M when the wall thickness conforms to ASME B36.10M. Letter designations signify  
 (a) STD = standard wall thickness  
 (b) XS = extra strong wall thickness  
 (c) XXS = double, extra strong wall thickness
- (2) Internal machining for continuous backing rings for sizes NPS 2 and smaller is not contemplated. See para. 4.2 for C dimension for sizes not listed.

# MANDATORY APPENDIX I

## INCH TABLE

This Appendix provides a table (Table I-1) of the standard inch dimensions for fittings.

**Table I-1 Dimensions of Welding Ends  
(See Figs. 1 Through 6)**

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends					<i>t</i>
		Wrought or Fabricated Components,		Cast Components,		<i>C</i> [Note (2)]	
		<i>A</i> [Note (1)]	<i>A</i>	<i>B</i>	<i>C</i>		
2½	30	2.875	2.96	2.499	2.505	0.188	
	40	2.875	2.96	2.469	2.479	0.203	
	80	2.875	2.96	2.323	2.351	0.276	
	160	2.875	2.96	2.125	2.178	0.375	
	XXS	2.875	2.96	1.771	1.868	0.552	
3	30	3.500	3.59	3.124	3.130	0.188	
	40	3.500	3.59	3.068	3.081	0.216	
	80	3.500	3.59	2.900	2.934	0.300	
	160	3.500	3.59	2.624	2.692	0.438	
	XXS	3.500	3.59	2.300	2.409	0.600	
3½	30	4.000	4.12	3.624	3.630	0.188	
	40	4.000	4.12	3.548	3.564	0.226	
	80	4.000	4.12	3.364	3.402	0.318	
4	30	4.500	4.62	4.124	4.130	0.188	
	40	4.500	4.62	4.026	4.044	0.237	
	80	4.500	4.62	3.826	3.869	0.337	
	120	4.500	4.62	3.624	3.692	0.438	
	160	4.500	4.62	3.438	3.530	0.531	
	XXS	4.500	4.62	3.152	3.279	0.674	
5	40	5.563	5.69	5.047	5.070	0.258	
	80	5.563	5.69	4.813	4.866	0.375	
	120	5.563	5.69	4.563	4.647	0.500	
	160	5.563	5.69	4.313	4.428	0.625	
	XXS	5.563	5.69	4.063	4.209	0.750	
6	40	6.625	6.78	6.065	6.094	0.280	
	80	6.625	6.78	5.761	5.828	0.432	
	120	6.625	6.78	5.501	5.600	0.562	
	160	6.625	6.78	5.187	5.326	0.719	
	XXS	6.625	6.78	4.897	5.072	0.864	
8	20	8.625	8.78	8.125	8.146	0.250	
	30	8.625	8.78	8.071	8.099	0.277	
	40	8.625	8.78	7.981	8.020	0.322	
	60	8.625	8.78	7.813	7.873	0.406	
	80	8.625	8.78	7.625	7.709	0.500	
	100	8.625	8.78	7.437	7.544	0.594	
	120	8.625	8.78	7.187	7.326	0.719	
	140	8.625	8.78	7.001	7.163	0.812	
	XXS	8.625	8.78	6.875	7.053	0.875	
160	8.625	8.78	6.813	6.998	0.906		
10	20	10.750	10.94	10.250	10.272	0.250	
	30	10.750	10.94	10.136	10.172	0.307	
	40	10.750	10.94	10.020	10.070	0.365	
	60	10.750	10.94	9.750	9.834	0.500	
	80	10.750	10.94	9.562	9.670	0.594	
	100	10.750	10.94	9.312	9.451	0.719	

**Table I-1 Dimensions of Welding Ends (Cont'd)**  
**(See Figs. 1 Through 6)**

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends					<i>t</i>
		Wrought or Fabricated Components, <i>A</i> [Note (1)]	Cast Components,		<i>C</i> [Note (2)]		
			<i>A</i>	<i>B</i>			
10 (Cont'd)	120	10.750	10.94	9.062	9.232	0.844	
	140	10.750	10.94	8.750	8.959	1.000	
	160	10.750	10.94	8.500	8.740	1.125	
12	20	12.750	12.97	12.250	12.272	0.250	
	30	12.750	12.97	12.090	12.132	0.330	
	STD	12.750	12.97	12.000	12.053	0.375	
	40	12.750	12.97	11.938	11.999	0.406	
	XS	12.750	12.97	11.750	11.834	0.500	
	60	12.750	12.97	11.626	11.725	0.562	
	80	12.750	12.97	11.374	11.505	0.688	
	100	12.750	12.97	11.062	11.232	0.844	
	120	12.750	12.97	10.750	10.959	1.000	
	140	12.750	12.97	10.500	10.740	1.125	
	160	12.750	12.97	10.126	10.413	1.312	
	14	20	14.000	14.25	13.376	13.413	0.312
STD		14.000	14.25	13.250	13.303	0.375	
40		14.000	14.25	13.124	13.192	0.438	
XS		14.000	14.25	13.000	13.084	0.500	
60		14.000	14.25	12.812	12.920	0.594	
80		14.000	14.25	12.500	12.646	0.750	
100		14.000	14.25	12.124	12.318	0.938	
120		14.000	14.25	11.812	12.044	1.094	
140		14.000	14.25	11.500	11.771	1.250	
160		14.000	14.25	11.188	11.498	1.406	
16		20	16.000	16.25	15.376	15.413	0.312
		STD	16.000	16.25	15.250	15.303	0.375
	40	16.000	16.25	15.000	15.084	0.500	
	60	16.000	16.25	14.688	14.811	0.656	
	80	16.000	16.25	14.312	14.482	0.844	
	100	16.000	16.25	13.938	14.155	1.031	
	120	16.000	16.25	13.562	13.826	1.219	
	140	16.000	16.25	13.124	13.442	1.438	
	160	16.000	16.25	12.812	13.170	1.594	
	18	20	18.000	18.28	17.376	17.413	0.312
		30	18.000	18.28	17.124	17.192	0.438
		STD	18.000	18.28	17.250	17.303	0.375
XS		18.000	18.28	17.000	17.084	0.500	
40		18.000	18.28	16.876	16.975	0.562	
60		18.000	18.28	16.500	16.646	0.750	
80		18.000	18.28	16.124	16.318	0.938	
100		18.000	18.28	15.688	15.936	1.156	
120		18.000	18.28	15.250	15.553	1.375	
140		18.000	18.28	14.876	15.225	1.562	
160		18.000	18.28	14.438	14.842	1.781	
20		STD	20.000	20.31	19.250	19.303	0.375
	XS	20.000	20.31	19.000	19.084	0.500	
	40	20.000	20.31	18.812	18.920	0.594	

**Table I-1 Dimensions of Welding Ends (Cont'd)**  
**(See Figs. 1 Through 6)**

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends				
		Wrought or Fabricated Components, A [Note (1)]	Cast Components,		C [Note (2)]	t
			A	B		
20 (Cont'd)	60	20.000	20.31	18.376	18.538	0.812
	80	20.000	20.31	17.938	18.155	1.031
	100	20.000	20.31	17.438	17.717	1.281
	120	20.000	20.31	17.000	17.334	1.500
	140	20.000	20.31	16.500	16.896	1.750
	160	20.000	20.31	16.062	16.513	1.969
22	STD	22.000	22.34	21.250	21.303	0.375
	XS	22.000	22.34	21.000	21.084	0.500
	60	22.000	22.34	20.250	20.428	0.875
	80	22.000	22.34	19.750	19.990	1.125
	100	22.000	22.34	19.250	19.553	1.375
	120	22.000	22.34	18.750	19.115	1.625
	140	22.000	22.34	18.250	18.678	1.875
	160	22.000	22.34	17.750	18.240	2.125
24	STD	24.000	24.38	23.250	23.303	0.375
	XS	24.000	24.38	23.000	23.084	0.500
	30	24.000	24.38	22.876	22.975	0.562
	40	24.000	24.38	22.624	22.755	0.688
	60	24.000	24.38	22.062	22.263	0.969
	80	24.000	24.38	21.562	21.826	1.219
	100	24.000	24.38	20.938	21.280	1.531
	120	24.000	24.38	20.376	20.788	1.812
	140	24.000	24.38	19.876	20.350	2.062
	160	24.000	24.38	19.312	19.857	2.344
26	10	26.000	26.38	25.376	25.413	0.312
	STD	26.000	26.38	25.250	25.303	0.375
	20	26.000	26.38	25.000	25.084	0.500
28	10	28.000	28.38	27.376	27.413	0.312
	STD	28.000	28.38	27.250	27.303	0.375
	20	28.000	28.38	27.000	27.084	0.500
	30	28.000	28.38	26.750	26.865	0.625
30	10	30.000	30.38	29.376	29.413	0.312
	STD	30.000	30.38	29.250	29.303	0.375
	20	30.000	30.38	29.000	29.084	0.500
	30	30.000	30.38	28.750	28.865	0.625
32	10	32.000	32.50	31.376	31.413	0.312
	STD	32.000	32.50	31.250	31.303	0.375
	20	32.000	32.50	31.000	31.084	0.500
	30	32.000	32.50	30.750	30.865	0.625
	40	32.000	32.50	30.624	30.755	0.688
34	10	34.000	34.50	33.376	33.413	0.312
	STD	34.000	34.50	33.250	33.303	0.375
	20	34.000	34.50	33.000	33.084	0.500
	30	34.000	34.50	32.750	32.865	0.625
	40	34.000	34.50	32.624	32.755	0.688

**Table I-1 Dimensions of Welding Ends (Cont'd)**  
**(See Figs. 1 Through 6)**

Nominal Pipe Size (NPS)	Schedule No. [Note (1)]	O.D. at Welding Ends					<i>t</i>
		Wrought or Fabricated Components, <i>A</i> [Note (1)]	Cast Components,		<i>C</i> [Note (2)]		
			<i>A</i>	<i>B</i>			
36	10	36.000	36.50	35.376	35.413	0.312	
	STD	36.000	36.50	35.250	35.303	0.375	
	20	36.000	36.50	35.000	35.084	0.500	
	30	36.000	36.50	34.750	34.865	0.625	
	40	36.000	36.50	34.500	34.646	0.750	
38	STD	38.000	38.50	37.250	37.303	0.375	
	XS	38.000	38.50	36.000	37.084	0.500	
40	STD	40.000	40.50	39.250	39.303	0.375	
	XS	40.000	40.50	39.000	39.084	0.500	
42	STD	42.000	42.50	41.250	41.303	0.375	
	XS	42.000	42.50	41.000	41.084	0.500	
44	STD	44.000	44.50	43.250	43.303	0.375	
	XS	44.000	44.50	43.000	43.084	0.500	
46	STD	46.000	46.50	45.250	45.303	0.375	
	XS	46.000	46.50	45.000	45.084	0.500	
48	STD	48.000	48.50	47.250	47.303	0.375	
	XS	48.000	48.50	47.000	47.084	0.500	

## GENERAL NOTES:

- (a) Dimensions are in inches.  
 (b) See section 5 for tolerances.

## NOTES:

- (1) Data are from ASME B36.10M and are also applicable to ASME B36.19M data when the wall thickness conforms to ASME B36.10M. Letter designations signify  
 (a) STD = standard wall thickness  
 (b) XS = extra strong wall thickness  
 (c) XXS = double, extra strong wall thickness
- (2) Internal machining for continuous backing rings for sizes NPS 2 and smaller is not contemplated. See para. 4.2 for *C* dimension for sizes not listed.



## MANDATORY APPENDIX II REFERENCES

The following is a list of publications referenced in this Standard.

ASME B16.5-2003, Pipe Flanges and Flanged Fittings  
ASME B16.9-2003, Factory-Made Wrought Butt Welding Fittings  
ASME B16.47-1996, Large Diameter Steel Flanges  
ASME B36.10M-2004, Welded and Seamless Wrought Steel Pipe  
ASME B36.19M-2004, Stainless Steel Pipe  
Publisher: The American Society of Mechanical Engineers (ASME), Three Park Avenue, New York, NY 10016-5990; Order Department: 22 Law Drive, Box 2300, Fairfield, NJ 07007-2300  
ASTM A 106/A 106M-06a, Specification for Seamless Carbon Steel Pipe for High-Temperature Service

ASTM A 335/A 335M-06, Specification for Seamless Ferritic Alloy Steel Pipe for High-Temperature Service  
ASTM E 29-06b, Standard Practice for Using Significant Digits in Test Data to Determine Conformance With Specifications  
Publisher: American Society for Testing and Materials (ASTM), 100 Barr Harbor Drive, West Conshohocken, PA 19428  
ISO 9000-2000: Quality management systems — Fundamentals and vocabulary  
ISO 9001-2000: Quality management systems — Requirements  
ISO 9004-2000: Quality management systems — Guidelines for performance improvement  
Publisher: International Organization for Standardization (ISO), 1 ch. de la Voie-Creuse, Case postale 56, CH-1211, Genève 20, Switzerland/Suisse

## NONMANDATORY APPENDIX A QUALITY SYSTEM PROGRAM

The products manufactured in accordance with this Standard shall be produced under a quality system program following the principles of an appropriate standard from the ISO 9000 series.<sup>1</sup> A determination of the need for registration and/or certification of the product

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<sup>1</sup> The series is also available from the American National Standards Institute (ANSI) and the American Society for Quality Control (ASQC) as American National Standards that are identified by a prefix "Q" replacing the prefix "ISO." Each standard of the series is listed in Mandatory Appendix II.

manufacturer's quality system program by an independent organization shall be the responsibility of the manufacturer. The detailed documentation demonstrating program compliance shall be available to the purchaser at the manufacturer's facility. A written summary description of the program utilized by the product manufacturer shall be available to the purchaser upon request. The product manufacturer is defined as the entity whose name or trademark appears on the product in accordance with the marking or identification requirements of this Standard.



## AMERICAN NATIONAL STANDARDS FOR PIPING, PIPE FLANGES, FITTINGS, AND VALVES

Scheme for the Identification of Piping Systems.....	A13.1-1996
Pipe Threads, General Purpose (Inch) .....	B1.20.1-1983(R1992)
Dryseal Pipe Threads (Inch) .....	B1.20.3-1976(R1998)
Cast Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.....	B16.1-1998
Malleable Iron Threaded Fittings: Classes 150 and 300.....	B16.3-1998
Gray Iron Threaded Fittings: Classes 125 and 250.....	B16.4-1998
Pipe Flanges and Flanged Fittings (NPS 1/2 Through NPS 24) .....	B16.5-1996
Factory-Made Wrought Butt welding Fittings.....	B16.9-2001
Face-to-Face and End-to-End Dimensions of Valves .....	B16.10-2000
Forged Fittings, Socket-Welding and Threaded .....	B16.11-2001
Cast Iron Threaded Drainage Fittings .....	B16.12-1998
Ferrous Pipe Plugs, Bushings, and Locknuts with Pipe Threads .....	B16.14-1991
Cast Bronze Threaded Fittings: Classes 125 and 250.....	B16.15-1985(R1994)
Cast Copper Alloy Solder Joint Pressure Fittings .....	B16.18-1984(R1994)
Metallic Gaskets for Pipe Flanges: Ring-Joint, Spiral-Wound, and Jacketed.....	B16.20-1998
Nonmetallic Flat Gaskets for Pipe Flanges.....	B16.21-1992
Wrought Copper and Copper Alloy Solder Joint Pressure Fittings.....	B16.22-1995
Cast Copper Alloy Solder Joint Drainage Fittings — DWV.....	B16.23-1992
Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500.....	B16.24-2006
Butt welding Ends.....	B16.25-2007
Cast Copper Alloy Fittings for Flared Copper Tubes.....	B16.26-1988
Wrought Steel Butt welding Short Radius Elbows and Returns.....	B16.28-1994
Wrought Copper and Wrought Copper Alloy Solder Joint Drainage Fittings — DWV.....	B16.29-1994
Manually Operated Metallic Gas Valves for Use in Gas Piping Systems up to 125 psig (Sizes 1/2 Through 2).....	B16.33-1990
Valves — Flanged, Threaded, and Welding End.....	B16.34-1996
Orifice Flanges.....	B16.36-1996
Large Metallic Valves for Gas Distribution (Manually Operated, NPS 2 1/2 to 12, 125 psig Maximum).....	B16.38-1985(R1994)
Malleable Iron Threaded Pipe Unions .....	B16.39-1998
Manually Operated Thermoplastic Gas Shutoffs and Valves in Gas Distribution Systems .....	B16.40-1985(R1994)
Functional Qualification Requirements for Power Operated Active Valve Assemblies for Nuclear Power Plants.....	B16.41-1983(R1989)
Ductile Iron Pipe Flanges and Flanged Fittings, Classes 150 and 300 .....	B16.42-1998
Manually Operated Metallic Gas Valves for Use in House Piping Systems.....	B16.44-1995
Cast Iron Fittings for Solvent® Drainage Systems.....	B16.45-1998
Large Diameter Steel Flanges (NPS 26 Through NPS 60) .....	B16.47-1996
Steel Line Blanks.....	B16.48-1997
Factory-Made, Wrought Steel, Butt welding Induction Bends for Transportation and Distribution Systems .....	B16.49-2007
Power Piping .....	B31.1-1998
Fuel Gas Piping (not an ANSI standard).....	B31.2-1968
Process Piping .....	B31.3-1999
Pipeline Transportation Systems for Liquid Hydrocarbons and Other Liquids.....	B31.4-1998
Refrigeration Piping and Heat Exchanger Components .....	B31.5-2000
Gas Transmission and Distribution Piping Systems .....	B31.8-1999
Building Services Piping.....	B31.9-1996
Slurry Transportation Piping Systems.....	B31.11-1989(R1998)
Manual for Determining the Remaining Strength of Corroded Pipelines .....	B31G-1991
Welded and Seamless Wrought Steel Pipe .....	B36.10M-1996
Stainless Steel Pipe .....	B36.19M-1985(R1994)
Self-Operated and Power-Operated Safety-Related Valves Functional Specification Standard .....	N278.1-1975(R1992)

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