

ASME B16.5-2017
(Revision of ASME B16.5-2013)

Pipe Flanges and Flanged Fittings

NPS 1/2 Through NPS 24
Metric/Inch Standard

AN AMERICAN NATIONAL STANDARD



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Mechanical Engineers**

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**The American Society of
Mechanical Engineers**

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CONTENTS

Foreword	viii
Committee Roster	x
Correspondence With the B16 Committee	xi
Summary of Changes	xiii
List of Changes in Record Number Order	xv
1	Scope	1
2	Pressure-temperature Ratings	2
3	Component Size	3
4	Marking	3
5	Materials	4
6	Dimensions	8
7	Tolerances	13
8	Pressure Testing	15
 Mandatory Appendices		
I	Threading of Pipe for American National Standard Threaded Flanges	108
II	Pressure-temperature Ratings and Dimensional Data for Classes 150, 300, 400, 600, 900, 1500, and 2500 flanges and classes 150 and 300 flanged fittings in u.s. customary units	110
III	References	195
 Nonmandatory Appendices		
A	Method Used for Establishing Pressure-temperature Ratings	198
B	Limiting Dimensions of Gaskets other than ring joint gaskets	203
C	Method for Calculating Bolt Lengths	205
D	Quality System Program	207
E	Dimensions of Classes 400, 600, 900, 1500, and 2500 Flanged Fittings in U.S. Customary Units	208
 Figures		
1	Bevel for Outside Thickness	15
2	Bevel for Inside Thickness	16
3	Bevel for Combined Thickness	16
4	Straight Hub Welding Flanges	16
5	Method of Designating Outlets of Reducing Fittings in Specifications (flanged fittings)	17
6	End Flange Facings and Their Relationship to Flange Thickness and center-to-end and end-to-end dimensions	18
7	Bevel for Wall Thicknesses t from 5 mm to 22 mm inclusive	20
8	Bevel for Wall Thicknesses t greater than 22 mm	20
9	Inside Contour for Use With Rectangular Backing Ring	21

10	Inside Contour for Use With Taper Backing Ring	21
11	Thread Length for Connection Tapping	22
12	Socket Welding for Connections	22
13	Bosses for Connections	22
14	Butt Welding for Connections	22
15	Method of Designating Location of Auxiliary Connections When Specified (flanged fittings)	23
II-6	End Flange Facings and Their Relationship to Flange Thickness and Center-To-End and end-to-end dimensions	111
II-7	Bevel for Wall Thicknesses t from 0.19 in. to 0.88 in. inclusive	113
II-8	Bevel for Wall Thicknesses t greater than 0.88 in.	113
II-9	Inside Contour for Use With Rectangular Backing Ring	114
II-10	Inside Contour for Use With Taper Backing Ring	114
II-11	Thread Length for Connection Tapping	115
II-12	Socket Welding for Connections	115
II-13	Bosses for Connections	115
II-14	Butt Welding for Connections	115
C-1	Specified Machine Bolt Length	206
C-2	Specified Stud Bolt Length	206

Tables

1A	list of material specifications	5
1B	List of Bolting Specifications: Applicable Astm Specifications	9
1C	flange bolting dimensional recommendations	13
2-1.1	Pressure–temperature Ratings for Group 1.1 Materials	24
2-1.2	Pressure–temperature Ratings for Group 1.2 Materials	25
2-1.3	Pressure–temperature Ratings for Group 1.3 Materials	26
2-1.4	Pressure–temperature Ratings for Group 1.4 Materials	27
2-1.5	Pressure–temperature Ratings for Group 1.5 Materials	28
2-1.7	Pressure–temperature Ratings for Group 1.7 Materials	29
2-1.9	Pressure–temperature Ratings for Group 1.9 Materials	30
2-1.10	Pressure–temperature Ratings for Group 1.10 Materials	31
2-1.11	Pressure–temperature Ratings for Group 1.11 Materials	32
2-1.13	Pressure–temperature Ratings for Group 1.13 Materials	33
2-1.14	Pressure–temperature Ratings for Group 1.14 Materials	34
2-1.15	Pressure–temperature Ratings for Group 1.15 Materials	35
2-1.17	Pressure–temperature Ratings for Group 1.17 Materials	36
2-1.18	pressure–temperature ratings for group 1.18 materials	37
2-2.1	Pressure–temperature Ratings for Group 2.1 Materials	38
2-2.2	Pressure–temperature Ratings for Group 2.2 Materials	39
2-2.3	Pressure–temperature Ratings for Group 2.3 Materials	40
2-2.4	Pressure–temperature Ratings for Group 2.4 Materials	41
2-2.5	Pressure–temperature Ratings for Group 2.5 Materials	42
2-2.6	Pressure–temperature Ratings for Group 2.6 Materials	43
2-2.7	Pressure–temperature Ratings for Group 2.7 Materials	44
2-2.8	pressure–temperature ratings for group 2.8 materials	45

2-2.9	Pressure-temperature Ratings for Group 2.9 Materials	46
2-2.10	Pressure-temperature Ratings for Group 2.10 Materials	47
2-2.11	Pressure-temperature Ratings for Group 2.11 Materials	48
2-2.12	Pressure-temperature Ratings for Group 2.12 Materials	49
2-3.1	Pressure-temperature Ratings for Group 3.1 Materials	50
2-3.2	Pressure-temperature Ratings for Group 3.2 Materials	50
2-3.3	Pressure-temperature Ratings for Group 3.3 Materials	51
2-3.4	Pressure-temperature Ratings for Group 3.4 Materials	52
2-3.5	Pressure-temperature Ratings for Group 3.5 Materials	53
2-3.6	Pressure-temperature Ratings for Group 3.6 Materials	54
2-3.7	Pressure-temperature Ratings for Group 3.7 Materials	55
2-3.8	Pressure-temperature Ratings for Group 3.8 Materials	56
2-3.9	Pressure-temperature Ratings for Group 3.9 Materials	57
2-3.10	Pressure-temperature Ratings for Group 3.10 Materials	58
2-3.11	Pressure-temperature Ratings for Group 3.11 Materials	58
2-3.12	Pressure-temperature Ratings for Group 3.12 Materials	59
2-3.13	Pressure-temperature Ratings for Group 3.13 Materials	59
2-3.14	Pressure-temperature Ratings for Group 3.14 Materials	60
2-3.15	Pressure-temperature Ratings for Group 3.15 Materials	61
2-3.16	Pressure-temperature Ratings for Group 3.16 Materials	62
2-3.17	Pressure-temperature Ratings for Group 3.17 Materials	63
2-3.19	Pressure-temperature Ratings for Group 3.19 Materials	64
3	permissible imperfections in flange facing finish for raised face and large male and female flanges	65
4	dimensions of facings (other than ring joints, all pressure rating classes)	66
5	dimensions of ring joint facings (all pressure rating classes)	68
6	Reducing Threaded and Slip-On Pipe Flanges for Classes 150 Through 2500 Pipe Flanges	75
7	templates for drilling class 150 pipe flanges and flanged fittings	76
8	dimensions of class 150 flanges	77
9	Dimensions of Class 150 Flanged Fittings	80
10	templates for drilling class 300 pipe flanges and flanged fittings	85
11	dimensions of class 300 flanges	86
12	Dimensions of Class 300 Flanged Fittings	90
13	templates for drilling class 400 pipe flanges	93
14	dimensions of class 400 flanges	94
15	templates for drilling class 600 pipe flanges and flanged fittings	96
16	dimensions of class 600 flanges	97
17	Templates for Drilling Class 900 Pipe Flanges and Flanged Fittings	99
18	Dimensions of Class 900 Flanges	100
19	Templates for Drilling Class 1500 Pipe Flanges	102
20	Dimensions of Class 1500 Flanges	103
21	Templates for Drilling Class 2500 Pipe Flanges	105
22	Dimensions of Class 2500 Flanges	106
I-1	Projection of Threaded Pipe End Through a Ring Gage	109
II-2-1.1	Pressure-temperature Ratings for Group 1.1 Materials	116
II-2-1.2	Pressure-temperature Ratings for Group 1.2 Materials	117

II-2-1.3	Pressure-temperature Ratings for Group 1.3 Materials	118
II-2-1.4	Pressure-temperature Ratings for Group 1.4 Materials	119
II-2-1.5	Pressure-temperature Ratings for Group 1.5 Materials	120
II-2-1.7	Pressure-temperature Ratings for Group 1.7 Materials	121
II-2-1.9	Pressure-temperature Ratings for Group 1.9 Materials	122
II-2-1.10	Pressure-temperature Ratings for Group 1.10 Materials	123
II-2-1.11	Pressure-temperature Ratings for Group 1.11 Materials	124
II-2-1.13	Pressure-temperature Ratings for Group 1.13 Materials	125
II-2-1.14	Pressure-temperature Ratings for Group 1.14 Materials	126
II-2-1.15	Pressure-temperature Ratings for Group 1.15 Materials	127
II-2-1.17	Pressure-temperature Ratings for Group 1.17 Materials	128
II-2-1.18	pressure-temperature ratings for group 1.18 materials	129
II-2-2.1	Pressure-temperature Ratings for Group 2.1 Materials	130
II-2-2.2	Pressure-temperature Ratings for Group 2.2 Materials	131
II-2-2.3	Pressure-temperature Ratings for Group 2.3 Materials	132
II-2-2.4	Pressure-temperature Ratings for Group 2.4 Materials	133
II-2-2.5	Pressure-temperature Ratings for Group 2.5 Materials	134
II-2-2.6	Pressure-temperature Ratings for Group 2.6 Materials	135
II-2-2.7	Pressure-temperature Ratings for Group 2.7 Materials	136
II-2-2.8	pressure-temperature ratings for group 2.8 materials	137
II-2-2.9	Pressure-temperature Ratings for Group 2.9 Materials	138
II-2-2.10	Pressure-temperature Ratings for Group 2.10 Materials	139
II-2-2.11	Pressure-temperature Ratings for Group 2.11 Materials	140
II-2-2.12	Pressure-temperature Ratings for Group 2.12 Materials	141
II-2-3.1	Pressure-temperature Ratings for Group 3.1 Materials	142
II-2-3.2	Pressure-temperature Ratings for Group 3.2 Materials	142
II-2-3.3	Pressure-temperature Ratings for Group 3.3 Materials	143
II-2-3.4	Pressure-temperature Ratings for Group 3.4 Materials	143
II-2-3.5	Pressure-temperature Ratings for Group 3.5 Materials	144
II-2-3.6	Pressure-temperature Ratings for Group 3.6 Materials	145
II-2-3.7	Pressure-temperature Ratings for Group 3.7 Materials	146
II-2-3.8	Pressure-temperature Ratings for Group 3.8 Materials	147
II-2-3.9	Pressure-temperature Ratings for Group 3.9 Materials	148
II-2-3.10	Pressure-temperature Ratings for Group 3.10 Materials	149
II-2-3.11	Pressure-temperature Ratings for Group 3.11 Materials	149
II-2-3.12	Pressure-temperature Ratings for Group 3.12 Materials	150
II-2-3.13	Pressure-temperature Ratings for Group 3.13 Materials	150
II-2-3.14	Pressure-temperature Ratings for Group 3.14 Materials	151
II-2-3.15	Pressure-temperature Ratings for Group 3.15 Materials	152
II-2-3.16	Pressure-temperature Ratings for Group 3.16 Materials	153
II-2-3.17	Pressure-temperature Ratings for Group 3.17 Materials	153
II-2-3.19	Pressure-temperature Ratings for Group 3.19 Materials	154
II-3	permissible imperfections in flange facing finish for raised face and large male and female flanges	155
II-4	dimensions of facings (other than ring joints, all pressure rating classes)	156
II-5	dimensions of ring joint facings (all pressure rating classes)	158

II-6	Reducing Threaded and Slip-On Flanges for Classes 150 Through 2500 Pipe Flanges	165
II-7	templates for drilling class 150 pipe flanges and flanged fittings	166
II-8	dimensions of class 150 flanges	167
II-9	Dimensions of Class 150 Flanged Fittings	170
II-10	templates for drilling class 300 pipe flanges and flanged fittings	173
II-11	dimensions of class 300 flanges	174
II-12	Dimensions of Class 300 Flanged Fittings	178
II-13	templates for drilling class 400 pipe flanges	181
II-14	dimensions of class 400 flanges	182
II-15	templates for drilling class 600 pipe flanges and flanged fittings	184
II-16	dimensions of class 600 flanges	185
II-17	Templates for Drilling Class 900 Pipe Flanges and Flanged Fittings	187
II-18	Dimensions of Class 900 Flanges	188
II-19	Templates for Drilling Class 1500 Pipe Flanges	190
II-20	Dimensions of Class 1500 Flanges	191
II-21	Templates for Drilling Class 2500 Pipe Flanges	193
II-22	Dimensions of Class 2500 Flanges	194
A-1	Rating Ceiling Pressure — p_c , bar	201
A-2	Rating Ceiling Pressure — p_c , psi	202
B-1	Gasket Groups and Typical Materials	204
C-1	Thickness for Lapped Joints	206
C-2	f values	206
C-3	n values	206
E-1	Dimensions of Class 400 Flanged Fittings	210
E-2	Dimensions of Class 600 Flanged Fittings	216
E-3	Dimensions of Class 900 Flanged Fittings	222
E-4	Dimensions of Class 1500 Flanged Fittings	228
E-5	Dimensions of Class 2500 Flanged Fittings	234

FOREWORD

In 1920, the American Engineering Standards Committee [later the American Standards Associations (ASA)] organized Sectional Committee B16 to unify and further develop standards for pipe flanges and fittings (and later for valves and gaskets). Cosponsors of the B16 Committee were ASME, the Heating and Piping Contractors National Association [now Mechanical Contractors Association of America (MCAA)], and the Manufacturers Standardization Society of the Valves and Fittings Industry (MSS). Cosponsors were later designated as cosecretariat organizations.

The Committee soon recognized the need for standardization of steel pipe flanges. In May 1923, Subcommittee 3 was organized to develop such standards for pressures in the 250-psi to 3,200-psi range and for elevated temperatures. Active work began in October, including steel flanged fittings. The first proposed standard was submitted to the Committee in April 1926 and approved by letter ballot in December. After favorable review by the three sponsor organizations, the Standard was approved as American Tentative Standard B16e in June 1927.

Experience in using the Standard showed the need for hub dimensions of companion flanges and for other changes, including rerating of 250-lb and 1,350-lb flanges and development of flanged fittings with integral bases. An investigation was made into the factors determining stiffness of flanges and flange hubs. The revised edition was approved as ASA B16E-1932.

A revision was initiated in 1936, stimulated by suggestions from Committee members and industrial users. The resulting 1939 edition contained standards for welding neck flanges (completed in March 1937), 1,500-lb flanges in the 14-in. through 24-in. range, 2,500-lb flanges and flanged fittings in the $\frac{1}{2}$ -in. through 12-in. range, and dimensions for a full line of ring joint flanges developed by the American Petroleum Institute. Pressure-temperature ratings for alloy steel flanges and fittings, developed by Subcommittee 4, were included for the first time.

In August 1942, the War Production Board requested a review of measures to conserve vital materials in piping components. A special War Committee of B16 was appointed and, operating under War Standard Procedure, developed revised pressure-temperature ratings for all materials and pressure classes. The ratings were published as American War Standard B16e5-1943. In 1945, under normal procedures, Subcommittees 3 and 4 reviewed the 1939 standard and 1943 ratings and recommended adoption of the wartime ratings. Their report was approved as Supplement No. 1 to B16e-1939 and published as ASA B16e6-1949. In addition to ratings, the supplement updated material specification references and added a table of metal wall thickness for welding-end valves.

Subcommittee 3 then began a revision of the entire standard. Technically, the 1949 Supplement was absorbed, new materials were recognized, a general rating method was developed and added as an appendix, and welding end preparations were expanded. Editorially, a new style of presentation was worked out, including tables rearranged for easier use. Approval by Sectional Committee, cosponsors, and ASA resulted in the publication of ASA B16.5-1953 (designation changed from B16e).

Work soon began on further revisions. Class B ratings were deleted, and Class A ratings were clarified as the standard. An appendix defined qualifications for gaskets, other than ring joint, which would merit the ratings. Another appendix defined the method for calculating bolt lengths, including the measurement of stud bolt length between thread ends instead of points. Pressure-temperature ratings for several new materials were added, the table of welding end dimensions was expanded, and the temperatures used in determining ratings were redefined. The resulting new edition, after approval, was published as ASA B16.5-1957.

The more modest revision approved as ASA B16.5-1961 changed the text to clarify the intent or to make requirements easier to administer. The next revision began in 1963 with nearly 100 comments and suggestions. No fundamental changes were made, but the text was further clarified, and wall thicknesses less than $\frac{1}{4}$ in. for flanged fittings were recognized in the 1968 edition.

A new joint study of ratings between Subcommittees 3 and 4 was initiated before the next revision. Based on the Subcommittee 4 report, the rating procedure was revised, and a rating basis for Class 150 (150 lb) flanges was developed. New product forms, bar and plate, were added for special applications, including fabricated flanged valves and fittings. Reference to welding-end valves was not included, because a separate standard for them was planned. Bolt length calculations based on worst case tolerances led to a revision of tabulated lengths. Testing of valves subsequently published by Subcommittee 15 closure members was added to the test requirements. Following final approval on October 23, the Standard was published as ANSI B16.5-1973.

Subcommittee N (formerly 15) was assigned responsibility for all valve standards in late 1973. Subcommittee C (formerly 3) continued to have responsibility for flange standards. A revision was accordingly initiated to remove all references to valves. At the same time, comments from users and changes in the ASME Boiler and Pressure Vessel Code led to significant revisions in the Class 150 rating basis and in the ratings of stainless steel and certain alloy steel flanges and flanged fittings in all rating classes. Extensive public review comments led to the addition of considerations for bolting and gaskets for flanged joints and of marking requirements. To avoid having to make frequent and confusing changes to the ratings as a result of further changes to the Code allowable stresses, Subcommittee C and Subcommittee N agreed that ratings would be left alone unless the relevant Code stress values were changed by more than 10%. After final approval by the Standards Committee, cosponsors, and the American National Standards Institute (ANSI), ANSI B16.5-1977, Steel Pipe Flanges and Flanged Fittings was published on June 16, 1977.

In 1979, work began on another new edition. Materials coverage was expanded by the addition of nickel and nickel alloys. Bolting rules were revised to cover nickel alloy bolts. Bolt hole and bolting were changed to provide interchangeability between inch and metric dimensions. Metric dimensional tables were made informational rather than alternative requirements of the Standard. Final approval was granted for ANSI B16.5-1984, Pipe Flanges and Flanged Fittings on August 14.

In 1982, American National Standards Committee B16 was reorganized as an ASME Committee operating under procedures accredited by ANSI. The 1988 edition of the Standard extended nickel alloy ratings to higher temperatures, clarifying flat face flange requirements, and included other minor revisions. The Committee determined that any metric standard for flanges would stand alone, with metric bolting and gaskets; hence, metric equivalents were deleted. Following approval by the Standard Committee and ASME, approval as an American National Standard was given by ANSI on April 7, 1988, with the new designation ASME/ANSI B16.5-1988.

The 1996 Edition allowed flanges marked with more than one material grade or specification, revised flange facing finish requirements, revised pressure–temperature ratings for several material groups, added a nonmandatory quality system annex, and included several other revisions. The 1996 Edition was approved by ANSI on October 3, 1996, with the new designation ASME B16.5-1996.

The 2003 Edition included metric units as the primary reference units while maintaining U.S. Customary units in either parenthetical or separate forms. New materials were added while some materials were shifted from one group to another, and new material groups were established.

All pressure–temperature ratings were recalculated using data from the latest edition of the ASME Boiler and Pressure Vessel Code, Section II, Part D. Annex F was added to cover pressure–temperature ratings and dimensional data for Classes 150 through 2500 flanges and Classes 150 and 300 flanged fittings in U.S. Customary units. Table and figure numbers in Annex F were prefixed by the letter F and corresponded to table and figure numbers in the main text for the metric version, with the exception of some table and figure numbers that were not used in Annex F. Of note, the flange thickness designations for Classes 150 and 300 were revised with reference to their raised faces. For these classes, the flange thickness dimensional reference planes were altered; however, required flange thickness remained unchanged. The minimum flange thickness designation was changed from C to t_f , and it did not include 2.0 mm (0.06 in.) raised face for Classes 150 and 300 raised face flanges and flanged fittings. Because of diminished interest, flanged end fittings conforming to ASME Class 400 and higher were listed only with U.S. Customary units in Annex G. In addition, straight hub welding flanges were incorporated as a new set of flanges in Classes 150 through 2500. Also, there were numerous requirement clarifications and editorial revisions. The 2003 Edition was approved by ANSI on July 9, 2003, with the designation ASME B16.5-2003.

The 2009 Edition added new materials, updated some pressure–temperature ratings, and designated the annexes as mandatory and nonmandatory appendices. The mandatory appendices were numbered using roman numerals, and the nonmandatory appendices were referenced using capital letters. The 2009 Edition was approved by ANSI on February 19, 2009, with the designation ASME B16.5-2009.

The 2013 Edition included a revision to the Materials [paragraph 5.1](#) and included the addition of perpendicularity tolerances. Additional errata and clarifying revisions were also applied. Following approval of the Standards Committee and ASME, approval for the 2013 edition was granted by ANSI on February 5, 2013.

The 2017 edition includes the use of bar stock for blind flanges without hubs; adds requirements for forgings, size NPS 22; and updates materials and working pressures.

Following approval of the Standards Committee and ASME, approval for the new edition was granted by the ANSI on February 14, 2017.

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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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.

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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 will 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 B16.5-2017 SUMMARY OF CHANGES

Following approval by the ASME Committee and ASME, and after public review, ASME B16.5-2017 was approved by the American National Standards Institute on February 14, 2017.

ASME B16.5-2017 includes the following changes identified by a margin note, **(17)**.

The Record Number listed below is explained in more detail in the “List of Changes in Record Number Order” following this Summary of Changes.

<i>Page</i>	<i>Location</i>	<i>Change (Record Number)</i>
4	5.1	Revised (10-511, 11-544)
5	Table 1A	(1) Fifth entry under Nominal Designation for Material Group 2.8, fifth entry under Nominal Designation revised (15-1970) (2) Fourth and fifth entries under Castings for Material Group 2.8, fourth and fifth entries under Castings revised (15-1970)
12	6.9.5	Revised (11-545)
13	Table 1C	(1) Note 1 deleted (14-2174) (2) First entry under Carbon Steel and Alloy Steel revised (14-2174)
37	Table 2-1.18	Last row, third and fifth through eighth columns revised (15-1921)
45	Table 2-2.8	(1) Fifth entry under Nominal Designation revised (15-1970) (2) Fourth, fifth, and sixth entries under Castings revised (15-1970)
65	Table 3	Second-to-last row added (12-566)
66	Table 4	Row for NPS 22 added (12-566)
69	Table 5	Entries for NPS 22 added (12-566)
76	Table 7	Row for NPS 22 added (12-566)
77	Table 8	Row for NPS 22 added (12-566)
85	Table 10	Row for NPS 22 added (12-566)
86	Table 11	(1) Illustration for “Threaded” revised (15-842) (2) Row for NPS 22 added (12-566)
93	Table 13	Row for NPS 22 added (12-566)
94	Table 14	Row for NPS 22 added (12-566)
96	Table 15	Row for NPS 22 added (12-566)
97	Table 16	Row for NPS 22 added (12-566)
129	Table II-2-1.18	Last row, third and fifth through eighth columns revised (15-1921)

137	Table II-2-2.8	(1) Fifth row under Nominal Designation revised (15-1970) (2) Fourth, fifth, and sixth entries under Castings revised (15-1970)
155	Table II-3	Row for NPS 22 added (12-566)
156	Table II-4	Row for NPS 22 added (12-566)
159	Table II-5	Entries for NPS 22 added (12-566)
166	Table II-7	Row for NPS 22 added (12-566)
167	Table II-8	Row for NPS 22 added (12-566)
173	Table II-10	Row for NPS 22 added (12-566)
174	Table II-11	(1) Illustration for "Threaded" revised (15-842) (2) Row for NPS 22 added (12-566)
181	Table II-13	Row for NPS 22 added (12-566)
182	Table II-14	Row for NPS 22 added (12-566)
184	Table II-15	Row for NPS 22 added (12-566)
185	Table II-16	Row for NPS 22 added (12-566)
195	Mandatory Appendix III	Revised (14-2174)

LIST OF CHANGES IN RECORD NUMBER ORDER

<u>Record Number</u>	<u>Change</u>
10-511	Revised para 5.1(a) to add use of bar stock for blind flanges without hubs.
11-544	Revised para. 5 to explicitly require forgings to be made near the shape of the finished flange.
11-545	Revised para 6.9.5 to correct thread gage plane reference.
12-566	Added NPS 22 to Tables 3, 4, 5, 7, 8, 10, 11, 13, 14, 15, 16, II-3, II-4, II-5, II-7, II-8, II-10, II-11, II-13, II-14, II-15, II-16.
14-2174	Revised references for stud bolts in Table 1C and Mandatory Appendix III.
15-842	Revised illustrations for “Threaded” in Tables 11 and II-11.
15-1921	Revised pressure–temperature working pressures in Tables 2-1.18 and II-2-1.18.
15-1970	In Table 1A , changed A351 Gr CE8MN to A995 Gr CE8MN, in Tables 2-2.8 and II-2-2.8 , changed A351 to A995 for CD4MCu and CD3MWCuN.

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PIPE FLANGES AND FLANGED FITTINGS

NPS ½ THROUGH NPS 24 METRIC/INCH STANDARD

1 SCOPE

1.1 General

(a) This Standard covers pressure–temperature ratings, materials, dimensions, tolerances, marking, testing, and methods of designating openings for pipe flanges and flanged fittings. Included are

(1) flanges with rating class designations 150, 300, 400, 600, 900, and 1500 in sizes NPS ½ through NPS 24 and flanges with rating class designation 2500 in sizes NPS ½ through NPS 12, with requirements given in both metric and U.S. Customary units with diameter of bolts and flange bolt holes expressed in inch units

(2) flanged fittings with rating class designation 150 and 300 in sizes NPS ½ through NPS 24, with requirements given in both metric and U.S. Customary units with diameter of bolts and flange bolt holes expressed in inch units

(3) flanged fittings with rating class designation 400, 600, 900, and 1500 in sizes NPS ½ through NPS 24 and flanged fittings with rating class designation 2500 in sizes ½ through NPS 12 that are acknowledged in [Nonmandatory Appendix E](#) in which only U.S. Customary units are provided

(b) This Standard is limited to

(1) flanges and flanged fittings made from cast or forged materials

(2) blind flanges and certain reducing flanges made from cast, forged, or plate materials

Also included in this Standard are requirements and recommendations regarding flange bolting, gaskets, and joints.

1.2 References

Codes, standards, and specifications, containing provisions to the extent referenced herein, constitute requirements of this Standard. These reference documents are listed in [Mandatory Appendix III](#).

1.3 Time of Purchase, Manufacture, or Installation

The pressure–temperature ratings in this Standard are applicable upon its publication to all flanges and flanged fittings within its scope, which otherwise meet its requirements. For unused flanges or flanged fittings maintained in inventory, the manufacturer of the flange or flanged fittings 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 ratings are applicable except as may be governed by the applicable code or regulation.

1.4 User Accountability

This Standard cites duties and responsibilities that are to be assumed by the flange or flanged fitting user in the areas of, for example, application, installation, system hydrostatic testing, operation, and material selection.

1.5 Quality Systems

Requirements relating to the product manufacturer's Quality System Program are described in [Nonmandatory Appendix D](#).

1.6 Relevant Units

This Standard states values in both SI (Metric) and U.S. Customary units. As an exception, diameter of bolts and flange bolt holes are expressed in inch units only. These systems of units are to be regarded separately as standard. Within the text, the U.S. Customary units are shown in parentheses or in separate tables that appear in [Mandatory Appendix II](#). 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 diameter of bolts and flange bolt holes, combining values from the two systems constitutes nonconformance with the Standard.

1.7 Selection of Materials

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

1.8 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.