ANSI/AWWA C207-18
(Revision of ANSI/AWWA C207-13)

American Water Works Association
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AWWA Standard

Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)

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AWWA Standard

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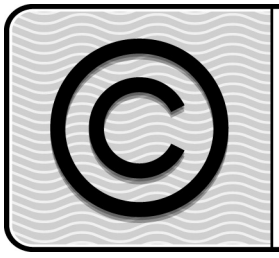

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Contents

All AWWA standards follow the general format indicated subsequently. Some variations from this format may be found in a particular standard.

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA C207.*

I. Introduction.

I.A. *Background.* Steel flanges have been used with steel pipe in the waterworks field since the first riveted steel water-supply lines were installed with flanges attached by riveting. Flanges manufactured according to unofficial flange standards, such as the riveted-pipe manufacturer's standards, were in common use for 50 years or more before the advent of ANSI/AWWA C207. Steel-plate ring flanges and rolled-angle flanges, to match the drilling of existing cast valves and cast fittings, were also used extensively.

The greatly increased usage of steel pipe for waterworks service during the 1930s made standardization of flanges desirable. The first step toward standardization was taken in 1942 when a paper† proposing standards for slip-on steel-ring flanges for welding to steel water pipe was presented at the annual conference of the American Water Works Association (AWWA).

In 1945, at the request of the American Society of Mechanical Engineers (ASME), a committee having representatives from both ASME and AWWA was formed. The ASME/AWWA committee was charged with establishing standards for steel flanges having dimensions and pressure ratings commonly used in waterworks service. The standards were necessary because the lowest pressure ratings for steel flanges at that time were those having cold-water pressure ratings of 275 psi (1,896 kPa) (ASME‡ B16.5, Pipe Flanges and Flanged Fittings). The ratings were far higher than those ordinarily needed for water service (150-psi [1,034-kPa]) primary pressure rating.

Generally accepted practice for the design of bolted flanged connections considers all fields of usage and a wide range of pressure and temperature applications. In waterworks practice, it is not necessary, within the scope of this standard, to deal with temperatures greater than the atmospheric range, and it is possible to limit the scope of consideration to gaskets contained in this standard and to flanges that are flat faced. The designs were prepared in conformity with these limitations.

The ASME/AWWA committee gave careful consideration to the following: (1) the effect of new standards on existing equipment; (2) the fact that cast valves and fittings will always have flanges of large outside diameter, which cannot be reduced because of

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

† Hill, H.O., et al. 1944. Fabricated Steel Ring Flanges for Water Pipe Service for Low Pressure and Low Temperatures. *Journal AWWA,* 36:9:968.

‡ ASME International, 3 Park Avenue, New York, NY 10016.

the wall thickness of this equipment; (3) the need for interchangeability of equipment through the use of common drilling patterns; and (4) the fact that standards could be based on the successful usage and good service records of existing installations.

A survey of water utility users indicated that it was desirable to maintain the outside diameter and drilling of flanged fittings and valves given in ANSI/AWWA C500, Gate Valves for Water and Sewage Systems, and ANSI/ASME B16.1, Cast Iron Pipe Flanges and Flanged Fittings (for Classes 25, 125, 250, and 800). The committee decided to follow this practice for sizes 6–48 in. (150–1,200 mm).

In its extensive deliberations, the ASME/AWWA committee had available the results of special research and testing conducted by Armco Steel Corporation, Bethlehem Steel Company, and Taylor Forge and Pipe Works. The various design methods and test results were given in "Steel Ring Flanges for Steel Pipe," *ARMCO Bulletin 47-A* (1947), from the American Rolling Mill Company, Middletown, Ohio. The design of flanges for waterworks service, with the results of the preceding report, was published in *Journal AWWA* in October 1950, pp. 931–944. A discussion in the paper by Taylor Forge, participants in the ASME/AWWA committee, states the reasons why a waterworks flange is not an ASME/Taylor Forge flange. Concern about high secondary stresses at the attachment, e.g., thick material to thin wall pipe, is covered here along with the published "Design of Wye Branches" (*Journal AWWA,* June 1955, appendix C, pp. 581–630).

Beginning in 2006, a special flange task group investigated the development history of the flange dimensions found in the standard. After 5 years of research, the task group reached the following conclusions:

1. There is no one exact stress-based design method that could reproduce the thickness values in the tables. However, it appears the ring flange thicknesses in this standard are based on using the LaTour–Barnard design procedure (*ARMCO Bulletin 47-A,* 1947) for ring flanges, which is based on ASME integral flange design procedures.
2. A current design analysis was performed based on the LaTour–Barnard proposed design method (which was based on physical tests on pipes with steel-ring flanges) that demonstrated comparable results. The original LaTour–Barnard design procedure was a bending-stress design methodology.
3. It has been established that flange thickness design based solely on a stress-based design procedure is incorrect. In Barnard's October 1950 *Journal AWWA* paper, he writes:

> "When the test results were analyzed, it became obvious that the design formulas used in establishing American Standard flange dimensions predicted

fantastically high localized stresses even when the joint assembly performed satisfactorily. Since a method of designing by test was being sought, a reconciliation of the apparent contradictions between theory and test results had to be explored. To find the answer, attention was turned to the behavior under load of the steel being tested in pipe wall and flange. Also, the stress factors in the formulas were further examined to discover whether or not a different concept of design would compose the apparent differences between theory and test results. It was found that theory fits the data when the concept of calculated stress level design is displaced by a concept of limiting-strain design. Then there was good correlation between theory, the test results, and past field experience and practice."

Simply put, the design of flange thickness was performed as a limiting-strain type of design procedure and not based on stress. The limiting strain was 5,000 μin./in. as determined by the 0.5 percent load extension method.

4. Many steel-ring flanges have been supplied with thicknesses and dimensions that match the tables herein since these initial investigations were performed in the 1940s and 1950s by the ASME/AWWA committees leading up to the first edition of AWWA C207. As written by Barnard in 1950, "the primary aim in flange design should be to prevent joint leakage since steel flange joints do not fail by fracture." The current flange task group has found this to be true over the past 60 years as there have been no reported occurrences of steel flanges fracturing when servicing the pressure that they were supplied to meet.

5. The determination of the steel-cylinder thickness at the flange attachment to be used in this standard is based on the design procedures for internal pressures shown in AWWA Manual M11, *Steel Pipe—A Guide for Design and Installation.* This practice is deemed acceptable based on empirical data of successful performance dating back to the early 1950s.

Tables 2 through 5 are based on historical dimensions and are presented without additional calculations.

I.B. *History*. The report of the ASME/AWWA committee was approved in 1951, and the first edition of this standard, designated AWWA C207-52T, was published in 1952 under the title *Tentative Standard Specifications for Steel Pipe Flanges*. That edition covered diameters from 6 to 48 in. (from 150 to 1,200 mm) and pressures through 150 psi (1,034 kPa). In 1954, a committee composed of Taylor Forge, Armco, Bethlehem Steel, and consulting engineers revised the existing standard to include diameters through 96 in. (2,400 mm) and pressures upto 275 psi (1,896 kPa). This

revision was published under designation AWWA C207-55, Standard Specifications/ Standard for Steel Pipe Flanges. The standard was further revised and the next edition published in 1978 as ANSI/AWWA C207, Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. The next edition, designated C207 with the same title, was published in 1986. It revised the maximum test pressure to 125 percent of the flange rating and added segmentation of flanges, blind flanges, Class E ring flanges, Class F ring and hub flanges, and tolerances for flange draft or layback. Subsequent editions were approved by the AWWA Board of Directors on June 17, 2001 and Jan. 21, 2007.

The 2013 edition of C207, approved on Jan. 20, 2013, deleted the use of ASTM A307 Grade B bolting requirements from Sec. 4.1.4, Bolting Materials. However, the design basis for the flange minimum thickness in Table 5, AWWA Blind-Flange Thickness, is 7,000-psi allowable bolt stress for Classes B and D flanges. The 2013 edition also removed hub flanges from the body of the standard, and the tables for steel-hub flanges for Classes D and E have been included in a new appendix B for information purposes only. This edition was approved on Jan. 20, 2018.

I.C. *Acceptance*. In May 1985, the US Environmental Protection Agency (USEPA) entered into a cooperative agreement with a consortium led by NSF International (NSF) to develop voluntary third-party consensus standards and a certification program for direct and indirect drinking water additives. Other members of the original consortium included the Water Research Foundation (formerly AwwaRF) and the Conference of State Health and Environmental Managers (COSHEM). The American Water Works Association (AWWA) and the Association of State Drinking Water Administrators (ASDWA) joined later.

In the United States, authority to regulate products for use in, or in contact with, drinking water rests with individual states.[*] Local agencies may choose to impose requirements more stringent than those required by the state. To evaluate the health effects of products and drinking water additives from such products, state and local agencies may use various references, including

1. Specific policies of the state or local agency.

2. Two standards developed under the direction of NSF[†], NSF/ANSI[‡] 60, Drinking Water Treatment Chemicals—Health Effects, and NSF/ANSI 61, Drinking Water System Components—Health Effects.

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* Persons outside the United States should contact the appropriate authority having jurisdiction.

† NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.

‡ American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

3. Other references, including AWWA standards, *Food Chemicals Codex*, *Water Chemicals Codex*,* and other standards considered appropriate by the state or local agency.

Various certification organizations may be involved in certifying products in accordance with NSF/ANSI 61. Individual states or local agencies have authority to accept or accredit certification organizations within their jurisdictions. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

Annex A, "Toxicology Review and Evaluation Procedures," to NSF/ANSI 61 does not stipulate a maximum allowable level (MAL) of a contaminant for substances not regulated by a USEPA final maximum contaminant level (MCL). The MALs of an unspecified list of "unregulated contaminants" are based on toxicity testing guidelines (noncarcinogens) and risk characterization methodology (carcinogens). Use of Annex A procedures may not always be identical, depending on the certifier.

ANSI/AWWA C207 does not address additives requirements. Users of this standard should consult the appropriate state or local agency having jurisdiction in order to

1. Determine additives requirements, including applicable standards.
2. Determine the status of certifications by parties offering to certify products for contact with, or treatment of, drinking water.
3. Determine current information on product certification.

II. Special Issues.

II.A. *Thickness and Dimensional Design*. Thickness and dimensional design of ring flanges have been based on references given in the background section of this Foreword, as well as on industry standards and other empirical data. Thickness design of the blind flanges has been based on the ASME Code Design Method. For hub-flange applications, refer to ASME B16.47 and ASME B16.5.

Because of potential corrosion issues and differences in material strengths between stainless and carbon steel, stainless-steel fasteners are not covered in ANSI/AWWA C207.

II.B. *Chlorine and Chloramine Degradation of Elastomers*. The selection of materials is critical for water service and distribution piping in locations where there is a possibility that elastomers will be in contact with chlorine or chloramines. Documented research has shown that elastomers such as gaskets, seals, valve seats, and encapsulations may be degraded when exposed to chlorine or chloramines. The impact of degradation is a function of the type of elastomeric material, chemical concentration,

* Both publications are available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

contact surface area, elastomer cross section, and environmental conditions as well as temperature. Careful selection of, and specifications for, elastomeric materials and the specifics of their application for each water system component should be considered to provide long-term usefulness and minimum degradation (swelling, loss of elasticity, or softening) of the elastomer specified.

II.C. *Gasket Degradation Study*. A pipe gasket having the hardness of a compressed elastomer with a large mass relative to the small exposed surfaced area experiences minimal degradation. This was validated in a research paper reported in the *Journal AWWA,*[*] where the pipe gasket degradation in a 110-mg/L chloramine solution was found to degrade just the exposed surface.

III. Use of This Standard. It is the responsibility of the user of an AWWA standard to determine that the products described in that standard are suitable for use in the particular application being considered.

III.A. *Purchaser Options and Alternatives.* When purchasing steel flanges for steel water pipe, the purchaser shall specify the following:

1. Standard used—that is, ANSI/AWWA C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm), of latest revision.
2. Whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required.
3. Type of flanges required—ring or blind type (Sec. 1.1).
4. Details of other federal, state or provincial, and local requirements (Sec. 4.1.1).
5. Gaskets—elastomeric (rubber), compressed fiber, or polytetrafluoroethylene (PTFE) based (Sec. 4.1.5).
6. Coating selection (Sec. 4.4).
7. Working pressure limit required (Tables 2 through 5).
8. Class of flange required (Tables 2 through 5).
9. Inside diameter of flanges (Tables 2 through 4).
10. Affidavit of compliance, if required (Sec. 6.2).

III.B. *Modification to Standard*. Any modification to the provisions, definitions, or terminology in the standard must be provided by the purchaser.

[*] Bonds, R.W. 2004. Effect of Chloramines on Ductile-Iron Pipe Gaskets of Various Elastomer Compounds. *Journal AWWA,* 96:4:153–160.

IV. Major Revisions. Major revisions made to the standard in this edition include the following:

1. An advisory statement was added in the Foreword (Sec. II.B and II.C) regarding chlorine and chloramine degradation of elastomers.

2. Section 2, References, was updated.

3. Sec. 4.1.4.2, under Sec. 4.1.4, Bolting Materials, was revised to clarify the use of studs with one nut versus two nuts.

4. Sec. 4.1.5, Gaskets, was revised to replace the term *rubber* with *elastomeric;* the reference to ASTM D1330 was removed; the maximum gasket seating stress for compressed fiber was revised; and a requirement for gaskets used for electrical isolation was added.

5. Table 1 was updated; the option of rubber gaskets for Class B and Class D flanges larger than 24 in. (600 mm) and for Class E flanges sizes 4 in. (100 mm) to 24 in. (600 mm) was deleted because of concerns of overcompressing the gasket; the term *rubber* was replaced with *elastomeric;* and Note 2 of Table 1 regarding insulation/isolation requirements was revised and the information was moved to Sec. 4.1.5.

6. The term *roughness average* (Ra) and a reference to ASME B46.1 were added to Sec. 4.2.2, Facing, for clarity.

7. Sec. 4.2.2.1 was rewritten to more clearly specify that a removable corrosion inhibitor is permitted on flange faces prior to installation.

8. A sentence was added to Sec. 4.2.3, Drilling, to require the use of washers for oversized bolt holes.

9. Sec. 4.2.4, Segmentation of Flanges, was revised to clarify that segments must be of approximate equal size.

10. In Sec. 4.2.4.2, the term *100 percent* was added to clarify that radiographic or ultrasonic testing is 100 percent required for all welds.

11. Sec. 4.3.1, Welding, was revised to reflect changes in Figure 1 where t has been revised to T_f, and T_y was added for the pipe cylinder thickness to clarify that for ¼-in. (6.4-mm) wall or smaller the weld size cannot be smaller than the cylinder wall.

12. The variable designations in Figure 1, Attachment of Flange, were revised to reflect the changes made to Sec. 4.3.1.

13. Sec. 4.3.2, Welding Procedure and Qualification, was revised.

14. Sec. 4.3.3, Draft or Layback Tolerance, was revised to reflect the tolerance for total draft or layback for a single flange.

15. The notation within Figure 2, Draft or Layback Measurement, was revised to be consistent with the change made in Sec. 4.3.3.

16. A new Figure 3, Negative Draft or Layback, was added to illustrate this issue.

17. Sec. 4.4, Protective Coating, was updated to reflect only those protective coatings allowed on flanges or flange joints.

V. Comments. If you have any comments or questions about this standard, please call AWWA Engineering and Technical Services at 303.794.7711, FAX at 303.795.7603, write to the department at 6666 West Quincy Avenue, Denver, CO 80235-3098, or e-mail at standards@awwa.org.

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AWWA Standard

Steel Pipe Flanges for Waterworks Service, Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm)

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes ring-type slip-on flanges and blind flanges. The flange pressure limits and the tables that describe them are

1. Ring-type, slip-on flanges (see Tables 2, 3, and 4).
2. Blind flanges (see Table 5).

Unless otherwise specified by the purchaser, the manufacturer shall select the type to be used.

Sec. 1.2 Purpose

The purpose of this standard is to provide minimum requirements and dimensions for a variety of steel flanges for attachment to steel water pipe and fittings.

Sec. 1.3 Application

1.3.1 *Intended use.* Flanges in this standard are intended for use with steel pipe, fittings, or appurtenances meeting the requirements of ANSI/AWWA C200, ANSI/AWWA C208, or other equivalent standards. It is intended that flanges be attached by welding in accordance with Sec. 4.3 of this standard.

1.3.2 *Pressure limits*. The pressure limits for flanges are provided in Tables 2 through 5. Pressure limits are for conditions and temperatures customary in water utility service.

1.3.2.1 This standard does not take into account external moments resulting from the pipe acting as a beam.

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, they form a part of this standard to the extent specified within the standard. In any case of conflict, the requirements of this standard shall prevail.

ANSI*/AWWA C200—Steel Water Pipe, 6 In. (150 mm) and Larger.

ANSI/AWWA C203—Coal-Tar Protective Coatings and Linings for Steel Water Pipe.

ANSI/AWWA C208—Dimensions for Fabricated Steel Water Pipe Fittings.

ANSI/AWWA C209—Cold-Applied Tape Coatings for Steel Water Pipe, Special Sections, Connections, and Fittings.

ANSI/AWWA C210—Liquid-Epoxy Coatings and Linings for Steel Water Pipe and Fittings.

ANSI/AWWA C213—Fusion-Bonded Epoxy Coatings and Linings for Steel Water Pipe and Fittings.

ANSI/AWWA C216—Heat-Shrinkable Cross-Linked Polyolefin Coatings for Steel Water Pipe and Fittings.

ANSI/AWWA C217—Microcrystalline Wax and Petrolatum Tape Coating Systems for Steel Water Pipe and Fittings.

ANSI/AWWA C218—Liquid Coatings for Aboveground Steel Water Pipe and Fittings.

ANSI/AWWA C222—Polyurethane Coatings and Linings for Steel Water Pipe and Fittings.

ASME† B16.1—Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250.

ASME B16.47—Large Diameter Steel Flanges: NPS 26 Through NPS 60 Metric/Inch Standard.

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

† ASME International, 3 Park Avenue, New York, NY 10016.

ASME B16.5—Pipe Flanges and Flanged Fittings: NPS ½ Through NPS 24 Metric/Inch Standard.

ASME B18.2.1—Square, Hex, Heavy Hex, and Askew Head Bolts and Hex, Heavy Hex, Hex Flange, Lobed Head, and Lag Screws (Inch Series).

ASME B46.1—Surface Texture (Surface Roughness, Waviness, and Lay).

ASME Boiler and Pressure Vessel Code (BPVC)—Section VIII, Rules for Construction of Pressure Vessels, Division 1.

ASME Boiler and Pressure Vessel Code—Section IX, Welding, Brazing, and Fusing Qualifications.

ASTM* A181/A181M—Standard Specification for Carbon Steel Forgings, for General-Purpose Piping.

ASTM A193/A193M—Standard Specification for Alloy-Steel and Stainless Steel Bolting for High-Temperature or High-Pressure Service and Other Special Purpose Applications.

ASTM A194/A194M—Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both.

ASTM A563—Standard Specification for Carbon and Alloy Steel Nuts.

ASTM A962/A962M—Standard Specification for Common Requirements for Bolting Intended for Use at Any Temperature From Cryogenic to the Creep Range.

ASTM F436—Standard Specification for Hardened Steel Washers Inch and Metric Dimensions.

AWS* D1.1/D1.1M—Structural Welding—Steel.

AWWA Manual M11—*Steel Pipe—A Guide for Design and Installation*.

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Field test pressure:* A pressure that is used to verify the integrity and soundness of an installed piping system or a zone of the system. Field test pressure recommendations are covered in AWWA Manual M11.

2. *Manufacturer:* The party that manufactures, fabricates, or produces materials or products.

3. *Potable water:* Water that is safe and satisfactory for drinking and cooking.

* American Welding Society, 550 Northwest LeJeune Road, Miami, FL 33126.

4. *Purchaser:* The person, company, or organization that purchases any materials or work to be performed.

5. *Transient pressure:* The purchaser-determined unsteady-state maximum pressure induced on a system resulting from a rapid change in flow velocity. Transient pressure as defined herein represents the total pressure level achieved during the transient event and is not an incremental pressure increase above the working pressure.

6. *Working pressure:* The maximum pressure under which a system or a zone within the system operates in a steady state or in a static condition, whichever is greater.

SECTION 4: REQUIREMENTS

Sec. 4.1 Materials

4.1.1 *Materials*. Materials shall comply with the requirements of the Safe Drinking Water Act and other federal regulations for water systems as applicable.

4.1.2 *Permeation*. The selection of materials is critical for water service and distribution piping in locations where there is likelihood the pipe will be exposed to significant concentrations of pollutants composed of low-molecular-weight petroleum products or organic solvents or their vapors. Documented research has shown that pipe materials (such as polyethylene and polyvinyl chloride) and elastomers, such as those used in jointing gaskets and packing glands, are subject to permeation by low-molecular-weight organic solvents or petroleum products. If a water pipe must pass through such a contaminated area or an area subject to contamination, consult with the manufacturer regarding permeation of pipe walls, jointing materials, and so on *before* selecting materials for use in that area.

4.1.3 *Manufacturing methods*. Flanges shall be made from seamless forgings, cut from plate as a single piece, welded bar rings, or segmented and welded plates.

4.1.3.1 *Flange materials.* Steel plate, bar, and forgings used in the manufacture of flanges shall meet the following requirements:

1. Specified minimum tensile strength = 50,000 psi (345 MPa).
2. Specified minimum yield strength = 32,000 psi (221 MPa).
3. Elongation, 2-in. (50-mm) gauge length (minimum) = 18 percent, or 8-in. (200-mm) gauge length (minimum) = 14 percent.
4. Carbon (maximum) = 0.35 percent.

5. Phosphorus (maximum) = 0.04 percent.

6. Sulfur (maximum) = 0.05 percent.

4.1.3.2 *Mill test reports.* The manufacturer shall provide mill test reports showing conformance to the physical and chemical requirements on request.

4.1.4 *Bolting materials*. Bolts and studs shall be ASTM A193/A193M Grade B7 with ASTM A194/A194M Grade 2H heavy hex nuts or ASTM A563 heavy hex nuts for 1 in. and smaller. Bolting shall have product marking in accordance with ASTM A193/A193M and ASTM A962/A962M.

4.1.4.1. Washers, when used, shall meet the requirements of ASTM F436.

4.1.4.2. Minimum bolt lengths shall be determined by adding the sum of the mating flange maximum thicknesses, the gasket, washers, and the depth of the nut plus ¼-in. (6.4-mm) minimum. If studs with two nuts are used, they shall be the same length as the bolts determined previously, plus the depth of a second nut and washer, plus an additional ⅛ in. (3.2 mm). If studs with only one nut are used to mate to a flange with tapped holes, the studs shall be the same length as the bolts determined previously.

4.1.5 *Gaskets*. This standard is predicated on gaskets of the type, thickness, and material shown in Table l for the class of flange, working pressure limit, and diameter listed.

Table 1 Flange gasket materials, type, and thickness

AWWA Flange Class	Working Pressure Limit*		Nominal Pipe Diameter		Material Options†	Type	Minimum Thickness	
	psi	*(kPa)*	*in.*	*(mm)*			*in.*	*(mm)*
B	86	(593)	4–24	(100–600)	Elastomeric	Full Face‡	1⁄16	(1.59)
B	86	(593)	4–24	100–600)	CFG, PTFE	Ring	1⁄16	(1.59)
B	86	(593)	26–144	(650–3,600)	CFG, PTFE	Ring	⅛	(3.18)
D	175	(1,207)	4–12	(100–300)	Elastomeric	Full Face‡	1⁄16	(1.59)
D	175	(1,207)	4–12	(100–300)	CFG, PTFE	Ring	1⁄16	(1.59)
D	150	(1,034)	14–24	(350–600)	Elastomeric	Full Face‡	1⁄16	(1.59)
D	150	(1,034)	14–24	(350–600)	CFG, PTFE	Ring	1⁄16	(1.59)
D	150	(1,034)	26–144	(650–3,600)	CFG, PTFE	Ring	⅛	(3.18)
E	275	(1,896)	4–24	(100–600)	CFG, PTFE	Ring†	1⁄16	(1.59)
E	275	(1,896)	26–144	(650–3,600)	CFG, PTFE	Ring†	⅛	(3.18)
F	300	(2,068)	4–24	(100–600)	CFG, PTFE	Ring†	1⁄16	(1.59)
F	300	(2,068)	26–48	(650–1,200)	CFG, PTFE	Ring†	⅛	(3.18)

CFG: compressed fiber gaskets, PTFE: polytetrafluoroethylene

* Maximum pressure (test or transient) is provided in Tables 2 through 5.

† Electrical isolation gaskets may be made of other materials that comply with this standard.

‡ Care must be taken with elastomeric gaskets to prevent overcompressing the gasket.

Elastomer (rubber) gaskets shall be hardness (Shore A) 70 to 85, suitable for water service temperature upto 200°F (93.3°C) with gasket seating stress of 200 psi (1,379 kPa) minimum. If assembly seating stress recommendations are unavailable, elastomeric gaskets shall be rated for a minimum of 175 psi (1,206 kPa) internal working pressure by the manufacturer.

Compressed fiber gaskets (CFG) shall be a blend of synthetic fibers, fillers, and elastomeric binders suitable for potable water service. Gaskets that are PTFE (polytetrafluoroethylene) based are also acceptable. Gasket seating stress shall be no greater than 4,800 psi (33 MPa).

Ring gasket dimensions shall be as follows:

Inside diameter (ID) = flange ID.

Outside diameter (OD) = bolt-circle diameter minus the bolt-hole diameter.

Gaskets used for electrical isolation shall be made so that the gasket will electrically isolate the joint and consist of materials that are suitable for potable water service. The gasket shall be pressure rated by the gasket manufacturer to a pressure no less than the applicable pressure class and shall meet the required seating stress to which it will be subjected.

Sec. 4.2 Fabrication

4.2.1 *Tolerances*. The dimensions listed in Tables 2 through 5 shall apply prior to attachment and are subject to the following tolerances:

4.2.1.1 Inside diameter of flange: +1⁄16 in. (1.6 mm), –0.

4.2.1.2 Outside diameter of flange: ±1⁄8 in. (3.2 mm).

4.2.1.3 Thickness of flanges 18 in. (450 mm) and smaller: +1⁄8 in. (3.2 mm), –0.

4.2.1.4 Thickness of flanges 20 in. (500 mm) and larger: +3⁄16 in. (4.8 mm), –0.

4.2.1.5 Bolt-circle diameter: ±1⁄16 in. (1.6 mm).

4.2.1.6 Bolt-hole spacing: ±1⁄32 in. (0.79 mm).

4.2.2 *Facing*. Flanges of all classes and types shall be flat faced—that is, without projection or raised face. Either a serrated concentric or serrated spiral finish having 24–55 grooves/in. (0.94–2.17 grooves/mm) shall be used. The cutting tool employed shall have a radius of 0.06 in. (1.52 mm) or larger. The resultant surface finish shall have a 125- to 500-µin. (3.2- to 12.7-µm) roughness average (Ra), as defined in ASME B46.1.

4.2.2.1 Flange faces shall be free of lining and coating materials, except that a removable corrosion inhibitor is permitted until installation. The gasket seating surface shall not have protrusions.

4.2.3 *Drilling*. For flanges up to 84 in. (2,100 mm) in diameter, bolt holes shall be drilled ⅛ in. (3.2 mm) larger in diameter than the nominal diameter of the bolt. For flanges larger than 84 in. (2,100 mm) in diameter, bolt holes shall be drilled 3⁄16-in. (4.8-mm) larger than the nominal bolt diameter. Bolt holes may be oversized by an additional ⅛ in. (3.2 mm) to accommodate insulators or to facilitate alignment with the mating flange. If bolt holes are oversized, washers shall be used.

4.2.4 *Segmentation of flanges*. Flanges shall be constructed by welding segments together when the OD of a flange exceeds the width of available plate material (approximately 78-in. [1,950-mm] ID and larger). The maximum number of segments in a single flange shall be four and segments shall be of approximately equal size.

4.2.4.1 Welding of the segments shall be performed in accordance with Sec. 4.3.2 of this standard.

4.2.4.2 100 percent radiographic or ultrasonic testing of all welds is required and shall be performed in accordance with the governing welding code as described in Sec. 4.3.2.

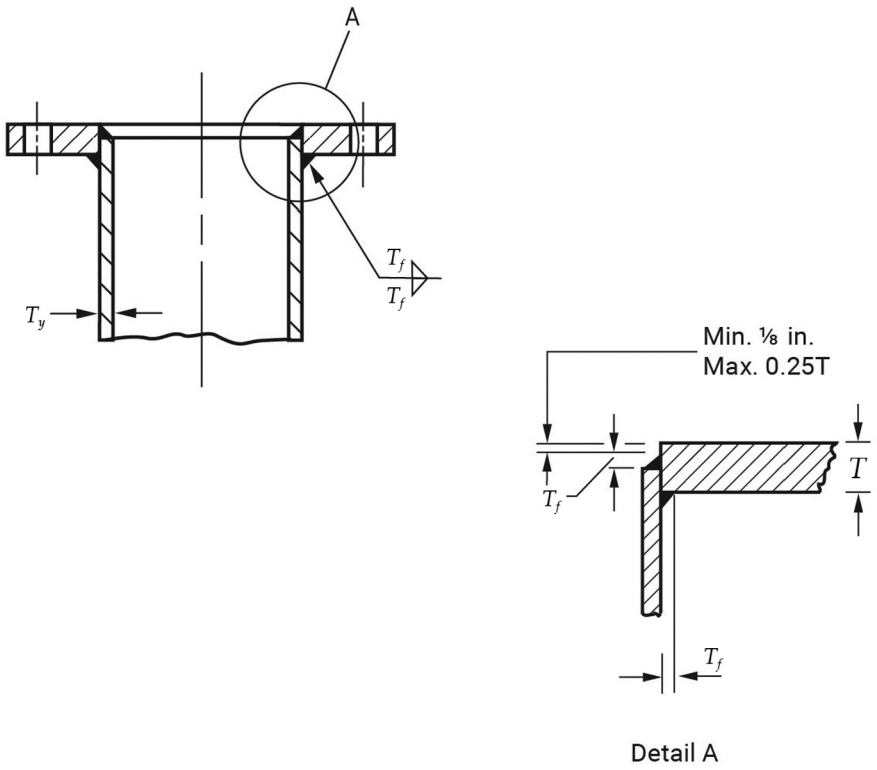
4.2.4.3 If any specimen tested in accordance with the approved procedure fails to meet the requirements, it shall be repaired using the approved repair procedure and radiographically or ultrasonically tested for conformance. If the retest fails to conform to the requirements, the flange shall be rejected.

4.2.4.4 Segmented flanges shall be stress relieved in accordance with the governing weld procedure after welding and before machining.

4.2.5 *Blind flanges*. Blind-flange thicknesses shall be as set forth in Table 5. For blind flanges over 48-in. (1,200-mm) nominal diameter, it is recommended that a combination of a ring flange and a flanged and dished head, suitable for the pressure and design conditions, be used. Blind-flange drilling and machine facing shall match the mating flange.

Sec. 4.3 Attachment of Flanges

4.3.1 *Welding*. Flanges shall be attached to pipe, fittings, or other appurtenances by means of two fillet welds as shown in Figure 1. For pipe cylinder thicknesses, T_y, ¼ in. (6.4 mm) or less, the fillet size, T_f, shall be equal to T_y. For pipe cylinder thicknesses greater than ¼ in. (6.4 mm), the fillet weld size, T_f, may be reduced to the calculated thickness of the attached steel pipe cylinder for pressure in accordance with AWWA Manual M11 or ¼ in. (6.4 mm), whichever is greater, with consideration given to the minimum single-pass fillet weld size and



NOTES: T_f – Fillet weld size (see Sec. 4.3.1)

T – Flange thickness as defined in Tables 2 through 4

T_y – Pipe cylinder thickness (see Sec. 4.3.1)

Figure 1 Attachment of flange

hydrogen-assisted cracking. When the weld root opening is greater than 1⁄16 in. (1.6 mm), increase the weld size according to the root opening. Root openings shall not exceed 3⁄16 in. (4.8 mm). Whenever attachment by this means is not practical, the flanges may be attached by welds shown in Section VIII, Division 1, of the ASME Boiler and Pressure Vessel Code.

4.3.2 *Welding procedure and qualification*. All welds performed in the attachment of flanges, welding of segments of flanges, and the repair of welding defects shall conform to a written procedure developed by the manufacturer.

The procedure used shall be based on a current applicable welding code, such as AWS D1.1/D1.1M or ASME Boiler and Pressure Vessel Code, Section IX.

4.3.2.1 Welder and welding operator qualification. Welders and welding operators shall be qualified under Section IX of the ASME Boiler and Pressure Vessel Code, applicable parts of AWS D1.1/D.1.1M, or other approved procedure.

4.3.3 *Draft or layback tolerance*. After welding of the flange has been completed, a draft or layback of the flange face may occur as shown in Figure 2. Total draft or layback shall not exceed 1 degree for a single flange or 1½ degrees between two mating flanges. Negative draft or layback as shown in Figure 3 shall not be permitted.

4.3.4 *Welding technique*. Care shall be taken during the welding process to avoid warping the flange face, particularly when attaching Class B flanges.

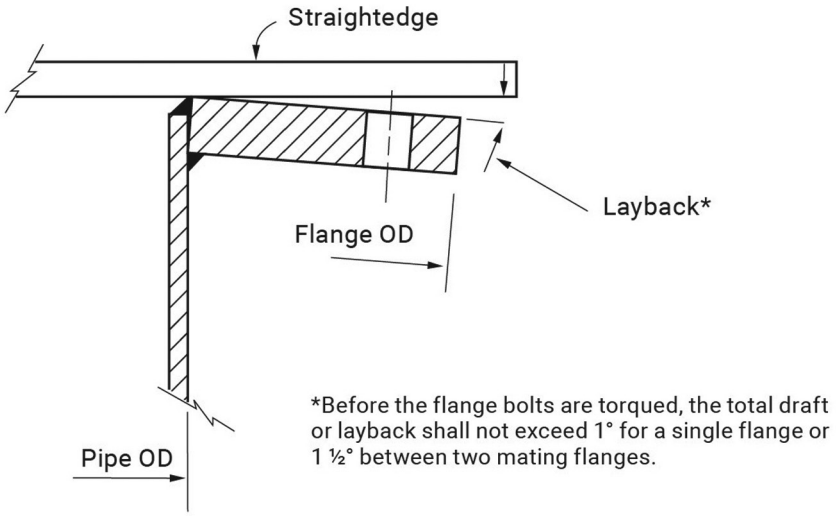


Figure 2 Draft or layback measurement

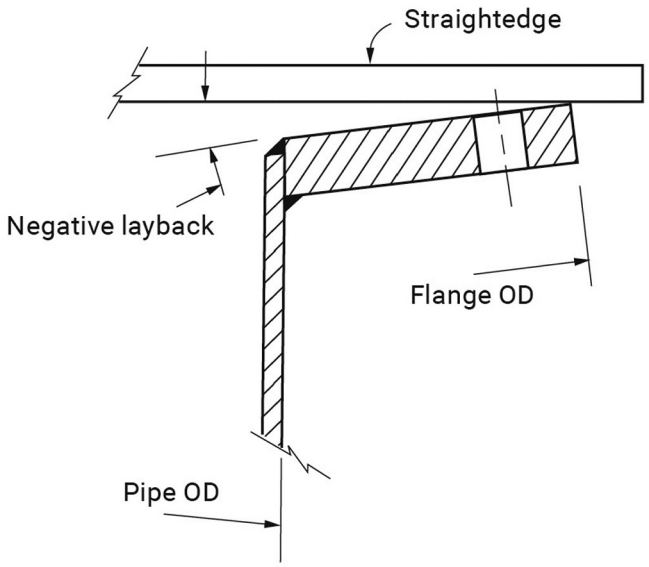


Figure 3 Negative draft or layback

4.3.5 *Bolt-hole alignment*. Bolt holes shall straddle the centerline, except where special mating conditions exist.

Sec. 4.4 Protective Coating

If specified by the purchaser, the flanges or flanged joints shall be given a protective coating conforming to ANSI/AWWA C203, ANSI/AWWA C209, ANSI/AWWA C210, ANSI/AWWA C213, ANSI/AWWA C216, ANSI/AWWA C217, ANSI/AWWA C218, ANSI/AWWA C222, or some combination of these coatings.

SECTION 5: VERIFICATION

Sec. 5.1 Inspection by the Purchaser

5.1.1 *Optional inspection*. At the purchaser's option, flange dimensions and attachment to pipe by welding may be inspected by the purchaser. This inspection shall not relieve the manufacturer of the responsibility to provide material and perform work in accordance with this standard.

5.1.2 *Access and facilities*. The purchaser shall have access at all reasonable times to those parts of the manufacturer's plant involved in the manufacture of the material ordered while the work contracted is being performed. The manufacturer shall provide the purchaser with the facilities necessary to determine that the material is being provided in accordance with this standard. Inspections shall be made at the place of manufacture or other mutually agreeable location prior to shipment.

5.1.3 *Rejection*. The purchaser may reject any flanges that do not conform to the requirements of this standard and the purchaser's specifications.

SECTION 6: DELIVERY

Sec. 6.1 Marking

Flanges shall be impression stamped with the size and name or trademark of the manufacturer and with the AWWA class as defined in Tables 2 through 5.

Sec. 6.2 Affidavit of Compliance

The purchaser may require an affidavit from the manufacturer that the material provided complies with applicable requirements of this standard.

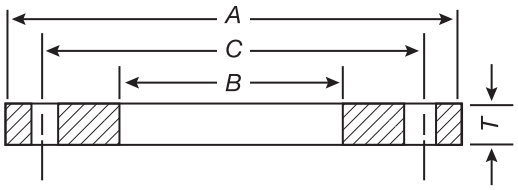


Table 2 AWWA standard steel-ring flanges, Class B* (86 psi) and Class D† (175–150 psi)
Maximum pressure (test or transient) allowed up to 129 psi for Class B, 262.5 psi for Class D up to 12 in., and 225 psi for Class D sizes larger than 12 in.

						Thickness of Flange *in.*	
Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*‡) *in.*	Number of Bolts	Diameter of Bolt Circle (*C*) *in.*	Diameter of Bolts§ *in.*	Class B (*T*)	Class D (*T*)
4	9.00	4.57	8	7.50	0.625	0.625	0.625
5	10.00	5.66	8	8.50	0.750	0.625	0.625
6	11.00	6.72	8	9.50	0.750	0.688	0.688
8	13.50	8.72	8	11.75	0.750	0.688	0.688
10	16.00	10.88	12	14.25	0.875	0.688	0.688
12	19.00	12.88	12	17.00	0.875	0.688	0.812
14	21.00	14.19	12	18.75	1.000	0.688	0.938
16	23.50	16.19	16	21.25	1.000	0.688	1.000
18	25.00	18.19	16	22.75	1.125	0.688	1.062
20	27.50	20.19	20	25.00	1.125	0.688	1.125
22	29.50	22.19	20	27.25	1.250	0.750	1.188
24	32.00	24.19	20	29.50	1.250	0.750	1.250
26	34.25		24	31.75	1.250	0.812	1.312
28	36.50		28	34.00	1.250	0.875	1.312
30	38.75		28	36.00	1.250	0.875	1.375
32	41.75		28	38.50	1.500	0.938	1.500
34	43.75		32	40.50	1.500	0.938	1.500
36	46.00		32	42.75	1.500	1.000	1.625
38	48.75		32	45.25	1.500	1.000	1.625
40	50.75		36	47.25	1.500	1.000	1.625
42	53.00		36	49.50	1.500	1.125	1.750
44	55.25		40	51.75	1.500	1.125	1.750
46	57.25		40	53.75	1.500	1.125	1.750
48	59.50		44	56.00	1.500	1.250	1.875
50	61.75		44	58.25	1.750	1.250	2.000
52	64.00		44	60.50	1.750	1.250	2.000
54	66.25		44	62.75	1.750	1.375	2.125
60	73.00		52	69.25	1.750	1.500	2.250
66	80.00		52	76.00	1.750	1.625	2.500

(table continues)

Table 2 AWWA standard steel-ring flanges, Class B[*] (86 psi) and Class D[†] (175–150 psi) (continued)

Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*[‡]) *in.*	Number of Bolts	Diameter of Bolt Circle (*C*) *in.*	Diameter of Bolts[§] *in.*	Thickness of Flange *in.*	
						Class B (*T*)	Class D (*T*)
72	86.50		60	82.50	1.750	1.750	2.625
78	93.00		64	89.00	2.000	2.000	2.750
84	99.75		64	95.50	2.000	2.000	2.875
90	106.50		68	102.00	2.250	2.250	3.000
96	113.25		68	108.50	2.250	2.250	3.250
102	120.00		72	114.50	2.500	2.500	3.250
108	126.75		72	120.75	2.500	2.500	3.375
114	133.50		76	126.75	2.750	2.750	3.500
120	140.25		76	132.75	2.750	2.750	3.500
126	147.00		80	139.25	3.000	3.000	3.750
132	153.75		80	145.75	3.000	3.000	3.875
144	167.25		84	158.25	3.250	3.250	4.125

Notes:

1. Ring flanges may be overbored or counterbored to accommodate larger outside-diameter (OD) pipe than shown as nominal. This is done to allow a clear inside diameter (ID) after cement–mortar lining. Wrench clearance between the pipe OD and bolt circle, as well as sufficient gasket seating area, must be maintained.
2. Metric conversion—nominal pipe size: in. × 25 = mm; dimensions: in. × 25.4 = mm; psi × 6.895 = kPa.

[*] Working pressure limit at water service temperature is 86 psi. These flanges have the same OD and drilling pattern as Class 125 cast-iron flanges (ASME B16.1). In sizes 24 in. and smaller, they also match ASME B16.5 Class 150-psi drilling for steel flanges.

[†] Working pressure limit at water service temperature: sizes 4–12 in. inclusive, 175 psi; sizes larger than 12 in., 150 psi. These flanges have the same diameter and drilling as Class 125 cast-iron flanges (ASME B16.1). In sizes 24 in. and smaller, they also match ASME B16.5 Class 150-psi standard for steel flanges.

[‡] The purchaser shall specify the ID of the flange, dimension *B*, for nominal pipe sizes 26 in. and larger. The diameter of the flange bore shall not exceed the pipe OD by more than 0.25 in.

[§] Bolt holes shall be drilled ⅛-in. larger in diameter than the nominal diameter of the bolt except as stated in Sec. 4.2.3.

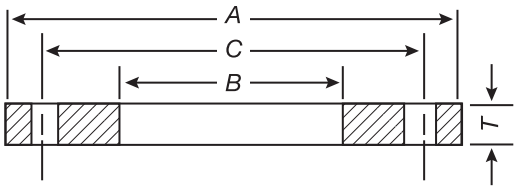


Table 3 AWWA standard steel-ring flanges, Class E* (275 psi)
Maximum pressure (test or transient) allowed up to 412.5 psi

Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*†) *in.*	Number of Bolts	Diameter of Bolt Circle (*C*) *in.*	Diameter of Bolts‡ *in.*	Thickness of Flange (*T*) *in.*
4	9.00	4.57	8	7.50	0.625	1.125
5	10.00	5.66	8	8.50	0.750	1.188
6	11.00	6.72	8	9.50	0.750	1.313
8	13.50	8.72	8	11.75	0.750	1.500
10	16.00	10.88	12	14.25	0.875	1.563
12	19.00	12.88	12	17.00	0.875	1.750
14	21.00	14.19	12	18.75	1.000	1.875
16	23.50	16.19	16	21.25	1.000	2.000
18	25.00	18.19	16	22.75	1.125	2.125
20	27.50	20.19	20	25.00	1.125	2.375
22	29.50	22.19	20	27.25	1.250	2.500
24	32.00	24.19	20	29.50	1.250	2.625
26	34.25		24	31.75	1.250	2.750
28	36.50		28	34.00	1.250	2.750
30	38.75		28	36.00	1.250	2.875
32	41.75		28	38.50	1.500	3.000
34	43.75		32	40.50	1.500	3.000
36	46.00		32	42.75	1.500	3.125
38	48.75		32	45.25	1.500	3.125
40	50.75		36	47.25	1.500	3.250
42	53.00		36	49.50	1.500	3.375
44	55.25		40	51.75	1.500	3.375
46	57.25		40	53.75	1.500	3.438
48	59.50		44	56.00	1.500	3.500
50	61.75		44	58.25	1.750	3.500
52	64.00		44	60.50	1.750	3.625
54	66.25		44	62.75	1.750	3.750
60	73.00		52	69.25	1.750	3.875
66	80.00		52	76.00	1.750	4.250
72	86.50		60	82.50	1.750	4.375

(table continues)

Table 3 AWWA standard steel-ring flanges, Class E* (275 psi) (continued)

Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*†) *in.*	Number of Bolts	Diameter of Bolt Circle (*C*) *in.*	Diameter of Bolts‡ *in.*	Thickness of Flange (*T*) *in.*
78	93.00		64	89.00	2.000	4.750
84	99.75		64	95.50	2.000	4.750
90	106.50		68	102.00	2.250	5.125
96	113.25		68	108.50	2.250	5.125
102	120.00		72	114.50	2.500	5.500
108	126.75		72	120.75	2.500	5.500
114	133.50		76	126.75	2.750	5.875
120	140.25		76	132.75	2.750	5.875
126	147.00		80	139.25	3.000	6.250
132	153.75		80	145.75	3.000	6.250
144	167.25		84	158.25	3.250	6.750

Notes:

1. Ring flanges may be overbored or counterbored to accommodate larger outside-diameter pipe than shown as nominal. This is done to allow a clear inside diameter after cement–mortar lining. Wrench clearance between the pipe OD and bolt circle, as well as sufficient gasket seating area, must be maintained.
2. Metric conversion—nominal pipe size: in. × 25 = mm; dimensions: in. × 25.4 = mm; psi × 6.895 = kPa.

* Working pressure limit at water service temperature is 275 psi. These flanges have the same OD and drilling pattern as ASME B16.1 Class 125 cast-iron flanges. In sizes 24 in. and smaller, they also match ASME B16.5 Class 150-psi standard for steel flanges.

† The purchaser shall specify the ID of the flange, dimension *B*, for nominal pipe sizes 26 in. and larger. The diameter of the flange bore shall not exceed the pipe OD by more than 0.25 in.

‡ Bolt holes shall be drilled ⅛ in. larger in diameter than the nominal diameter of the bolt except as stated in Sec. 4.2.3.

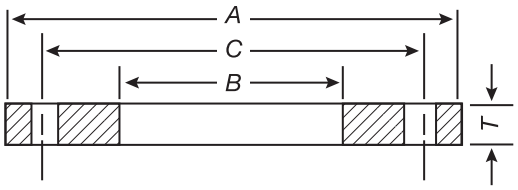


Table 4 AWWA standard steel-ring flanges, Class F* (300 psi)
Maximum pressure (test or transient) allowed up to 450 psi

Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*†) *in.*	Number of Bolts	Diameter of Bolt Circle (*C*) *in.*	Diameter of Bolts‡ *in.*	Thickness of Flange (*T*) *in.*
4	10.00	4.57	8	7.88	0.750	1.13
5	11.00	5.66	8	9.25	0.750	1.21
6	12.50	6.73	12	10.62	0.750	1.31
8	15.00	8.73	12	13.00	0.875	1.31
10	17.50	10.88	16	15.25	1.000	1.50
12	20.50	12.88	16	17.75	1.125	1.63
14	23.00	14.19	20	20.25	1.125	1.94
16	25.50	16.19	20	22.50	1.250	2.14
18	28.00	18.19	24	24.75	1.250	2.25
20	30.50	20.19	24	27.00	1.250	2.33
22	33.00	22.19	24	29.25	1.250	2.50
24	36.00	24.19	24	32.00	1.500	2.69
26	38.25	—	28	34.50	1.750	3.00
28	40.75	—	28	37.00	1.750	3.13
30	43.00	—	28	39.25	1.750	3.15
32	45.25	—	28	41.50	1.750	3.25
34	47.50	—	28	43.50	1.750	3.38
36	50.00	—	32	46.00	2.000	3.46
38	52.25	—	32	48.00	2.000	3.50
40	54.25	—	36	50.25	2.000	3.63
42	57.00	—	36	52.75	2.000	3.81
44	59.25	—	36	55.00	2.000	4.00
46	61.50	—	40	57.25	2.000	4.13
48	65.00	—	40	60.75	2.000	4.50

Notes:

1. Ring flanges may be overbored or counterbored to accommodate larger outside-diameter (OD) pipe than shown as nominal. This is done to allow a clear inside diameter (ID) after cement–mortar lining. Wrench clearance between the pipe OD and bolt circle, as well as sufficient gasket seating area, must be maintained.
2. Metric conversion—nominal pipe size: in. × 25 = mm; dimensions: in. × 25.4 = mm; psi × 6.895 = kPa.

* Working pressure limit at water service temperature is 300 psi. These flanges have the same OD and drilling pattern as ASME B16.1 Class 250 cast-iron pipe and flanged fittings and ASME B16.5 Class 300 for steel flanges.

† The purchaser shall specify the ID of the flange, dimension *B*, for nominal pipe sizes 26 in. and larger. The diameter of the flange bore shall not exceed the pipe OD by more than 0.25 in.

‡ Bolt holes shall be drilled ⅛ in. larger in diameter than the nominal diameter of the bolt except as stated in Sec. 4.2.3.

Table 5 AWWA blind-flange thickness

Nominal Pipe Size *in.*	Minimum Thickness[*] Class B[†] (86 psi) Max P[‡] = 129 psi *in.*	Class D[§] *in.*	Class E[**] (275 psi) Max P = 412.5 psi *in.*	Class F[††] (300 psi) Max P = 450 psi *in.*
4	0.625	0.625	1.125	1.130
5	0.625	0.650	1.188	1.210
6	0.688	0.693	1.313	1.310
8	0.688	0.812	1.500	1.310
10	0.688	0.953	1.563	1.500
12	0.719	1.117	1.750	1.630
14	0.791	1.133	1.875	1.940
16	0.892	1.265	2.000	2.140
18	0.950	1.331	2.125	2.250
20	1.040	1.448	2.375	2.330
22	1.132	1.568	2.500	2.500
24	1.216	1.661	2.625	2.690
26	1.307	1.786	2.750	3.000
28	1.398	1.906	2.750	3.130
30	1.477	2.008	2.875	3.166
32	1.581	2.150	3.000	3.332
34	1.661	2.252	3.050	3.475
36	1.751	2.370	3.209	3.671
38	1.853	2.506	3.394	3.815
40	1.933	2.609	3.533	3.982
42	2.023	2.729	3.695	4.171
44	2.114	2.849	3.857	4.338
46	2.194	2.952	3.997	4.505
48	2.285	3.072	4.159	4.781
50	2.377	3.196	4.327	N/A
52	2.468	3.315	4.489	N/A
54	2.559	3.435	4.651	N/A

(table continues)

Table 5 AWWA blind-flange thickness (continued)

Nominal Pipe Size *in.*	Minimum Thickness* Class B† (86 psi) Max P‡ = 129 psi *in.*	Class D§ *in.*	Class E** (275 psi) Max P = 412.5 psi *in.*	Class F†† (300 psi) Max P = 450 psi *in.*
60	2.820	3.779	5.116	N/A
66	3.092	4.136	5.601	N/A
72	3.353	4.480	6.066	N/A

Notes:

1. All flanges are flat faced.
2. Minimum thickness based on allowable stress of 16,000 psi.
3. Minimum thickness based on 7,000 psi allowable bolt stress for Classes B and D.
4. Minimum thickness based on 25,000 psi allowable bolt stress for Classes E and F.
5. For diameters over 48 in., see recommendation in Sec. 4.2.5.
6. Metric conversion—nominal pipe size: in. × 25 = mm; dimensions: in. × 25.4 = mm; psi × 6.895 = kPa.

* Design method: ASME Boiler and Pressure Vessel Code, Sec. VIII, Div. 1, UG-34, Eq 2 (2010), or corresponding ring-flange thickness, whichever is greater.

† Working pressure limit at water service temperature is 86 psi. These flanges have the same outside diameter (OD) and drilling pattern as Class 125 cast-iron flanges (ASME B16.1). In sizes 24 in. and smaller, they also match ASME B16.5 Class 150-psi drilling for steel flanges.

‡ Max P = maximum pressure (test or transient).

§ Class D flanges have a working pressure limit at water service temperature of 175 psi (1,207 kPa) for nominal pipe sizes ≤12 in. (600 mm), and 150 psi (1,034 kPa) for nominal pipe sizes >12 in. (600 mm). Maximum pressure (test or transient) for nominal pipe sizes up to 12 in. is 260 psi and 225 psi for sizes larger than 12 in.

** Working pressure limit at water service temperature is 275 psi. These flanges have the same OD and drilling pattern as ASME B16.1 Class 125 cast-iron flanges. In sizes 24 in. and smaller, they also match ASME B16.5 Class 150-psi standard for steel flanges.

†† Working pressure limit at water service temperature is 300 psi. These flanges have the same OD and drilling pattern as ASME B16.1 Class 250 cast-iron pipe and flanged fittings and ASME B16.5 Class 300 for steel flanges.

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APPENDIX A

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This appendix is for information only and is not a part of ANSI/AWWA C207.

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APPENDIX B

Steel-Hub Flanges

This appendix is for information only and is not a part of ANSI/AWWA C207.

For additional information on hub flanges, refer to ASME B16.47 and ASME B16.5.

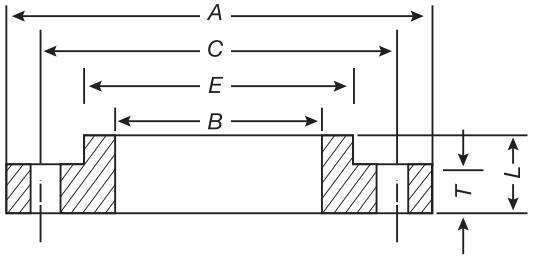

Table B.1 AWWA standard steel-hub flanges, Class D* (175–150 psi)
Maximum pressure (test or transient) allowed up to 260 psi for Class D up through 12 in., and 225 psi for Class D sizes larger than 12 in.

Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*) *in.*	Number of Bolts	Diameter of Bolt Circle (*C*) *in.*	Diameter of Bolts† *in.*	Flange Dimensions *in.* (*T*)	(*L*)	(*E*)
4	9.00	4.57	8	7.50	0.625	0.500	0.875	5.312
5	10.00	5.66	8	8.50	0.750	0.562	1.250	6.312
6	11.00	6.72	8	9.50	0.750	0.562	1.250	7.562
8	13.50	8.72	8	11.75	0.750	0.562	1.250	9.688
10	16.00	10.88	12	14.25	0.875	0.688	1.250	12.000
12	19.00	12.88	12	17.00	0.875	0.688	1.250	14.375
14	21.00	14.19	12	18.75	1.000	0.750	1.250	15.750
16	23.50	16.19	16	21.25	1.000	0.750	1.250	18.000
18	25.00	18.19	16	22.75	1.125	0.750	1.250	19.875
20	27.50	20.19	20	25.00	1.125	0.750	1.250	22.000
22	29.50	22.19	20	27.25	1.250	1.000	1.750	24.250
24	32.00	24.19	20	29.50	1.250	1.000	1.750	26.125
26	34.25	26.19	24	31.75	1.250	1.000	1.750	28.500
28	36.50	28.19	28	34.00	1.250	1.000	1.750	30.500
30	38.75	30.19	28	36.00	1.250	1.000	1.750	32.500
32	41.75	32.19	28	38.50	1.500	1.125	1.750	34.750
34	43.75	34.19	32	40.50	1.500	1.125	1.750	36.750
36	46.00	36.19	32	42.75	1.500	1.125	1.750	38.750
38	48.75	38.19	32	45.25	1.500	1.125	1.750	40.750
40	50.75	40.19	36	47.25	1.500	1.125	1.750	43.000

(table continues)

Table B.1 AWWA standard steel-hub flanges, Class D* (175–150 psi) (continued)

Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*) *in.*	Number of Bolts	Diameter of Bolt Circle (*C*) *in.*	Diameter of Bolts† *in.*	Flange Dimensions *in.* (*T*)	(*L*)	(*E*)
42	53.00	42.19	36	49.50	1.500	1.250	1.750	45.000
44	55.25	44.19	40	51.75	1.500	1.250	2.250	47.000
46	57.25	46.19	40	53.75	1.500	1.250	2.250	49.000
48	59.50	48.19	44	56.00	1.500	1.375	2.500	51.000
50	61.75	50.19	44	58.25	1.750	1.375	2.500	53.000
52	64.00	52.19	44	60.50	1.750	1.375	2.500	55.000
54	66.25	54.19	44	62.75	1.750	1.375	2.500	57.000
60	73.00	60.19	52	69.25	1.750	1.500	2.750	63.000
66	80.00	66.19	52	76.00	1.750	1.500	2.750	69.000
72	86.50	72.19	60	82.50	1.750	1.500	2.750	75.000
78	93.00	78.19	64	89.00	2.000	1.750	3.000	81.250
84	99.75	84.19	64	95.50	2.000	1.750	3.000	87.500
90	106.50	90.19	68	102.00	2.250	2.000	3.250	93.750
96	113.25	96.19	68	108.50	2.250	2.000	3.250	100.000

NOTES:

1. Hub flanges are to be used on pipe that has an outer diameter (OD) equal to the nominal pipe size in the first column and shall not be overbored. ID: inner diameter
2. Metric conversion—nominal pipe size: in. × 25 = mm; dimensions: in. × 25.4 = mm; psi × 6.895 = kPa.

* Working pressure limit at water service temperature: sizes 4–12 in. inclusive, 175 psi; sizes larger than 12 in., 150 psi. These flanges have the diameter OD and drilling as Class 125 cast-iron flanges (ASME B16.1). In sizes 24 in. and smaller, they also match ASME B16.5 Class 150-psi standard for steel flanges.

† Bolt holes shall be drilled ⅛-in. larger in diameter than the nominal diameter of the bolt except as stated in Sec.4.2.3.

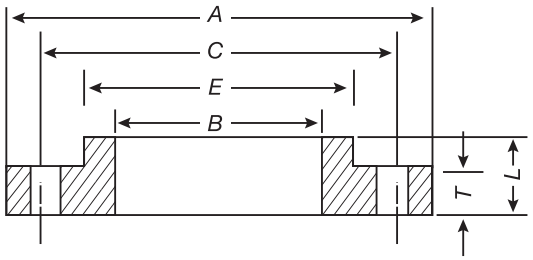

Table B.2 AWWA standard steel-hub flanges, Class E* (275 psi)

Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*†) *in.*	Number of Bolts	Diameter of Bolt Circle (*C*) *in.*	Diameter of Bolts‡ *in.*	Flange Dimensions *in.*		
						(*T*)§	(*L*)	(*E*)
4	9.00	4.57	8	7.50	0.625	0.938	1.312	5.312
5	10.00	5.66	8	8.50	0.750	0.938	1.438	6.438
6	11.00	6.72	8	9.50	0.750	1.000	1.562	7.562
8	13.50	8.72	8	11.75	0.750	1.125	1.750	9.688
10	16.00	10.88	12	14.25	0.875	1.188	1.938	12.000
12	19.00	12.88	12	17.00	0.875	1.250	2.188	14.375
14	21.00	14.19	12	18.75	1.000	1.375	2.250	15.750
16	23.50	16.19	16	21.25	1.000	1.438	2.500	18.000
18	25.00	18.19	16	22.75	1.125	1.562	2.688	19.875
20	27.50	20.19	20	25.00	1.125	1.688	2.875	22.000
22	29.50	22.19	20	27.25	1.250	1.812	3.125	24.000
24	32.00	24.19	20	29.50	1.250	1.875	3.250	26.125
26	34.25	26.19	24	31.75	1.250	2.000	3.375	28.500
28	36.50	28.19	28	34.00	1.250	2.062	3.438	30.750
30	38.75	30.19	28	36.00	1.250	2.125	3.500	32.750
32	41.75	32.19	28	38.50	1.500	2.250	3.625	35.000
34	43.75	34.19	32	40.50	1.500	2.312	3.688	37.000
36	46.00	36.19	32	42.75	1.500	2.375	3.750	39.250
38	48.75	38.19	32	45.25	1.500	2.375	3.750	41.750
40	50.75	40.19	36	47.25	1.500	2.500	3.875	43.750
42	53.00	42.19	36	49.50	1.500	2.625	4.000	46.000
44	55.25	44.19	40	51.75	1.500	2.625	4.000	48.000
46	57.25	46.19	40	53.75	1.500	2.688	4.062	50.000
48	59.50	48.19	44	56.00	1.500	2.750	4.125	52.250
50	61.75	50.19	44	58.25	1.750	2.750	4.125	54.250
52	64.00	52.19	44	60.50	1.750	2.875	4.250	56.500
54	66.25	54.19	44	62.75	1.750	3.000	4.375	58.750
60	73.00	60.19	52	69.25	1.750	3.125	4.500	65.250

(table continues)

Table B.2 AWWA standard steel-hub flanges, Class E* (275 psi) (continued)

Nominal Pipe Size *in.*	OD of Flange (*A*) *in.*	ID of Flange (*B*†) *in.*	Number of Bolts	Diameter of Bolt Circle (*C*) *in.*	Diameter of Bolts‡ *in.*	Flange Dimensions *in.*		
						(*T*)§	(*L*)	(*E*)
66	80.00	66.19	52	76.00	1.750	3.375	4.875	71.500
72	86.50	72.19	60	82.50	1.750	3.500	5.000	78.500
78	93.00	78.19	64	89.00	2.000	3.875	5.375	84.500
84	99.75	84.19	64	95.50	2.000	3.875	5.375	90.500
90	106.50	90.19	68	102.00	2.250	4.250	5.750	96.750
96	113.25	96.19	68	108.50	2.250	4.250	5.750	102.750

Notes:

1. Hub flanges are to be used on pipe that has an outer diameter (OD) equal to the nominal pipe size in the first column and shall not be overbored. ID: inner diameter
2. Metric conversion—nominal pipe size: in. × 25 = mm; dimensions: in. × 25.4 = mm; psi × 6.895 = kPa.

* Water pressure rating at water service temperature is 275 psi. These flanges have the same diameter and drilling as ASME B16.1 Class 125 cast-iron flanges. In sizes 24 in. and smaller, they also match ASME B16.5 Class 150-psi standard for steel flanges.

† Welding neck flanges may be used if desired, at the purchaser's option.

‡ Bolt holes shall be drilled ⅛ in. larger in diameter than the nominal diameter of the bolt as stated in Sec. 4.2.3.

§ The thickness *T* of a flange from which the raised face has been removed shall be no less than dimension *T* minus 0.06 in.

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