ASME B16.24-2021

(Revision of ASME B16.24-2016)

Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves

Classes 150, 300, 600, 900, 1500, and 2500

AN AMERICAN NATIONAL STANDARD

The American Society of Mechanical Engineers

ASME B16.24-2021
(Revision of ASME B16.24-2016)

Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves

Classes 150, 300, 600, 900, 1500, and 2500

AN AMERICAN NATIONAL STANDARD

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

Date of Issuance: April 8, 2022

The next edition of this Standard is scheduled for publication in 2026.

ASME issues written replies to inquiries concerning interpretations of technical aspects of this Standard. Periodically certain actions of the ASME B16 Committee may be published as Cases. Cases and interpretations are published on the ASME website under the Committee Pages at http://cstools.asme.org as they are issued.

Errata to codes and standards may be posted on the ASME website under the Committee Pages to provide corrections to incorrectly published items, or to correct typographical or grammatical errors in codes and standards. Such errata shall be used on the date posted.

The Committee Pages can be found at http://cstools.asme.org/. There is an option available to automatically receive an e-mail notification when errata are posted to a particular code or standard. This option can be found on the appropriate Committee Page after selecting "Errata" in the "Publication Information" section.

This code or standard was developed under procedures accredited as meeting the criteria for American National Standards. The standards committee that approved the code or standard was balanced to ensure that individuals from competent and concerned interests had an opportunity to participate. The proposed code or standard was made available for public review and comment, which provided an opportunity for additional public input from industry, academia, regulatory agencies, and the public-at-large.

ASME does not "approve," "rate," or "endorse" any item, construction, proprietary device, or activity. ASME does not take any position with respect to the validity of any patent rights asserted in connection with any items mentioned in this document, and does not undertake to insure anyone utilizing a standard against liability for infringement of any applicable letters patent, nor assume any such liability. Users of a code or standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.

Participation by federal agency representatives or persons affiliated with industry is not to be interpreted as government or industry endorsement of this code or standard.

ASME accepts responsibility for only those interpretations of this document issued in accordance with the established ASME procedures and policies, which precludes the issuance of interpretations by individuals.

The American Society of Mechanical Engineers
Two Park Avenue, New York, NY 10016-5990

CONTENTS

FOREWORD

The development of the first Bronze Flanged Standard began in 1910 to eliminate the confusion prevailing in the trade with respect to bronze flange dimensions and service ratings. The work culminated and was published in 1914 under the title "1914 Brass Standard Flange Dimensions" for 150-lb and 250-lb (now Class 150 and Class 250) steam pressures.

This was superseded in 1928 by the Manufacturers Standardization Society of Valves and Fittings Industry (MSS) "Standard Practice" SP-2, which contained changes to provide inter-changeability with the American Cast-Iron Flange Standards for 125-lb (now Class 125) and Class 250 stream pressures. Subsequent revisions were issued in 1930 and 1936. In the latter, a new column of thickness for 300-lb (now Class 300) flanges was added.

In the 1937 edition, illustrations and dimensions of bronze-flanged fittings were added. This was edited and reprinted in 1943 to conform to the U.S. Department of Commerce, National Bureau of Standards, Simplified Practice Recommendation R-183-42, and to the War Production Board Limitation Order L-252, dated January 23, 1943.

In the 1946 edition, the pressure–temperature ratings were added for the Class 150 and Class 300 standards and the dimensions for that reference to the Class 250 standard were omitted. Limitation Order L-252 was canceled on April 28, 1945. The period of government prohibition of manufacture and civilian use of the Class 250 standard (during the life of Order L-252) caused no hardship on the part of either the manufacturer or the consumer, indicating that this pressure class in bronze products did not warrant being recognized as a standard.

This Standard was reviewed and reaffirmed in 1949. In October 1951, MSS ceded it to Sectional Committee B16 on Pipe Flanges and Flanged Fittings for review and possible approval as an American Standard.

Following approval of the sectional committee and sponsor organizations, it was sent to the American Standards Association (ASA), now the American National Standards Institute (ANSI), for approval and designation as an American Standard. This was granted on February 27, 1953.

In 1961, following the organization of Subcommittee No. 11 (now Subcommittee J), the 1953 edition was revised. Chief among the changes recommended was the deletion of reference to brass. This resulted from an action of ASTM redefining the alloys that could properly be called bronze. Several other changes that brought the Standard up to date were also approved by the B16 Committee, with approval designation as an American Standard being granted on July 20, 1962.

Subcommittee J, in keeping with regulations of ANSI, reviewed the Standard in 1969. Only minor changes were made. Among these were the presentation of pressure–temperature ratings in tabular form, and the gasket-retaining grooves being made permissible rather than recommended. Final approval of the changes was granted by ANSI on January 27, 1971.

A revision was undertaken in 1977, and several changes were proposed. Foremost among these was the addition of metric equivalents and the elimination of the optional gasket-retaining grooves. In addition, the Standard was extensively revised editorially. Following approvals by Subcommittee J and the Standards Committee, ANSI granted its approval on June 26, 1979.

In 1982, the American National Standard Committee B16 was reorganized as an ASME Committee, operating under procedures accredited by ANSI.

In 1991, the scope of the Standard was changed from bronze pipe flanges and fittings to cast copper alloy flanges and flanged fittings, and it was expanded to include class designations 150, 300, 600, 900, 1500, and 2500. The 1991 edition also established U.S. Customary units as the standard, and editorial revisions were made to improve the text. Following approval by the Standards Committee and ASME, the 1991 edition of the Standard was approved as an American National Standard by ANSI on February 1, 1991, with the new designation ASME B16.24-1991 and the new title "Cast Copper Alloy Pipe Flanges and Flanged Fittings."

In 2001, the Standard was revised to include Nonmandatory Appendix A, Quality System Program. Editorial revisions were made for clarification. Following approval by the B16 Standards Committee and the ASME Supervisory Board, the Standard was approved as an American National Standard by ANSI on October 24, 2001.

In the 2006 edition, metric units became the primary reference units while maintaining U.S. Customary units in either parenthetical or separate forms. Requirements for Class 400 flanges were omitted from the Standard. In addition, several editorial revisions were made for clarity. Following approval by the Standards Committee and the ASME Board, ASME B16.24-2006, Cast Copper Alloy Pipe Flanges and Flanged Fittings: Classes 150, 300, 600, 900, 1500, and 2500 was approved as an American National Standard by ANSI on November 9, 2006.

In the 2011 edition, references to ASME Standards were revised to no longer list specific edition years; the latest edition of ASME publications applies unless stated otherwise. Materials manufactured to other editions of the referenced ASTM standards have been permitted to be used to manufacture fittings meeting the requirements of this Standard as long as the fitting manufacturer verifies the material meets the requirements of the referenced edition. Following approval by the Standards Committee and the ASME Board on PTCS, the 2011 revision was approved as an American National Standard by ANSI on August 9, 2011, with the designation ASME B16.24-2011.

In the 2016 edition, provisions were made to revise the scope and table readings, and a new Mandatory Appendix and a new Nonmandatory Appendix were added. Following approval by the ASME B16 Standards Committee, approval was given by ANSI on September 23, 2016, with the new designation ASME B16.24-2016 and the new title "Cast Copper Alloy Pipe Flanges, Flanged Fittings, and Valves: Classes 150, 300, 600, 900, 1500, and 2500."

In ASME B16.24-2021, the U.S. Customary tables in former Mandatory Appendix I have been merged with the SI tables in the main text. The tables and figures have been redesignated, former Mandatory Appendix I has been deleted, and the subsequent Mandatory Appendices have been redesignated. Cross-references have been updated accordingly. Also in this edition, paras. 3.1(c), 5.1.2, 6.2.3, 7.1.2, I-0(c), and I-4.3 have been revised, illustrations for "True Y" in Tables 8.1.2-1 and 8.1.2-2 have been revised, Table 3.1-4 has been added, and the references in Mandatory Appendix II (formerly Mandatory Appendix III) have been updated. Following approval by the ASME B16 Standards Committee, ASME B16.24-2021 was approved by ANSI on December 10, 2021.

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.)

STANDARDS COMMITTEE OFFICERS

C. E. Davila, *Chair*
R. M. Bojarczuk, *Vice Chair*
S. J. Rossi, *Secretary*

STANDARDS COMMITTEE PERSONNEL

A. Appleton, Alloy Stainless Products Co., Inc.
J. E. Barker, DeZURIK, Inc.
R. W. Barnes, ANRIC Enterprises, Inc.
D. C. Bayreuther, Neles Corp.
W. B. Bedesem, Consultant
R. M. Bojarczuk, Retired
A. M. Cheta, Shell Global Solutions (U.S.)
M. A. Clark, NIBCO, Inc.
G. A. Cuccio, Capitol Manufacturing Co.
C. E. Davila, Crane Chempharma and Energy
K. S. Felder, Valero Energy
D. R. Frikken, Becht Engineering Co., Inc.
J. R. Holstrom, Val-Matic Valve and Manufacturing Corp.
D. Hunt, Jr., Fastenal
G. A. Jolly, Samshin, Ltd.
E. J. Lain, Exelon Nuclear
T. A. McMahon, Emerson Automation Solutions
R. C. Merrick, Consultant
W. H. Patrick, Dow Chemical Co.
D. W. Rahoi, CCM 2000
D. F. Reid, VSP Technologies
S. J. Rossi, The American Society of Mechanical Engineers
R. A. Schmidt, Canadoil
J. Sekerak, CSA Group
F. R. Volgstadt, Volgstadt and Associates, Inc.
F. Feng, *Delegate,* China Productivity Center for Machinery
J. D. Grant, *Alternate,* DeZURIK, Inc.
P. V. Craig, *Contributing Member,* Jomar Group
B. G. Fabian, *Contributing Member,* Pennsylvania Machine Works
A. G. Kireta, Jr., *Contributing Member,* Copper Development Association, Inc.

SUBCOMMITTEE J — COPPER AND COPPER ALLOY FLANGES, FLANGED FITTINGS, AND SOLDER-JOINT FITTINGS

A. G. Kireta, Jr., *Chair,* Copper Development Association, Inc.
W. E. Chapin, *Vice Chair,* Professional Code Consulting, LLC
R. R. Rahaman, *Secretary,* The American Society of Mechanical Engineers
J. A. Ballanco, JB Engineering and Code Consulting, PC
D. R. Frikken, Becht Engineering Co., Inc.
D. Hunt, Jr., Fastenal
R. Kelsey, NIBCO, Inc.
C. A. Mueller, Mueller Streamline Co.
F. Shingleton, Viega, LLC
J. C. Gast, *Alternate,* Mueller Fittings
J. Atkinson, *Contributing Member,* Consultant

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 or a case, and attending Committee meetings. Correspondence should be addressed to:

Secretary, B16 Standards Committee
The American Society of Mechanical Engineers
Two Park Avenue
New York, NY 10016-5990
http://go.asme.org/Inquiry

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.

Proposing a Case. Cases may be issued to provide alternative rules when justified, to permit early implementation of an approved revision when the need is urgent, or to provide rules not covered by existing provisions. Cases are effective immediately upon ASME approval and shall be posted on the ASME Committee web page.

Requests for Cases shall provide a Statement of Need and Background Information. The request should identify the Standard and the paragraph, figure, or table number(s), and be written as a Question and Reply in the same format as existing Cases. Requests for Cases should also indicate the applicable edition(s) of the Standard to which the proposed Case applies.

Interpretations. Upon request, the B16 Standards 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.

Requests for interpretation should preferably be submitted through the online Interpretation Submittal Form. The form is accessible at http://go.asme.org/InterpretationRequest. Upon submittal of the form, the Inquirer will receive an automatic e-mail confirming receipt.

If the Inquirer is unable to use the online form, he/she may e-mail the request to the Secretary of the B16 Standards Committee at SecretaryB16@asme.org, or mail it to the above address. The request for an 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 in one or two words.
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. Please provide a condensed and precise question, composed in such a way that a "yes" or "no" reply is acceptable.
Proposed Reply(ies):	Provide a proposed reply(ies) in the form of "Yes" or "No," with explanation as needed. If entering replies to more than one question, please number the questions and replies.
Background Information:	Provide the Committee with any background information that will assist the Committee in understanding the inquiry. The Inquirer may also include any plans or drawings that are necessary to explain the question; however, they should not contain proprietary names or information.

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

Moreover, 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 inquiry information submitted, it is the opinion of the Committee that the Inquirer should seek assistance, the inquiry will be returned with the recommendation that such assistance be obtained.

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 and/or telephone conferences that are open to the public. Persons wishing to attend any meeting and/or telephone conference should contact the Secretary of the B16 Standards Committee.

ASME B16.24-2021
SUMMARY OF CHANGES

Following approval by the ASME B16 Standards Committee and ASME, and after public review, ASME B16.24-2021 was approved by the American National Standards Institute on December 10, 2021.

In ASME B16.24-2021, the U.S. Customary tables in former Mandatory Appendix I have been merged with the SI tables in the main text. The tables and figures have been redesignated, former Mandatory Appendix I has been deleted, and the subsequent Mandatory Appendices have been redesignated. Cross-references have been updated accordingly. In addition, ASME B16.24-2021 includes the following changes identified by a margin note, **(21)**. The Record Numbers listed below are explained in more detail in the "List of Changes in Record Number Order" following this Summary of Changes.

Page	*Location*	*Change*
2	3.1	Subparagraph (c) updated *(17-2586)*
4	Table 3.1-4	Added *(17-2586)*
3	5.1.2	Revised *(17-2586)*
6	6.2.3	Revised *(17-2586)*
7	7.1.2	Revised *(17-2586)*
10	Table 8.1.2-1	Illustration for "True Y" revised *(18-1179)*
12	Table 8.1.2-2	Illustration for “True Y” revised *(18-1179)*
16	I-0	Subparagraph (c) revised *(17-2586)*
16	I-4.3	Subparagraph (c) revised *(17-2586)*
19	Mandatory Appendix II	Updated *(20-2565)*

LIST OF CHANGES IN RECORD NUMBER ORDER

Record Number	Change
20-2565	Updated references.
18-1179	Revised error in Table 8.1.2-1 (former Tables 3 and I-3) and Table 8.1.2-2 (former Tables 5 and I-5) illustrations.
17-2586	Revised paras. 3.1(c), 5.1.2, 6.2.3, 7.1.2, I-0(c), and I-4.3(c), and added Table 3.1-4.

CAST COPPER ALLOY PIPE FLANGES, FLANGED FITTINGS, AND VALVES
Classes 150, 300, 600, 900, 1500, and 2500

1 SCOPE

1.1 Inclusions

This Standard covers the following cast copper alloy:

(a) threaded pipe flanges and blind flanges having class designations 150, 300, 600, 900, 1500, and 2500

(b) flanged fittings having rating class designations 150 and 300

(c) threaded and flanged valves having rating class designations 150, 300, 600, 1500, and 2500

1.2 Dimensional Requirements

This Standard establishes requirements for

(a) pressure–temperature ratings

(b) size and method of designating openings for reduced fittings

(c) markings

(d) materials

(e) dimensions

(f) bolting and gaskets

(g) tolerances

(h) nondestructive examination for valves

(i) tests

1.3 MSS SP-80 Requirements

This Standard also provides dimensional requirements for flanged ends of valves conforming to MSS SP-80.

1.4 ASTM B148 Requirements

ASME B16.24 requirements and the supplemental requirements of Mandatory Appendix I shall apply for the construction of valves under this Standard that are made from ASTM B148 materials.

2 GENERAL

2.1 Relevant Units

This Standard states values in both SI (Metric) and U.S. Customary units. As an exception, diameters of bolts and flange bolt holes are expressed in U.S. Customary units only. These systems of units are to be regarded separately as standard. In this Standard, the U.S. Customary units are shown in parentheses or in separate tables following the SI tables. 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. Except for the diameter of bolts and flange bolt holes, combining values from the two systems constitutes nonconformance with the Standard.

2.2 References

Codes, standards, and specifications containing provisions to the extent referenced herein constitute requirements of this Standard. These references are listed in Mandatory Appendix II.

2.3 Quality Systems

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

2.4 Service Conditions

Criteria for selection of material suitable for particular fluid service are not within the scope of this Standard.

2.5 User Accountability

This Standard cites duties and responsibilities that are to be assumed by the flange or flange fitting and valve user in the following areas:

(a) application

(b) installation

(c) system hydrostatic testing

(d) operation

(e) material selection

2.6 Time of Purchase, Manufacture, or Installation

The pressure–temperature ratings in this Standard are applicable upon its publication to all flanges, flanged fittings, and valves within its scope that otherwise meet its requirements. For unused flanges, flanged fittings, and valves maintained in inventory, the manufacturer of the flanges, flanged fittings, and valves may certify conformance to this edition, provided that it can be demonstrated that all requirements of this edition have been met. Where such components were installed

in accordance with the pressure–temperature ratings of an earlier edition of this Standard, those pressure–temperature ratings are applicable except as may be governed by the applicable code or regulation.

2.7 Denotation

2.7.1 Pressure–Temperature Rating Designation. Class, followed by a dimensionless number, is the designation for pressure–temperature ratings as follows: Class 150, Class 300, Class 600, Class 900, Class 1500, and Class 2500.

2.7.2 Size. NPS, followed by a dimensionless number, is the designation for nominal fittings 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

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

3 PRESSURE–TEMPERATURE RATINGS

(21) 3.1 General

(a) For flanges and flanged fittings, the tabulated pressure–temperature ratings of Table 3.1-1 (Table 3.1-1C) shall apply for the materials listed in paras. 6.2.1 and 6.2.2, provided that the dimensional requirements of Tables 7.1.1-1, 7.1.1-2, 8.1.2-1, and 8.1.2-2 are met.

(b) Requirements for valves made from ASTM B61 alloy C92200 and ASTM B62 alloy C83600 are covered by MSS SP-80.

(c) For ASTM B148 alloys C95200, C95400, and C95800 flanges, and flanged and threaded end valves only, the tabulated pressure–temperature ratings of Tables 3.1-2, 3.1-3, and 3.1-4 shall apply, provided that the dimensional requirements of ASME B16.5 are met for flanges and applicable dimensional requirements of ASME B16.5 or ASME B16.47 are met for flanged valves. Threaded end valves shall have taper pipe threads (NPT) meeting the dimensional requirements of ASME B1.20.1.

3.2 Flanged Joints

A flanged joint is composed of separate and independent, although interrelated, components. The flanges, the gasket, and the bolting are assembled by another influence — the assembler. Proper controls must be exercised in the selection and application for all these elements to attain a joint that has acceptable leak tightness. Special techniques (e.g., controlled bolt tightening) are described in ASME PCC-1.

3.3 Pressure–Temperature Ratings of Flanged Joints

Pressure–temperature ratings in this Standard apply to flanged joints that conform to the requirements on bolting in paras. 6.5 and 9.1, on gaskets in paras. 6.6 and 9.2, and to flanged joints that are made up in accordance with good practice for alignment and assembly. Use of the pressure–temperature ratings for flanged joints not conforming to these requirements is the sole responsibility of the user. Requirements for alignment and assembly of joints and consideration of leakage due to forces and moments developed in the connected piping or equipment are not covered in this Standard. If the two flanges in a flanged joint do not have the same pressure–temperature ratings, the pressure–temperature rating of the joint at any temperature is the lower of the two flange pressure–temperature ratings at that temperature.

3.4 Rating Temperature

The temperature shown for a corresponding pressure–temperature rating is the temperature of the pressure-containing shell of the flange, flanged fitting, or valve. In general, this temperature is the same as that of the contained fluid. Use of a pressure–temperature rating corresponding to a temperature other than that of the contained fluid is the responsibility of the user, subject to the applicable code or regulation. For any temperature below −29°C (−20°F), the pressure–temperature rating shall be no greater than the pressure–temperature rating for −29°C (−20°F). See para. 6.5.1 for temperature limitations on use of ASTM A307 bolting.

3.5 Low-Temperature Service

It is the responsibility of the user to verify that all of the component materials (i.e., flange, bolting, and gasket) selected are acceptable for use in temperature applications below −29°C (−20°F). When permitted, copper alloy flanges, flanged fittings, and valves manufactured in accordance with this Standard, assembled with suitable bolting and gaskets, and subject to the applicable code or regulations shall not be used at temperatures below −198°C (−325°F) except for ASTM B148 alloy C95200, which can be used to −269°C (−452°F). For guidance on low-temperature service, refer to ASME B31T.

Table 3.1-1
Pressure–Temperature Ratings for ASTM B61 Alloy C92200 and ASTM B62 Alloy C83600

Service Temperature, °C	Pressure, bar			
	Class 150		Class 300	
	ASTM B62 C83600	ASTM B61 C92200	ASTM B62 C83600	ASTM B61 C92200
−29 to 66	15.5	15.5	34.5	34.5
100	14.3	14.6	31.4	32.4
125	13.4	14.1	29.1	30.9
150	12.4	13.4	26.8	29.3
175	11.4	12.4	24.3	27.6
200	...	11.9	...	26.1
208 [Note (1)]	10.3	...	21.4	...
225	...	11.5	...	24.6
232	9.3	...	19.3	...
250	...	10.5	...	23.0
275	...	10.0	...	21.6
289	...	9.7	...	20.7
Test pressure	24.1	24.1	51.7	51.7

GENERAL NOTE: 1 bar = 100 kPa.

NOTE: (1) Some codes (e.g., ASME BPVC, Section I; ASME B31.1; and ASME B31.5) limit the rating temperature of the indicated material to 208°C.

Table 3.1-1C
Pressure–Temperature Ratings for ASTM B61 Alloy C92200 and ASTM B62 Alloy C83600

Service Temperature, °F	Pressure, psig			
	Class 150		Class 300	
	ASTM B62 C83600	ASTM B61 C92200	ASTM B62 C83600	ASTM B61 C92200
−20 to 150	225	225	500	500
175	220	220	480	490
200	210	215	465	475
225	205	210	445	465
250	195	205	425	450
275	190	200	410	440
300	180	195	390	425
350	165	180	350	400
400	...	170	...	375
406	150	...	...	...
450	135 [Note (1)]	160	280 [Note (1)]	350
500	...	150	...	325
550	...	140	...	300
Test pressure	350	350	750	750

GENERAL NOTE: 1 psig = 6.89 kPa.

NOTE: (1) Some codes (e.g., ASME BPVC, Section I; ASME B31.1; and ASME B31.5) limit the rating temperature of the indicated material to 406°F.

3.6 System Hydrostatic Test

Flanged joints, flanged fittings, and flanged or threaded end valves may be subjected to system hydrostatic tests at pressures not to exceed 1.5 times the tabulated pressure at 38°C (100°F). System testing at higher pressures is the responsibility of the user, subject to the requirements of the applicable code or regulations.

4 SIZE AND METHOD OF DESIGNATING OPENINGS

4.1 Flanges, Fittings, and Valves

The size of a flange, fitting, or valve is identified by the corresponding NPS.

4.2 Reducing Fittings

Reducing fittings shall be designated by the size of the openings in their proper sequence as indicated in Figure 4.2-1.

5 MARKING

5.1 General

Except as modified herein, flanges, flanged fittings, and valves shall be marked as required in MSS SP-25.

5.1.1 Name. The manufacturer's name or trademark shall be applied.

5.1.2 Material. All flanges, flanged fittings, and valves shall be marked with the material's applicable ASTM designation (e.g., B61, B62, and B148). In addition, the applicable grade identification symbol "952," "954," or "958" is required for flanges cast to ASTM B148.[1] (21)

5.1.3 Pressure–Temperature Rating Designation. The flange, flanged fitting, or valve shall be marked with the number that corresponds to its pressure–temperature rating class designation (i.e., 150, 300, 600, 900, 1500, or 2500).

5.1.4 Conformance. The designation B16 or B16.24 shall be applied to the flange, flanged fitting, and valve, preferably located adjacent to the class designation, to indicate conformance to this Standard. The use of the prefix "ASME" is optional.

[1] An ASME BPVC, Section II specification number may be substituted for an ASTM Specification number, provided the requirements of the ASME Specification are identical to or more stringent than the ASTM Specification for the grade, class, or type of material.

Table 3.1-2
Pressure–Temperature Ratings for ASTM B148 Alloy C95200 Flanges

	Pressure, bar (psi)					
Service Temperature, °C (°F)	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
−29 to 38 (−20 to 100)	13.6 (195)	35.4 (515)	70.8 (1,030)	106.1 (1,555)	176.9 (2,570)	294.9 (4,285)
65 (150)	12.5 (185)	33.5 (480)	66.7 (965)	100.0 (1,450)	166.6 (2,415)	277.7 (4,030)
100 (200)	12.3 (180)	32.1 (470)	64.2 (940)	96.3 (1,405)	160.5 (2,345)	267.4 (3,910)
125 (250)	12.1 (175)	31.5 (455)	62.9 (915)	94.4 (1,370)	157.4 (2,285)	262.3 (3,805)
150 (300)	11.8 (170)	30.9 (445)	67.7 (895)	92.6 (1,340)	154.3 (2,230)	257.1 (3,720)
175 (350)	11.7 (170)	30.4 (440)	60.9 (880)	91.3 (1,320)	152.2 (2,200)	253.7 (3,670)
200 (400)	11.6 (170)	30.2 (440)	60.5 (875)	90.7 (1,315)	151.2 (2,190)	252.0 (3,650)
225 (450)	11.5 (165)	30.0 (435)	60.1 (870)	90.1 (1,310)	150.2 (2,180)	250.3 (3,635)
250 (500)	11.5 (165)	30.0 (435)	60.1 (870)	90.1 (1,310)	150.2 (2,180)	250.3 (3,635)
275 (550)	11.5 (155)	30.0 (400)	60.1 (800)	90.1 (1,205)	150.2 (2,005)	250.3 (3,345)
300 (600)	9.0 (95)	23.3 (255)	46.7 (505)	70.0 (760)	116.7 (1,270)	194.6 (2,115)
325 [Note (1)]	5.4 (...)	14.0 (...)	28.0 (...)	42.0 (...)	69.9 (...)	116.6 (...)

NOTE: (1) The maximum use temperature shall be 316°C. Datum for 325°C temperature is provided for interpolation purposes.

Table 3.1-3
Pressure–Temperature Ratings for ASTM B148 Alloy C95400 Flanges

	Pressure, bar (psi)					
Service Temperature, °C (°F)	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
−29 to 38 (−20 to 100)	16.3 (235)	42.6 (615)	85.2 (1,235)	127.7 (1,850)	212.9 (3,085)	354.9 (5,145)
65 (150)	15.5 (225)	40.5 (585)	81.1 (1,175)	121.6 (1,760)	202.6 (2,930)	337.7 (4,885)
100 (200)	15.2 (220)	39.7 (575)	79.4 (1,150)	119.1 (1,730)	198.5 (2,880)	330.9 (4,800)
125 (250)	15.1 (220)	39.5 (570)	79.0 (1,145)	118.5 (1,715)	197.5 (2,860)	329.1 (4,765)
150 (300)	15.1 (220)	39.5 (570)	79.0 (1,145)	118.5 (1,715)	197.5 (2,860)	329.1 (4,765)
175 (350)	15.1 (220)	39.5 (570)	79.0 (1,145)	118.5 (1,715)	197.5 (2,860)	329.1 (4,765)
200 (400)	13.8 (200)	39.5 (570)	79.0 (1,145)	118.5 (1,715)	197.5 (2,860)	329.1 (4,765)
225 (450)	13.0 (185)	39.5 (570)	79.0 (1,145)	118.5 (1,715)	197.5 (2,860)	329.1 (4,765)
250 (500)	12.1 (170)	34.5 (475)	69.3 (955)	103.9 (1,430)	173.1 (2,380)	288.6 (3,970)
275 (550)	11.2 (145)	29.3 (375)	58.6 (755)	87.8 (1,130)	146.4 (1,885)	244.0 (3,145)
300 (600)	8.9 (110)	23.2 (290)	46.5 (585)	69.7 (875)	116.2 (1,455)	193.7 (2,430)
325 [Note (1)]	7.0 (...)	19.1 (...)	36.3 (...)	54.4 (...)	90.7 (...)	151.1 (...)

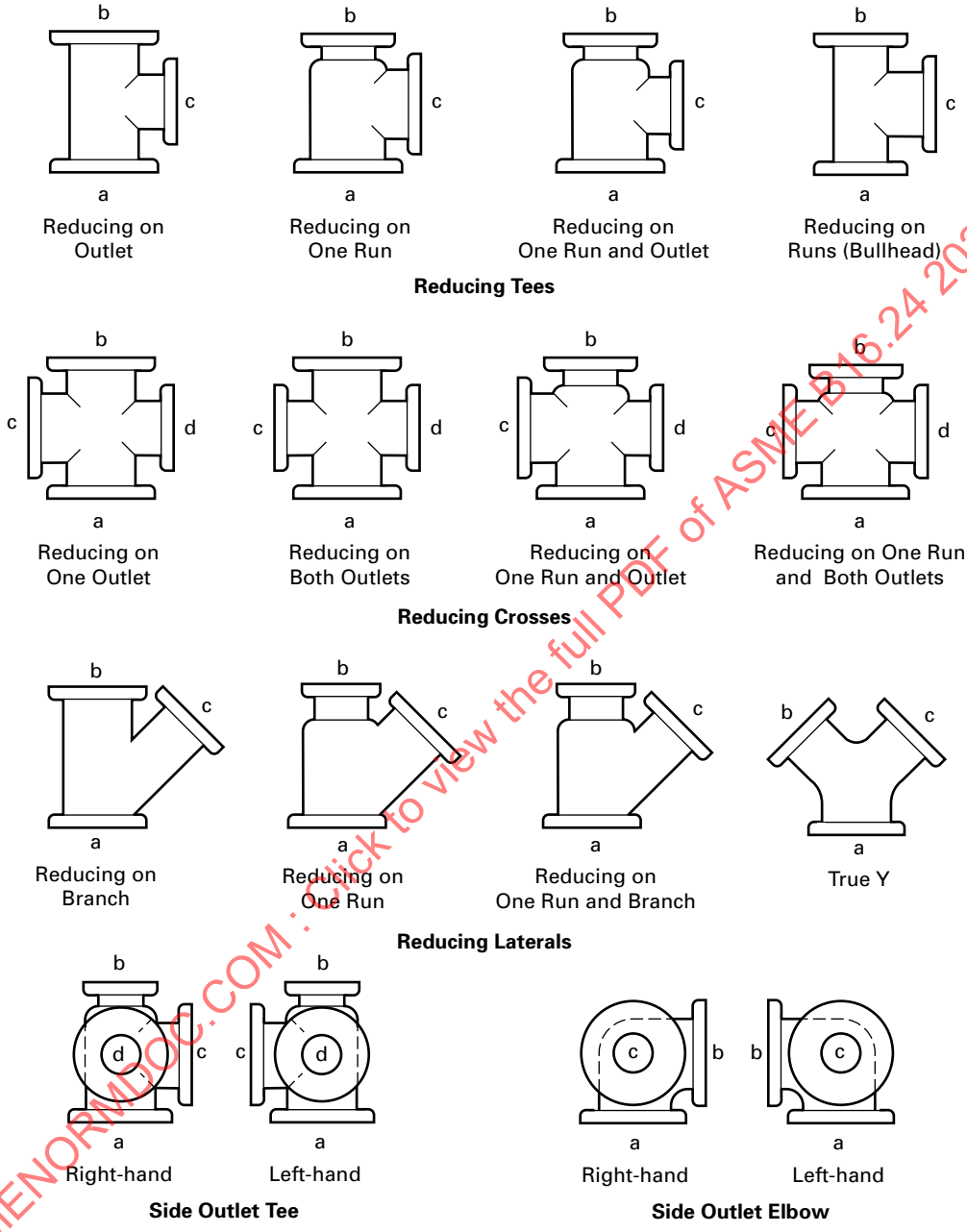
NOTE: (1) The maximum use temperature shall be 316°C. Datum for 325°C temperature is provided for interpolation purposes.

(21) **Table 3.1-4**
Pressure–Temperature Ratings for ASTM B148 Alloy C95800 Flanges

	Pressure, bar (psi)					
Service Temperature, °C (°F)	Class 150	Class 300	Class 600	Class 900	Class 1500	Class 2500
−29 to 30 (−20 to 100)	19.0 (275)	49.6 (720)	99.2 (1,440)	148.7 (2,160)	247.9 (3,600)	413.1 (6,000)
65 (150)	18.8 (270)	49.0 (710)	97.9 (1,420)	146.9 (2,130)	244.8 (3,550)	408.0 (5,915)
100 (200)	18.6 (260)	48.5 (705)	97.1 (1,410)	145.6 (2,115)	242.7 (3,530)	404.6 (5,880)
125 (250)	18.5 (245)	48.3 (705)	96.7 (1,405)	145.0 (2,110)	241.7 (3,520)	402.9 (5,865)
150 (300)	18.5 (230)	48.3 (700)	96.7 (1,400)	145.0 (2,100)	241.7 (3,495)	402.9 (5,830)
175 (350)	18.5 (215)	48.1 (695)	96.3 (1,395)	144.4 (2,090)	240.7 (3,485)	401.1 (5,810)
200 (400)	18.4 (200)	47.9 (695)	95.9 (1,390)	143.8 (2,085)	239.7 (3,475)	399.4 (5,795)
225 [Note (1)]	18.3 (...)	47.7 (...)	95.5 (...)	143.2 (...)	238.6 (...)	397.7 (...)

NOTE: (1) The maximum use temperature shall be 204°C. Datum for 225°C temperature is provided for interpolation purposes.

Figure 4.2-1
Method of Designating Outlets of Reducing Fittings



GENERAL NOTES:

(a) In designating the openings of reducing fittings, they should be read in the order indicated by the sequence of the letters "a," "b," "c," and "d." In designating the outlets of side outlet reducing fittings, the side outlet is named last and in the case of the cross, which is not shown, the side outlet is designated by the letter "e."

(b) The largest opening establishes the basic size of a reducing fitting. The largest opening is named first, except for bullhead tees, which are reducing on both runs, and for double branch elbows where both branches are reducing, the outlet is the largest opening and named last in both cases. (Double branch elbows are not included in this Standard.)

5.1.5 Size. The NPS designation shall be marked on flanges, flanged fittings, and valves. Reducing flanges and reducing flanged fittings shall be marked with the applicable NPS designations as required by paras. 4.1 and 4.2.

6 MATERIALS

6.1 General

Products covered by this Standard shall be made of castings produced to the requirements of para. 6.2 or para. 6.3.

6.2 Flanges

Flanges shall be in accordance with the material requirements specified in para. 6.2.1, para. 6.2.2, or para. 6.2.3.

6.2.1 ASTM B61. Castings shall meet the requirements of ASTM B61 alloy C92200.

6.2.2 ASTM B62. Castings shall meet the requirements of ASTM B62 alloy C83600.

(21) **6.2.3 ASTM B148.** Castings shall meet the requirements of ASTM B148 alloy C95200, C95400, or C95800, and the additional requirements specified in paras. 6.2.3.1 through 6.2.3.5.

6.2.3.1 Ordering Information. Ordering information for ASTM B148 castings shall include tests on each lot and the form of the test bar.

6.2.3.2 Test Bars. For ASTM B148 castings, a minimum of three test bars shall be poured from each lot of cast metal. Chemical composition and mechanical property tests shall be performed using the test bars from each lot.

6.2.3.3 Sampling. For ASTM B148 castings, the sample for chemical analysis shall be taken from the test bar casting or other casting sample in such a manner as to be representative of each casting lot.

6.2.3.4 Weld Repair Approval. ASTM B148 castings shall not be repaired, plugged, welded, or burned-in unless permission from the user of the cast product has been previously secured. This will be requested of the user upon the manufacturer's determination that casting defects are such that after the approved repair, the usefulness and the strength of the casting will not be impaired.

6.2.3.5 Weld Repair. For ASTM B148 castings, preparation for repair welding shall include inspection to ensure complete removal of the defect. Repairs shall be made using welding procedures qualified in accordance with ASME BPVC, Section IX. Repair welding shall be done by welders or welding operators meeting the qualification requirements of that Code.

6.3 Flanged Fittings

Material for flanged fittings shall be in accordance with either para. 6.2.1 or para. 6.2.2.

6.4 Valves — Flanged and Threaded

Material for flanged and threaded valves shall be in accordance with para. 6.2.3.

6.5 Bolting

Bolting materials recommended for use with copper alloy flanges and flanged fittings are described in paras. 6.5.1 and 6.5.2.

6.5.1 Steel Bolting. Carbon steel bolting conforming to ASTM A307 is not recommended to be used below −29°C (−20°F) nor above 204°C (400°F) and is limited to use with Classes 150 and 300 flanges, flanged fittings, and flanged valve end connections.

6.5.2 Nonferrous Boltings. The following nonferrous bolting materials are recommended for Classes 150 and 300 flanges, flanged fittings, and valves within the temperature limitation stated. Other bolting materials that have a specified minimum yield strength of at least 206 MPa (30 ksi) may be used when permitted by the applicable code or regulation.

ASTM Specification	Alloy No.	Condition	Notes
B98	C65100	Half hard	(1)
	C65500	Half hard	(1)
	C66100	Half hard	(1)
B150	C61400	...	(2)
	C63000	...	(2)
	C64200	...	(2)
B164	N04400	Hot finish	...
	N04400	Cold drawn	(2)
	N04400	Cold drawn, stress relieved	(2)
	N04400	Cold drawn, stress equalized	(2)
	N04405	Hot finish	...
	N04405	Cold drawn	(2)

NOTES:
(1) Maximum operating temperature is 177°C (350°F).
(2) Maximum operating temperature is 288°C (550°F).

6.6 Gaskets

Materials for gaskets are described in ASME B16.5. The user is responsible for selection of gasket materials that will withstand the expected bolt loading without injurious crushing and that are suitable for the service conditions. Particular attention needs to be given to gasket selection if a hydrostatic test approaches or exceeds the test pressure specified in para. 3.6.

6.7 Materials Selection

Criteria for the selection of materials are not within the scope of this Standard. The possibility of material deterioration in service should be considered by the user. A discussion of precautionary considerations can be found in ASME B31.3, Appendix F.

7 FLANGE AND VALVE BODY DIMENSIONS

7.1 General

Flange dimensions are dependent on the flange casting material.

7.1.1 ASTM B61 and ASTM B62. For flange castings made of ASTM B61 alloy C92200 or ASTM B62 alloy C83600, the flange dimensions shall be in accordance with Tables 7.1.1-1 and 7.1.1-2 with alternative facings as permitted in para. 7.2.

(21) **7.1.2 ASTM B148 Alloys.** For flange castings made of ASTM B148 alloys C95200, C95400, and C95800, the flange dimensions shall be in accordance with the applicable dimensional requirements of ASME B16.5.

7.1.3 ASTM B148 End Flanges. For valve flanged body castings, the end flange dimensions shall be in accordance with the applicable dimensional requirements of ASME B16.5 or ASME B16.47.

7.2 End-Flange Facings

Unless otherwise specified by the purchaser, Classes 150 and 300 blind and companion flanges shall be furnished with a flat face. Unless otherwise specified by the purchaser, Class 600 and higher companion flanges shall be furnished with a 6.4-mm (0.25-in.) raised face, with the exception of the small male face (on end of pipe) and the small female face (on end of pipe). When using straight pipe threads, any of the flange pipe threads shown in ASME B16.5 may be used with copper alloy flanges. When flanges of ASTM B61 or ASTM B62 are furnished with one of the alternative ASME B16.5 facings, any required raised-face dimension shall be in addition to the basic flange thickness, t_f, of Tables 7.1.1-1 and 7.1.1-2.

7.3 Threaded Flanges

Threaded flanges shall have a taper pipe thread in accordance with ASME B1.20.1. Variations in alignment of the thread with the axis of the flange shall not exceed 5 mm/m (0.06 in./ft) (0.5%).

7.4 Thread Chamfer

All flanges of ASTM B61 and ASTM B62 materials shall be made without a counterbore. The threads shall be chamfered approximately to the major diameter of the thread at the pipe end of the flange at an angle approximately 45 deg with the axis of the thread. The chamfer shall be concentric with the thread and shall be included in the measurement of the thread length.

7.5 Thread Length

The length of the thread shall include the chamfer.

7.6 Thread Gauging

The reference point for gauging is the starting end of the flange, provided the chamfer does not exceed the major diameter of the internal thread. When a chamfer on the internal thread exceeds this limit, the reference point becomes the last thread scratch on the chamfer cone.

7.7 Threaded Flange Assembly

External pipe threads used with higher-pressure flanges shall be longer than normal to bring the end of the pipe close to the face of the flange when parts are assembled by power equipment. The additional length and number of turns are shown in ASME B16.5, Mandatory Appendix I for ASME B1.20.1 threads.

7.8 Flanged Bolt Holes

Bolt holes are in multiples of four. Bolt holes shall be equally spaced, and pairs of bolt holes shall straddle fitting or valve centerlines.

7.9 Spot and Back Facing

Flanges, flanged fittings, and flanged valves covered by this Standard shall have bearing surfaces for bolting that shall be parallel to the flange face within 1 deg. Any spot or back facing shall not reduce the flange thickness, t_f, below the dimension required by para. 7.1. The spot facing diameter shall be in accordance with MSS SP-9. When cutting into the hub of flanges, flanged fittings, and flanged valve bodies with back-facing tools, the intersection shall have a radius not less than 1.5 mm (0.06 in.).

8 FITTING AND VALVE DIMENSIONS

8.1 Center-to-Face Dimensions

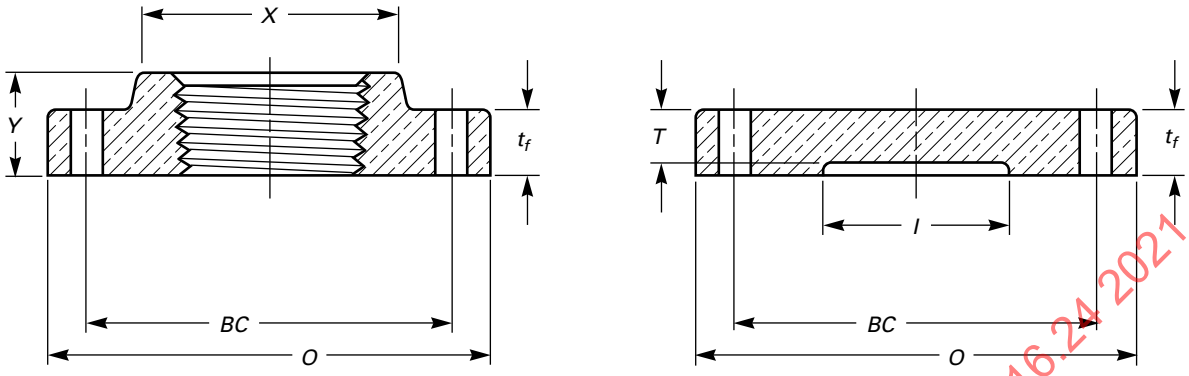
8.1.1 Side Outlet Fittings. Side outlet elbows and side outlet tees shall have all openings on intersecting centerlines.

8.1.2 Elbows

(a) The center-to-face dimensions for straight size 90-deg elbows, 90-deg long radius elbows, 45-deg elbows, and side outlet 90-deg elbows are shown in Tables 8.1.2-1 and 8.1.2-2.

(b) Reducing 90-deg elbows and reducing side outlet 90-deg elbows shall have the same center-to-face dimensions as straight size fittings shown in Tables 8.1.2-1 and 8.1.2-2, corresponding to the size of the largest opening.

Table 7.1.1-1
Dimensions of Class 150 Threaded Companion and Blind Flanges for Alloys C83600 and C92200

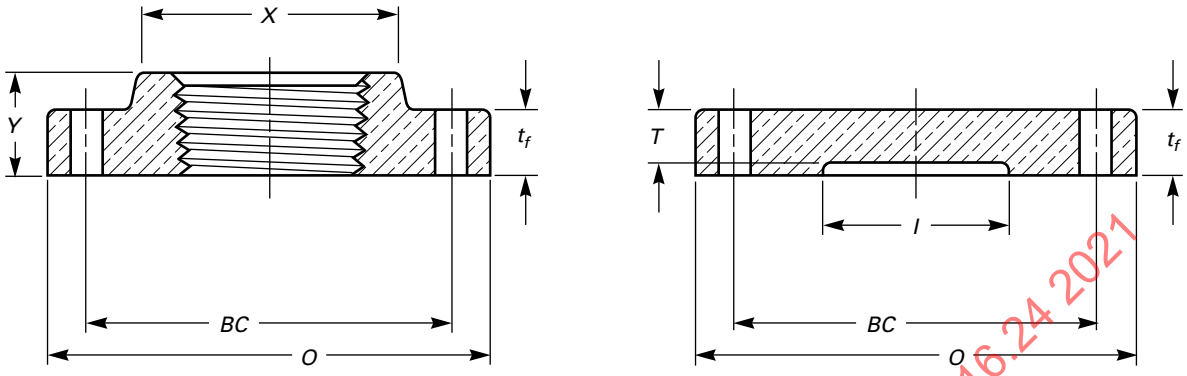


NPS	Diameter of Flange, *O*	Minimum Thickness of Flange, t_f [Note (1)]	Bolt Circle, *BC*	Number of Bolts [Note (2)]	Nominal Bolt Size, in.	Nominal Diameter of Bolt Hole, in.	Minimum Diameter of Hub, *X*	Minimum Length Overall, *Y*	Maximum Diameter of Counter-bore, *I*	Minimum Thickness at Recess, *T*
½	90 (3.50)	7.9 (0.31)	60.3 (2.38)	4	½	⅝	30 (1.19)	15 (0.59)	13 (0.50)	6.4 (0.25)
¾	100 (3.88)	8.6 (0.34)	69.9 (2.75)	4	½	⅝	38 (1.25)	16 (0.62)	19 (0.75)	7.1 (0.28)
1	110 (4.25)	9.7 (0.38)	79.4 (3.12)	4	½	⅝	49 (1.94)	17 (0.69)	25 (1.00)	7.9 (0.31)
1¼	115 (4.62)	10.4 (0.41)	88.9 (3.50)	4	½	⅝	59 (2.31)	21 (0.81)	32 (1.25)	8.6 (0.34)
1½	125 (5.00)	11.2 (0.44)	98.4 (3.88)	4	½	⅝	65 (2.56)	22 (0.88)	38 (1.50)	9.6 (0.38)
2	150 (6.00)	12.7 (0.50)	120.7 (4.75)	4	⅝	¾	78 (3.06)	25 (1.00)	51 (2.00)	11.2 (0.44)
2½	180 (7.00)	14.2 (0.56)	139.7 (5.50)	4	⅝	¾	90 (3.56)	29 (1.12)	64 (2.50)	12.7 (0.50)
3	190 (7.50)	15.7 (0.62)	152.4 (6.00)	4	⅝	¾	108 (4.25)	30 (1.19)	76 (3.00)	14.2 (0.56)
3½	215 (8.50)	17.5 (0.69)	177.8 (7.00)	8	⅝	¾	122 (4.81)	32 (1.25)	89 (3.50)	15.7 (0.62)
4	230 (9.00)	17.5 (0.69)	190.5 (7.50)	8	⅝	¾	135 (5.31)	33 (1.31)	102 (4.00)	15.7 (0.62)
5	255 (10.00)	19.1 (0.75)	215.9 (8.50)	8	¾	⅞	164 (6.44)	37 (1.44)	127 (5.00)	17.5 (0.69)
6	280 (11.00)	20.6 (0.81)	241.3 (9.50)	8	¾	⅞	192 (7.56)	40 (1.56)	152 (6.00)	19.1 (0.75)
8	345 (13.50)	23.9 (0.94)	298.5 (11.75)	8	¾	⅞	246 (9.69)	44 (1.75)	203 (8.00)	22.4 (0.88)
10	405 (16.00)	25.4 (1.00)	362.0 (14.25)	12	⅞	1	305 (12.00)	49 (1.94)	254 (10.00)	23.9 (0.94)
12	485 (19.00)	26.9 (1.06)	431.8 (17.00)	12	⅞	1	365 (14.38)	56 (2.19)	305 (12.00)	25.4 (1.00)

GENERAL NOTES:
(a) Dimensions are in millimeters (inches).
(b) For flange facing, see para. 7.2.
(c) Flange diameters and drilling templates correspond to those prescribed in ASME B16.1, ASME B16.5, and ASME B16.42.

NOTES:
(1) For flange spot facing and thickness, see para. 7.9.
(2) For flanges integral with fittings or valves, see para. 7.8.

Table 7.1.1-2
Dimensions of Class 300 Threaded Companion and Blind Flanges for Alloys C83600 and C92200



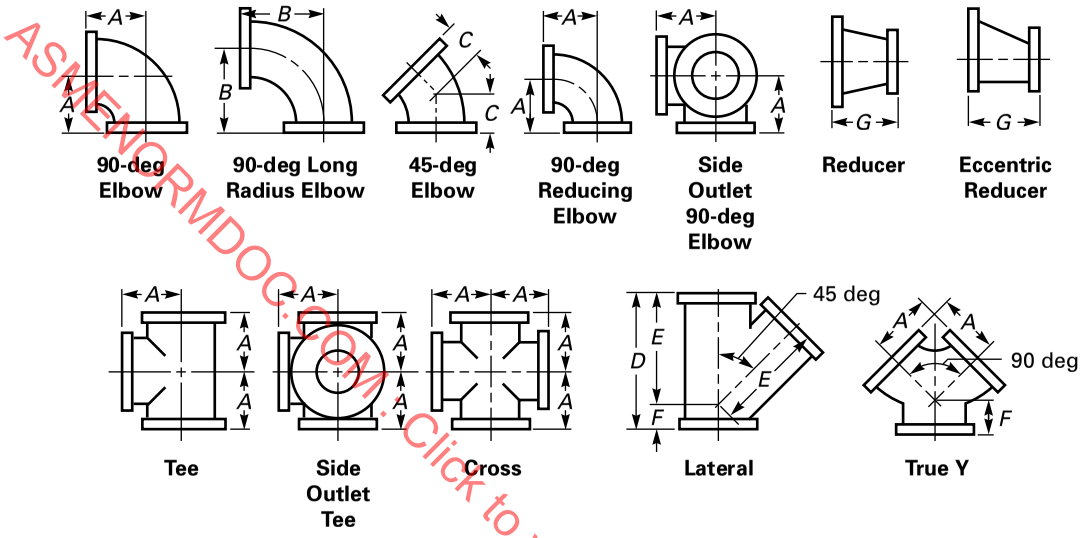
NPS	Diameter of Flange, *O*	Minimum Thickness of Flange, t_f [Note (1)]	Bolt Circle, *BC*	Number of Bolts [Note (2)]	Nominal Bolt Size, in.	Nominal Diameter of Bolt Hole, in.	Minimum Diameter of Hub, *X*	Minimum Length Overall, *Y*	Maximum Diameter of Counter-bore, *I*	Minimum Thickness at Recess, *T*
½	95 (3.75)	12.7 (0.50)	66.7 (2.62)	4	½	⅝	30 (1.19)	15 (0.59)	13 (0.50)	11.2 (0.44)
¾	115 (4.62)	13.5 (0.53)	82.6 (3.25)	4	⅝	¾	38 (1.50)	16 (0.62)	19 (0.75)	11.9 (0.47)
1	125 (4.88)	15.0 (0.59)	88.9 (3.50)	4	⅝	¾	49 (1.94)	18 (0.69)	25 (1.00)	13.5 (0.53)
1¼	135 (5.25)	15.7 (0.62)	98.4 (3.88)	4	⅝	¾	59 (2.31)	21 (0.81)	32 (1.25)	14.2 (0.56)
1½	155 (6.12)	17.5 (0.69)	114.3 (4.50)	4	¾	⅞	65 (2.56)	22 (0.88)	38 (1.50)	15.7 (0.62)
2	165 (6.50)	19.1 (0.75)	127.0 (5.00)	8	⅝	¾	78 (3.06)	25 (1.00)	51 (2.00)	17.5 (0.69)
2½	190 (7.50)	20.6 (0.81)	149.2 (5.88)	8	¾	⅞	90 (3.56)	28 (1.12)	64 (2.50)	19.1 (0.75)
3	210 (8.25)	23.1 (0.91)	168.3 (6.62)	8	¾	⅞	108 (4.25)	30 (1.19)	76 (3.00)	21.3 (0.84)
3½	230 (9.00)	24.6 (0.97)	184.2 (7.25)	8	¾	⅞	122 (4.81)	32 (1.25)	89 (3.50)	23.1 (0.91)
4	255 (10.00)	26.9 (1.06)	200.0 (7.88)	8	¾	⅞	135 (5.31)	33 (1.31)	102 (4.00)	25.4 (1.00)
5	280 (11.00)	28.4 (1.12)	235.0 (9.25)	8	¾	⅞	164 (6.44)	37 (1.44)	127 (5.00)	26.9 (1.06)
6	320 (12.50)	30.2 (1.19)	269.9 (10.62)	12	¾	⅞	192 (7.56)	40 (1.56)	152 (6.00)	28.4 (1.12)
8	380 (15.00)	35.1 (1.38)	330.2 (13.00)	12	⅞	1	246 (9.69)	44 (1.75)	203 (8.00)	33.3 (1.31)

GENERAL NOTES:
(a) Dimensions are in millimeters (inches).
(b) For flange facing, see para. 7.2.
(c) Flange diameters and drilling templates correspond to those prescribed in ASME B16.1, ASME B16.5, and ASME B16.42.

NOTES:
(1) For flange spot facing and thickness, see para. 7.9.
(2) For flanges integral with fittings or valves, see para. 7.8.

(21)

Table 8.1.2-1
Dimensions of Class 150 Elbows, Tees, Crosses, Laterals, True Ys (Straight Sizes), and Reducers



NPS	Center-to-Face, *A* [Notes (1)–(7)]	Face-to-Face, *A+A*	Center-to-Face, *B* [Note (1)]	Center-to-Face, *C* [Note (1)]	Face-to-Face, *D* [Notes (4), (5)]	Center-to-Face, *E* [Notes (4), (5)]	Center-to-Face, *F* [Notes (4), (5)]	Face-to-Face, *G* [Note (8)]	Wall Thickness, *t* [Note (9)]	Minimum Port Diameter, *I*
½	76 (3.00)	152 (6.00)	...	41 (1.62)	...	...	...	...	2.3 (0.09)	13 (0.50)
¾	83 (3.25)	166 (6.50)	...	45 (1.75)	...	...	...	...	2.8 (0.11)	19 (0.75)
1	89 (3.50)	178 (7.00)	127 (5.00)	45 (1.75)	191 (7.50)	146 (5.75)	45 (1.75)	...	3.0 (0.12)	25 (1.00)
1¼	95 (3.75)	190 (7.50)	140 (5.50)	51 (2.00)	204 (8.00)	159 (6.25)	45 (1.75)	...	3.6 (0.14)	32 (1.25)
1½	102 (4.00)	204 (8.00)	152 (6.00)	57 (2.25)	229 (9.00)	178 (7.00)	51 (2.00)	...	4.1 (0.16)	38 (1.50)
2	114 (4.50)	228 (9.00)	165 (6.50)	64 (2.50)	267 (10.50)	203 (8.00)	64 (2.50)	127 (5.00)	4.8 (0.19)	51 (2.00)
2½	127 (5.00)	254 (10.00)	178 (7.00)	76 (3.00)	305 (12.00)	241 (9.50)	64 (2.50)	140 (5.50)	5.1 (0.20)	64 (2.50)
3	140 (5.50)	280 (11.00)	197 (7.75)	76 (3.00)	330 (13.00)	254 (10.00)	76 (3.00)	152 (6.00)	5.6 (0.22)	76 (3.00)
3½	152 (6.00)	304 (12.00)	216 (8.50)	89 (3.50)	368 (14.50)	292 (11.50)	76 (3.00)	165 (6.50)	6.4 (0.25)	89 (3.50)
4	165 (6.50)	330 (13.00)	229 (9.00)	102 (4.00)	381 (15.00)	305 (12.00)	76 (3.00)	178 (7.00)	6.8 (0.27)	102 (4.00)
5	191 (7.50)	380 (15.00)	260 (10.25)	114 (4.50)	432 (17.00)	343 (13.50)	89 (3.50)	203 (8.00)	7.6 (0.30)	127 (5.00)
6	203 (8.00)	406 (16.00)	292 (11.50)	127 (5.00)	457 (18.00)	368 (14.50)	89 (3.50)	229 (9.00)	8.4 (0.33)	152 (6.00)
8	229 (9.00)	458 (18.00)	356 (14.00)	140 (5.50)	559 (22.00)	445 (17.50)	114 (4.50)	279 (11.00)	10.4 (0.41)	203 (8.00)
10	279 (11.00)	558 (22.00)	419 (16.50)	165 (6.50)	648 (25.50)	521 (20.50)	127 (5.00)	305 (12.00)	12.2 (0.48)	254 (10.00)
12	305 (12.00)	610 (24.00)	483 (19.00)	191 (7.50)	762 (30.00)	622 (24.50)	140 (5.50)	356 (14.00)	14.2 (0.56)	305 (12.00)

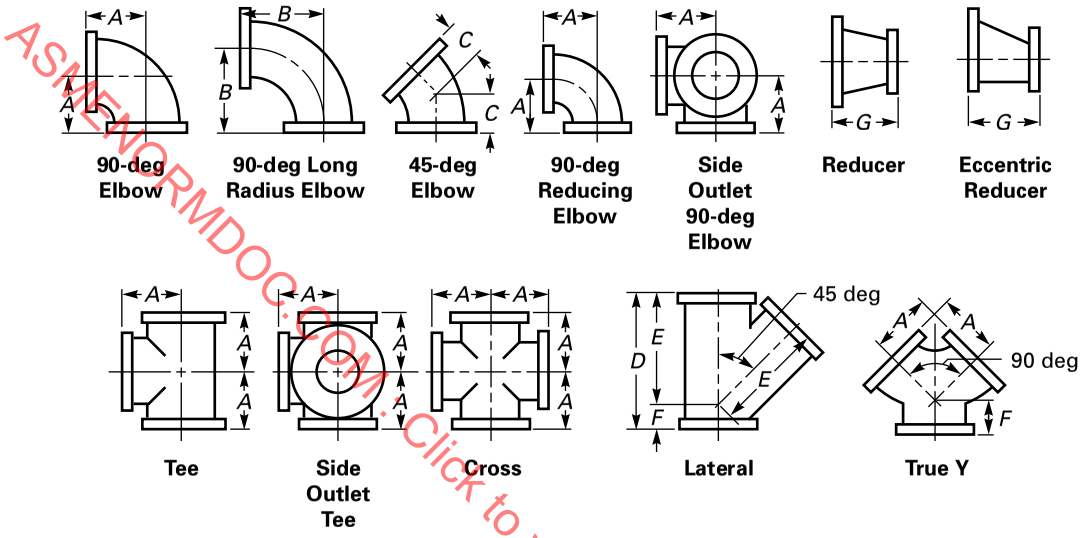
Table 8.1.2-1
Dimensions of Class 150 Elbows, Tees, Crosses, Laterals, True Ys (Straight Sizes), and Reducers (Cont'd)

GENERAL NOTES:
(a) Dimensions are in millimeters (inches).
(b) For flange and bolt hole dimensions, see Table 7.1.1-1 and para. 7.8.
(c) For center-to-face tolerance, see para. 10.3.

NOTES:
(1) For intersecting centerlines of side outlet fittings, see para. 8.1.1.
(2) For center-to-face dimensions of reducing elbows, see para. 8.1.2(b).
(3) For center-to-face dimensions of special degree elbows, see para. 8.1.2(c).
(4) For reinforcements of crosses and laterals, see para. 8.2.
(5) For center-to-face dimensions of reducing tees, crosses, and laterals, see para 8.1.3(a).
(6) For center-to-face dimensions of tees reducing on both runs, see para 8.1.3(c).
(7) For center-to-face dimensions of reducing side outlet tees having two different size reductions on the outlets, see para. 8.1.3(b).
(8) For face-to-face dimensions of reducers and eccentric reducers, see para. 8.1.5.
(9) For wall thickness tolerance, see para. 10.2.

(21)

Table 8.1.2-2
Dimensions of Class 300 Elbows, Tees, Crosses, Laterals, True Ys (Straight Sizes), and Reducers



NPS	Center-to-Face, *A* [Notes (1)–(7)]	Face-to-Face, *A+A*	Center-to-Face, *B* [Note (1)]	Center-to-Face, *C* [Note (1)]	Face-to-Face, *D* [Notes (4), (5)]	Center-to-Face, *E* [Notes (4), (5)]	Center-to-Face, *F* [Notes (4), (5)]	Face-to-Face, *G* [Note (8)]	Wall Thickness, *t* [Note (9)]	Minimum Port Diameter, *I*
½	76 (3.00)	152 (6.00)	...	44 (1.75)	...	...	...	...	3.0 (0.12)	13 (0.50)
¾	89 (3.50)	178 (7.00)	...	57 (2.25)	...	...	...	...	4.1 (0.16)	19 (0.75)
1	102 (4.00)	204 (8.00)	127 (5.00)	57 (2.25)	216 (8.50)	165 (6.50)	51 (2.00)	...	4.3 (0.17)	25 (1.00)
1¼	108 (4.25)	216 (8.50)	140 (5.50)	64 (2.50)	241 (9.50)	184 (7.25)	57 (2.25)	...	4.8 (0.19)	32 (1.25)
1½	114 (4.50)	228 (9.00)	152 (6.00)	70 (2.75)	280 (11.00)	216 (8.50)	64 (2.50)	...	5.1 (0.20)	38 (1.50)
2	127 (5.00)	254 (10.00)	165 (6.50)	76 (3.00)	293 (11.50)	229 (9.00)	64 (2.50)	127 (5.00)	6.4 (0.25)	51 (2.00)
2½	140 (5.50)	280 (11.00)	178 (7.00)	89 (3.50)	331 (13.00)	267 (10.50)	64 (2.50)	140 (5.50)	7.1 (0.28)	64 (2.50)
3	152 (6.00)	304 (12.00)	197 (7.75)	89 (3.50)	355 (14.00)	279 (11.00)	76 (3.00)	152 (6.00)	8.4 (0.33)	76 (3.00)
3½	165 (6.50)	330 (13.00)	216 (8.50)	102 (4.00)	394 (15.50)	318 (12.50)	76 (3.00)	165 (6.50)	9.1 (0.36)	89 (3.50)
4	178 (7.00)	356 (14.00)	229 (9.00)	114 (4.50)	419 (16.50)	343 (13.50)	76 (3.00)	178 (7.00)	10.4 (0.41)	102 (4.00)
5	203 (8.00)	406 (16.00)	260 (10.25)	127 (5.00)	470 (18.50)	381 (15.00)	89 (3.50)	203 (8.00)	12.2 (0.48)	127 (5.00)
6	216 (8.50)	432 (17.00)	292 (11.50)	104 (5.50)	547 (21.50)	445 (17.50)	102 (4.00)	229 (9.00)	14.2 (0.56)	152 (6.00)
8	254 (10.00)	508 (20.00)	356 (14.00)	152 (6.00)	648 (25.50)	521 (20.50)	127 (5.00)	279 (11.00)	18.3 (0.72)	203 (8.00)

GENERAL NOTES:
(a) Dimensions are in millimeters (inches).
(b) For flange and bolt hole dimensions, see Table 7.1.1-2 and para. 7.8.
(c) For center-to-face tolerance, see para. 10.3.

Table 8.1.2-2
Dimensions of Class 300 Elbows, Tees, Crosses, Laterals, True Ys (Straight Sizes), and Reducers (Cont'd)

NOTES:
(1) For intersecting centerlines of side outlet fittings, see para 8.1.1.
(2) For center-to-face dimensions of reducing elbows, see para. 8.1.2(b).
(3) For center-to-face dimensions of special degree elbows, see para. 8.1.2(c).
(4) For reinforcement of crosses and laterals, see para. 8.2.
(5) For center-to-face dimensions of reducing tees, crosses, and laterals, see para. 8.1.3(a).
(6) For center-to-face dimensions of tees reducing on both runs, see para. 8.1.3(c).
(7) For center-to-face dimensions on reducing side outlet tees having two different size reductions on the outlets, see para. 8.1.3(b).
(8) For face-to-face dimensions of reducers and eccentric reducers, see para. 8.1.5.
(9) For wall thickness tolerance, see para. 10.2.

(c) Special degree elbows ranging from 1 deg to 45 deg, inclusively, shall have the same center-to-face dimensions given for 45-deg elbows, and those over 45 deg and up to 90 deg, inclusively, shall have the same center-to-face dimensions given for 90-deg elbows. The angle designation of an elbow is its deflection from straight line flow and is the angle between the flange faces.

8.1.3 Tees, Crosses, and Laterals

(a) The center-to-face dimensions for straight size tees, with or without side outlet, crosses, and laterals are shown in Tables 8.1.2-1 and 8.1.2-2.

(b) Reducing tees, with or without side outlet, reducing crosses, and reducing laterals shall have the same center-to-face dimensions as straight size fittings shown in Tables 8.1.2-1 and 8.1.2-2, corresponding to the size of the largest opening. Tees, crosses, and laterals, reducing on the run only, shall have the same center-to-face dimensions as straight size fittings shown in Tables 8.1.2-1 and 8.1.2-2, corresponding to the size of the largest opening.

(c) Tees reducing on both runs are generally known as bullhead tees and have the same center-to-face dimensions as straight size fittings corresponding to the size of the outlet.

8.1.4 True Ys. Center-to-face dimensions for straight size true Ys are shown in Tables 8.1.2-1 and 8.1.2-2. Reducing sizes are considered special and should be made to suit conditions.

8.1.5 Reducers and Eccentric Reducers. The face-to-face dimensions for all combinations of reducers and eccentric reducers shall be the same as given in Tables 8.1.2-1 and 8.1.2-2 for the larger opening.

8.1.6 Valves. Flanged valves shall have face-to-face dimensions in accordance with ASME B16.10. Threaded valves face-to-face shall be manufacturer's standard.

8.1.7 Interchangeability. Class 150 flanged fittings and valves in NPS 1 and larger sizes have a bolting pattern that is dimensionally interchangeable with ASME B16.1, Class 125 Cast Iron Flanged Fittings; ASME B16.5, Class 150 Steel Flanged Fittings; and ASME B16.42, Class 150 Ductile Iron Flanged Fittings. Class 300 flanged fittings in NPS 1 and larger have a bolting pattern that is dimensionally interchangeable with ASME B16.1, Class 250 Cast Iron Flanged Fittings; ASME B16.5, Class 300 Steel Flanged Fittings; and ASME B16.42, Class 300 Ductile Iron Flanged Fittings.

8.2 Wall Thickness

8.2.1 Fittings. For inspection purposes, the minimum wall thickness, t, of flanged fittings at the time of manufacture shall be as shown in Tables 8.1.2-1 and 8.1.2-2, except as provided in para. 10.2. Additional metal thickness needed to withstand assembly stresses, shapes other than circular, and stress concentrations shall be determined by the manufacturer. In particular, 45-deg laterals, true Ys, and crosses may require additional reinforcement to compensate for inherent weaknesses in these shapes.

8.2.2 Valves. ASME B16.34 wall thickness shall apply for ASTM B148 valves.

9 BOLTING AND GASKETS

9.1 Bolting

For carbon steel and nonferrous bolts smaller than $^3/_4$ in., ASME B18.2.1, Square Heads; ASME B18.2.1, Heavy Hex Heads; and ASME B18.2.2, Heavy Hex Nuts are recommended. For carbon steel and nonferrous bolts $^3/_4$ in. and larger, ASME B18.2.1, Standard Heads; ASME B18.2.1, Hex Heads; ASME B18.2.2, Hex Nuts; and ASME B18.2.2, Heavy Hex Nuts are recommended.

It is recommended that all bolting be threaded in accordance with ASME B1.1, Unified Screw Threads, Coarse Thread Series, Class 2A and Class 2B.

9.2 Gaskets

Full-faced gaskets extending to the flange edge as given in ASME B16.21 are recommended for flat-faced surfaces such as shown in Tables 7.1.1-1 and 7.1.1-2. Metallic gaskets are not recommended to be used with flat-faced flanges.

10 TOLERANCES[2]

10.1 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.

10.2 Wall Thickness

Fittings with local areas having a less than minimum wall thickness will be acceptable, provided that

(a) the area of minimum thickness can be enclosed by a circle whose diameter is no greater than $0.35\sqrt{dt}$ where d is the inside diameter, and t is the minimum wall thickness, as shown in Tables 8.1.2-1 and 8.1.2-2

(b) measured thickness is not less than $0.9t$

(c) enclosure circles are separated from each other by an edge-to-edge distance not less than $1.75\sqrt{dt}$

[2] Unless otherwise stated, tolerances are equal, plus, and minus.

10.3 Center-to-Face

The following tolerances shall be permitted on all center-to-contact surface dimensions of fittings:

NPS	Tolerance, mm (in.)
≤10	±0.8 (±0.03)
≥12	±1.5 (±0.06)

Tolerances for contact surface-to-contact surface (face-to-face) dimensions shall be twice those given above. The largest opening in the fitting governs the tolerance to be applied to all openings.

10.4 Facings

Tolerances that apply to both flange and flanged fitting facings are as follows:

Outside diameter, 6.4 mm (0.25 in.) raised face, 0.5 mm (0.02 in.).

10.5 Flange Thickness

NPS	Tolerance, mm (in.)
≤12	+3.0 (+0.12) −0.0 (−zero)

10.6 Counterbore, Threaded Flanges

NPS	Tolerance, mm (in.)
≤10	+0.8 (+0.03) −0.0 (−zero)
≥12	+1.5 (+0.06) −0.0 (−zero)

10.7 Drilling and Facing

The required tolerances are as follows:

(a) Bolt circle diameter, ±1.5 mm (±0.06 in.)

(b) Center-to-center of adjacent bolt holes, ±0.8 mm (±0.03 in.)

11 PRESSURE TESTING

11.1 Flange Test

Flanges are not required to be pressure-tested.

11.2 Flanged Fitting Test

11.2.1 Shell Pressure Test. Each flanged fitting shall be given a shell pressure test.

11.2.2 Test Conditions. The shell pressure test for flanged fittings shall be at a pressure no less than 1.5 times the 38°C (100°F) pressure–temperature rating rounded off to the next higher 0.5-bar (10-psi) increment.

11.2.3 Test Fluid. The pressure test shall be made using water, which may contain a corrosion inhibitor or kerosene, as the test fluid. Other suitable test fluids may be used, provided their viscosity is not greater than that of water. The test-fluid temperature shall not exceed 50°C (125°F).

11.2.4 Test Duration. The minimum test duration shall be as follows:

Fitting Size	Duration, s
NPS ≤ 2	60
2½ ≤ NPS ≤ 8	120
NPS ≥ 10	180

11.2.5 Acceptance. No visible leakage is permitted through the pressure boundary wall.

11.3 Valve Pressure Test

Each valve shall be given a shell and closure test that meets the requirements of ASME B16.34, section 7.

MANDATORY APPENDIX I
ASTM B148 VALVE CONSTRUCTION SUPPLEMENTAL REQUIREMENTS

(21) ## I-0 GENERAL STATEMENTS

(a) This Appendix describes requirements for ASTM B148 flanged and threaded end valves constructed under this Standard.

(b) Except as specified in (c) below, the organization, content, and paragraph designations of this Appendix correspond with sections 1 through 11 of this Standard.

(c) Requirements are included by reference to applicable requirements in ASME B16.34-2017.

I-1 SCOPE

With exception to material, pressure–temperature ratings, rating designations, end connections, NDE, and Special Class and Limited Class requirements, ASTM B148 valves constructed under this Standard shall meet the applicable requirements of ASME B16.34, Standard Class Designation.

I-2 GENERAL

Section 2 applies in its entirety, with the supplemental requirement for ASTM B148 valves in accordance with para. I-2.7.1.

I-2.7 Denotation

I-2.7.1 Pressure–Temperature Rating Designation. Only Standard Pressure Class Rating Designation numbers 150, 300, 600, 900, 1500, and 2500 shall be used for ASTM B148 valves constructed under this Standard.

I-3 PRESSURE–TEMPERATURE RATINGS

Except for paras. 3.1(a) and 3.1(b), and with the added requirement of para. I-3.6, section 3 applies in its entirety for construction of ASTM B148 valves.

I-3.6 System Hydrostatic Test

When system hydrostatic testing that includes ASTM B148 valves constructed under this Standard is performed, the requirements in ASME B16.34, paras. 2.5.3.1 and 2.5.3.2 apply.

I-4 SIZE AND METHOD OF DESIGNATING OPENINGS

Except for para 4.2, section 4 applies in its entirety, with added requirements per para. I-4.3.

I-4.3 Valves (21)

(a) The valve size shall be identified by the NPS of its end flanges or threaded ends.

(b) Classes 150, 300, 600, 900, 1500, and 2500 ASTM B148 flanged valves shall be size limited to the NPS that have appropriate Class flange dimensions in ASME B16.5 or ASME B16.47.

(c) Flanged end valves larger than NPS 60 are beyond the scope of this Standard.

(d) Threaded valves larger than NPS $2\frac{1}{2}$ are beyond the scope of this Standard.

I-5 MARKING

Section 5 applies in its entirety for the construction of ASTM B148 valves with the exception to para. 5.1.4 in para. I-5.1.4 and the additional requirements in para. I-5.2.

I-5.1 General

I-5.1.4 Conformance. Valves constructed under this Standard shall be marked "B16.24."

I-5.2 Valve Identification Plate

An identification plate that includes the manufacturer's name shall be secured to each ASTM B148 valve. Other information to appear on the nameplate includes the following:

(a) valve size.

(b) materials, body, bonnet, and trim.

(c) Pressure Class Designation.

(d) pressure rating at −29°C to 38°C (−20°F to 100°F).

(e) conformance — B16.24.

(f) special markings for low-melting-point materials, operator closure pressure limits, etc., that limit operating pressure and/or temperature. Limiting pressure and/ or temperature is to be marked on the nameplate.

I-6 MATERIALS

Section 6 applies in its entirety for construction of ASTM B148 valves with the exceptions in paras. I-6.4 and I-6.5.

I-6.4 Valves — Flanged and Threaded

Flanged valve body castings shall have flanges integral with the body casting.

I-6.5 Bolting

This paragraph applies in its entirety for valve body joint, body bonnet, and cover bolting for construction of ASTM B148 valves, with additional requirements in paras. I-6.5.1 and I-6.5.2.

I-6.5.1 Steel Bolting. ASME B16.34, Table 1, Group 4 or ASME BPVC, Section II, Part D, Table 3 bolting material may be used for ASTM B148 valve end flange or body joint bolting not exposed to service fluid.

I-6.5.2 Nonferrous Bolting. ASME B16.34, Table 1, Group 4 or ASME BPVC, Section II, Part D, Table 3 nonferrous bolting material may be used for ASTM B148 valve end flange or body joint bolting exposed to service fluid.

I-7 FLANGE AND VALVE BODY DIMENSIONS

With the added requirements in paras. I-7.1.3, I-7.6, 7.1, 7.2, 7.5, 7.8, and 7.9 apply in their entirety for ASTM B148 valve body flanges.

I-7.1 General

I-7.1.3 ASTM B148 End Flanges. For flanged valve body castings, the flange end dimensions shall be prepared with flange facing, nut bearing surfaces, outside diameter, flange thickness, and drilling in accordance with ASME B16.5 or ASME B16.47 dimensional requirements.

I-7.6 Thread Gauging

All ASTM B148 threaded valves with internal threads shall be threaded with American National Standard Taper Pipe Threads (see ASME B1.20.1). Variations in threading shall be limited to one turn large or one turn small from the gauging notch when using working gauges. The reference point for gauging is the starting end of the valve, provided the chamfer does not exceed the major diameter of the internal thread. When a chamfer on the internal thread exceeds this limit, the reference point becomes the last thread scratch on the chamfer cone.

I-8 FITTING AND VALVE DIMENSIONS

The requirements in section 8 apply, with the additional requirements in paras. I-8.1.6, I-8.1.8, and I-8.3.

I-8.1 Center-to-Face Dimensions

I-8.1.6 Valves. ASTM B148 flanged valve bodies shall have face-to-face dimensions in accordance with ASME B16.10 for the appropriate steel valve type and class. Threaded valve body face-to-face dimension shall be in accordance with the manufacturer's standard.

I-8.1.8 Valve Body Flanges. Flanged valve body castings shall have end flanges integral with the body casting.

I-8.3 Additional Valve Body Dimensional Requirements

All the applicable requirements of ASME B16.34 are required for construction of ASTM B148 valves, including those described in paras. I-8.3.1 through I-8.3.6.

I-8.3.1 Wall Thickness. Valve body wall thickness shall be in accordance with the requirements of ASME B16.34, para. 6.1.

I-8.3.2 Threaded End Dimensions. Valve body threaded end minimum wall thickness dimensions, length, and gauging shall meet the requirements of ASME B16.34, para. 6.2.4.

I-8.3.3 Auxiliary Connections. Auxiliary connections to the valve body or bonnet shall be of a threaded design and shall meet the dimensional requirements of ASME B16.34, para. 6.3.

I-8.3.4 Body Joints. Valves with bolted or threaded bonnet or cover joints or body joints shall meet the tensile and/or shear area requirements of ASME B16.34, para. 6.4.

I-8.3.5 Stem Retention. Valves with stems or spindles shall have a stem retention feature that meets the requirements of ASME B16.34, para. 6.5.1.

I-8.3.6 Wafer or Flangeless Valves. Wafer or flangeless valves shall meet the requirements of ASME B16.34, para. 6.7.

I-9 BOLTING AND GASKETS

Section 9 applies in its entirety for valve end flange joints (see para. I-8.3.4).

I-10 TOLERANCES

Valve body flange dimensional tolerance shall meet the applicable requirements of ASME B16.5 or ASME B16.47 and the additional requirements in para. I-10.8.