ANSI/AWWA C115/A21.15-11
(Revision of ANSI/AWWA C115/A21.15-05)

American Water Works Association

The Authoritative Resource on Safe Water®

AWWA Standard

Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

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AWWA Standard

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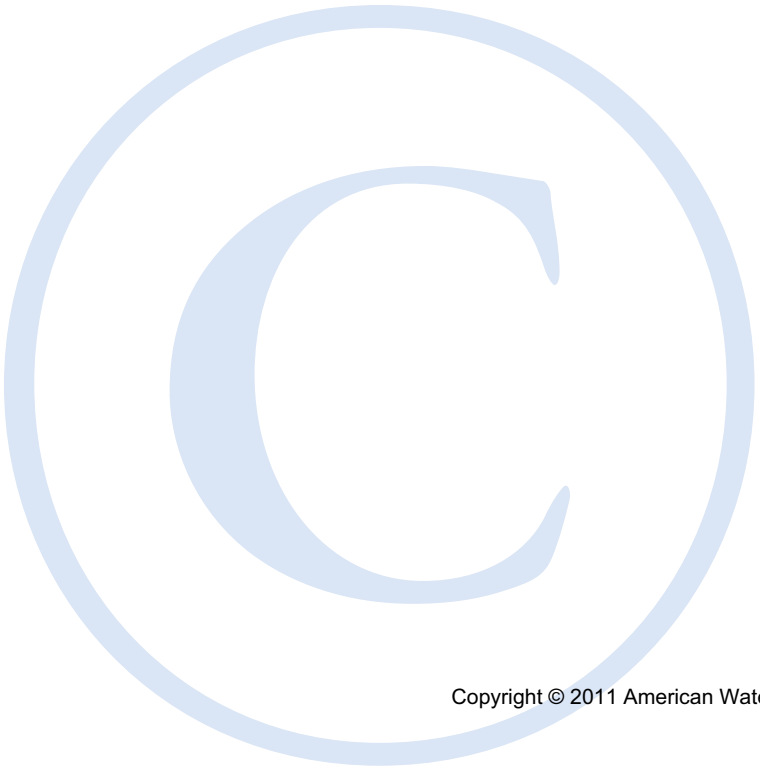

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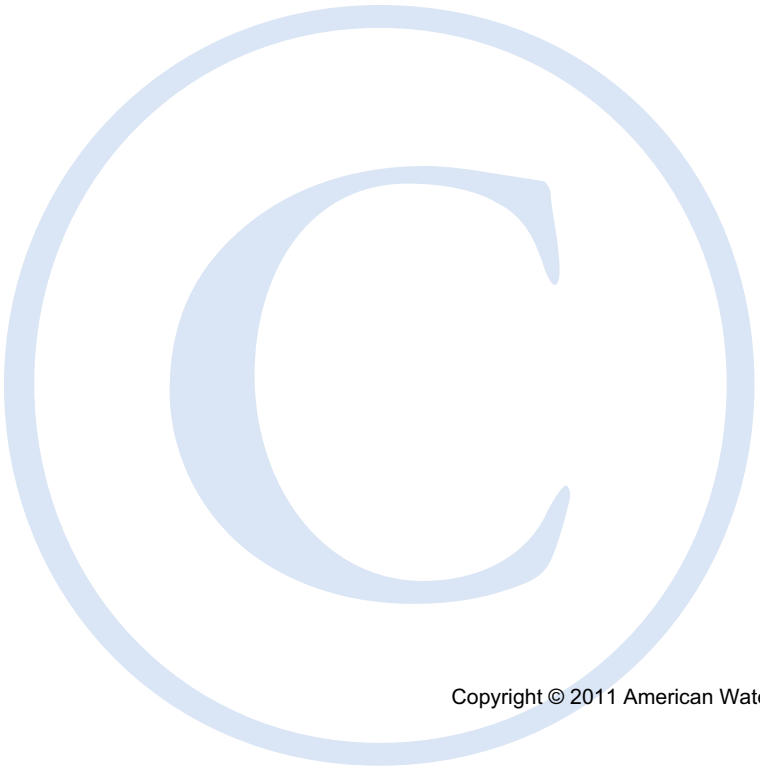


Foreword

This foreword is for information only and is not a part of ANSI/AWWA C115/A21.15.*

I. Introduction.

I.A. *Background.* American National Standards Institute (ANSI) Committee A21 on Cast-Iron Pipe and Fittings was organized in 1926 and sponsored by the American Gas Association (AGA), the American Society for Testing and Materials (ASTM), the American Water Works Association (AWWA), and the New England Water Works Association (NEWWA). Between 1972 and 1984, the co-secretariats were AGA, AWWA, and NEWWA, with AWWA serving as administrative secretariat. In 1984, the committee became an AWWA committee with the name AWWA Standards Committee A21 on Ductile-Iron Pipe and Fittings. In 1988, NEWWA withdrew as a separate secretariat; however, it continues to maintain its representation on the A21 Committee. In 1997, AGA withdrew as co-secretariat.

The present scope of Committee A21 activity is the development of standards and manuals addressing ductile-iron pressure pipe for water and ductile-iron and gray-iron fittings for use with such pipe. These standards and manuals include topics such as design, dimensions, materials, coatings, linings, joints, accessories, methods of inspection and testing, and installation.

The work of Committee A21 is conducted by subcommittees. The scope of Subcommittee 1, Pipe, includes the periodic review of all current Committee A21 standards for pipe, the preparation of revisions and new standards, and other matters pertaining to pipe standards.

I.B. *History.* Flanged fittings, sizes 3 in. through 48 in. (80 mm through 1,200 mm), are described in ANSI/AWWA C110/A21.10, Standard for Ductile-Iron and Gray-Iron Fittings. Flanged fittings, sizes 54 in. through 64 in. (1,400 mm through 1,600 mm), are covered in ANSI/AWWA C153/A21.53, Standard for Ductile-Iron Compact Fittings. The flanged pipe used with these fittings has been purchased for many years in accordance with users', manufacturers', and fabricators' standards. An ANSI/AWWA standard was needed for flanged pipe. Consequently, Subcommittee 1 submitted a proposed standard for flanged pipe to Committee A21 in 1974. The first edition of the standard was adopted in 1975. Subsequent revisions to ANSI/AWWA C115/A21.15 were approved by the AWWA Board of Directors in 1983, 1988, 1994,

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

1999, and 2005. Subcommittee 1 reviewed the 2005 edition and submitted a proposed revision to Committee A21 in 2010. This seventh edition of ANSI/AWWA C115/A21.15 was approved on June 12, 2011.

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 American Water Works Association Research Foundation (AwwaRF, now Water Research Foundation†) 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. An advisory program formerly administered by USEPA, Office of Drinking Water, discontinued on Apr. 7, 1990.
2. Specific policies of the state or local agency.
3. 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.
4. 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 jurisdiction. Accreditation of certification organizations may vary from jurisdiction to jurisdiction.

* NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.

† Water Research Foundation, 6666 W. Quincy Avenue, Denver, CO 80235.

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

§ Both publications available from National Academy of Sciences, 500 Fifth Street, N.W., Washington, DC 20418.

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 C115/A21.15 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. *Flange Material Properties.* Because this standard requires the material properties of gray-iron and ductile-iron flanges to comply with ANSI/AWWA C110/A21.10, the following material properties specified in ANSI/AWWA C110/A21.10 are listed for information purposes.

1. Gray-iron flanges, in accordance with ANSI/AWWA C110/A21.10, shall be manufactured of the following minimum tensile-strength iron listed in Table F.1.
2. Ductile-iron flanges made in accordance with ANSI/AWWA C110/A21.10 shall be manufactured of grades of ductile iron with the following minimum physical properties:

70,000 psi (483,000 kPa) tensile strength,
50,000 psi (345,000 kPa) yield strength, and
5 percent elongation;
or

Table F.1 Gray-iron flange minimum tensile strength

Nominal Size* *in.*†	Minimum Tensile Strength	
	psi	*(kPa)*
3–12	25,000	(172,000)
14–24	30,000	(207,000)

*Purchasers of gray-iron flanges greater than 24 in. should contact the manufacturer or fabricator for strength requirements.
†To convert inches to millimeters, multiply by 25.4.

60,000 psi (414,000 kPa) tensile strength,
42,000 psi (290,000 kPa) yield strength, and
10 percent elongation.

II.B. *Special Service Requirements.* Special service conditions, such as elevated temperatures, the conveyance of acids or chemicals, and the application of a glass lining, may require special thread compounds. Special service requirements must be specified by the purchaser.

Please note the apparent conflict between this standard and ASME B16.1* with regard to pressure ratings for pipe flanges.

All flanges provided in accordance with ANSI/AWWA C115/A21.15 are rated† for water service of 250 psi (1,720 kPa) or greater working pressure. These flanges have facing and drilling identical to ASME B16.1, class 125 flanges. ASME B16.1, class 125 B16.1 flanges for service at temperatures ranging from 20°F to 150°F (–6.7°C to 65.6°C) are pressure–temperature rated for 150 psi to 200 psi (1,030 kPa to 1,380 kPa), depending on the flange size, class or grade of iron, and fluid temperature. ANSI B16.1 covers both flanges and flanged fittings for service at both ambient and elevated temperatures.

ASME B16.1 also describes class 250 flanges that are heavier, have a larger bolt circle, and use larger bolts than class 125 flanges or the flanges described in ANSI/AWWA C115/A21.15 and ANSI/AWWA C110/A21.10. Class 250 flanges will not bolt to ASME B16.1, class 125, ANSI/AWWA C115/A21.15, or ANSI/AWWA C110/A21.10 flanges. (See the example illustrated in Figure F.1.)

Dimensions of ANSI/AWWA C115/A21.15 flanges correspond to those of ANSI/AWWA C207, class E flanges. They also have the same outside diameter (OD); bolt circle diameter; and number of bolts as ANSI/AWWA C207, class B and D flanges, but bolt sizes and holes or flange thicknesses are different. Also, they will not match ANSI/AWWA C207, class F flanges.

II.C. *Advisory Information.* Purchasers of pipe conforming to this standard are advised that the purchaser's specification or purchase order should address delivery

* ASME B16.1, Cast-Iron Pipe Flanges and Flanged Fittings. Available from ASME International, Three Park Avenue, New York, NY 10016.

† The 250-psi joint rating is dependent on gaskets, installation, and other factors beyond the scope of this standard and has evolved over an extended period of time of satisfactory performance. This rating was developed prior to the use of ductile-iron flanges. Ductile-iron pipe with ductile-iron, screwed-on flanges can now be rated for a working pressure of 350 psi for 24-in. and smaller sizes, and 250 psi for 30-in. to 64-in. sizes. A surge allowance of 100 psi may be added to these working pressures. Refer to ANSI/AWWA C150/A21.50 for calculation methods for pipe barrels. Special gaskets are required for flanged joints with working pressures above 250 psi. Note that the strength of all ductile-iron flanges will be greater than that of gray-iron flanges.

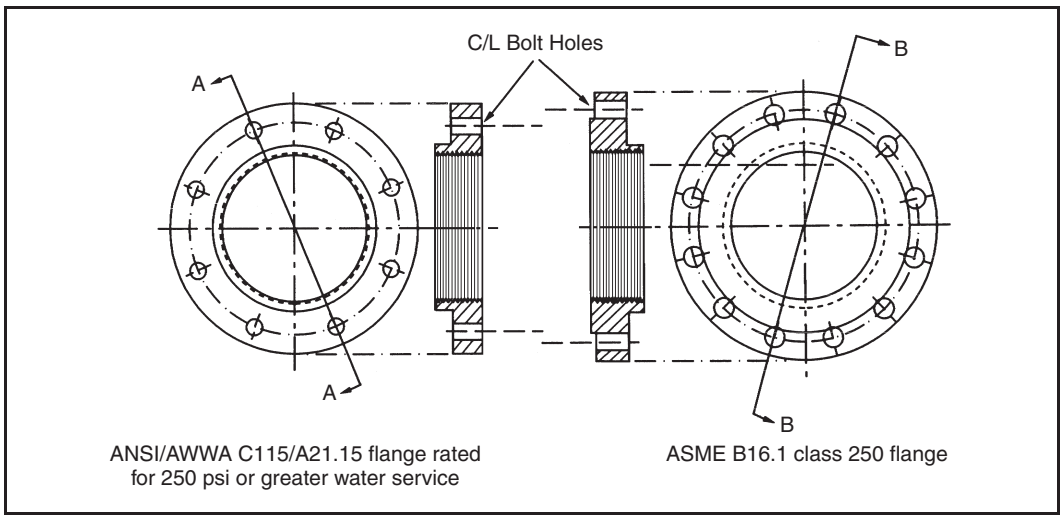


Figure F.1 Comparison of flange dimensions

instructions and acceptance. Normally, the purchaser examines the pipe at the point of delivery to verify conformance with the specification or purchase order and inspects for damage. The purchaser should carefully document any nonconformance or damage and promptly notify the appropriate parties (manufacturer, fabricator, supplier, carrier, etc.), because these parties may not be liable if nonconformance or damage is discovered later. The purchaser should also require the carrier's agent to record shortages or damage on the delivery receipt prior to leaving the point of delivery.

This standard defines both manufacturer and fabricator. A manufacturer may manufacture the pipe or the flange and fabricate the finished product and, therefore, be identified by both terms. A fabricator may procure the pipe and flanges and fabricate the finished product and, therefore, would not be labeled a manufacturer for the purposes of this standard.

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.* The following items should be provided by the purchaser:

1. Standard used—that is, ANSI/AWWA C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges, of latest revision.
2. Required information
   a. Size.
   b. Finished length.
   c. Linings.

1) Cement–mortar lining (Sec. 4.5.2). Experience has indicated that asphaltic inside coating is not complete protection against loss in pipe capacity because of tuberculation. Cement–mortar linings are recommended for most waters.

2) Asphaltic lining (Sec. 4.5.3).

3) Special linings (Sec. 4.5.5).

4) No lining.

d. Working pressure, if higher than 250 psi.

e. Details of other federal, state or provincial, and local requirements (Sec. 4.1.1).

f. For applications other than potable water, whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required (Sec. 4.1.2).

3. Optional information.

a. Pipe wall thickness, if greater than shown in Table 1 of the standard (Sec. 1.1).

b. Solid or hollow-back flange (Sec. 4.3.1).

c. Type of material to be used in the flanges (Sec. 4.3.3).

d. Flanges tapped for studs and stud bolt dimensions (Sec. 4.3.4).

e. Bolt-hole alignment (Sec. 4.4.4).

f. Outside coating (Sec. 4.5.1).

g. Special coatings (Sec. 4.5.5).

h. Inspection by purchaser (Sec. 5.2.1). If the purchaser wishes to inspect flanged pipe at the manufacturer's or fabricator's plant, the purchaser shall specify the conditions (such as time and the extent of inspection) under which the inspection shall be made.

i. Affidavit of compliance (Sec. 5.3). If required by the purchaser, the manufacturer or fabricator shall provide an affidavit of compliance that the flanged pipe complies with the requirements of this standard.

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

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

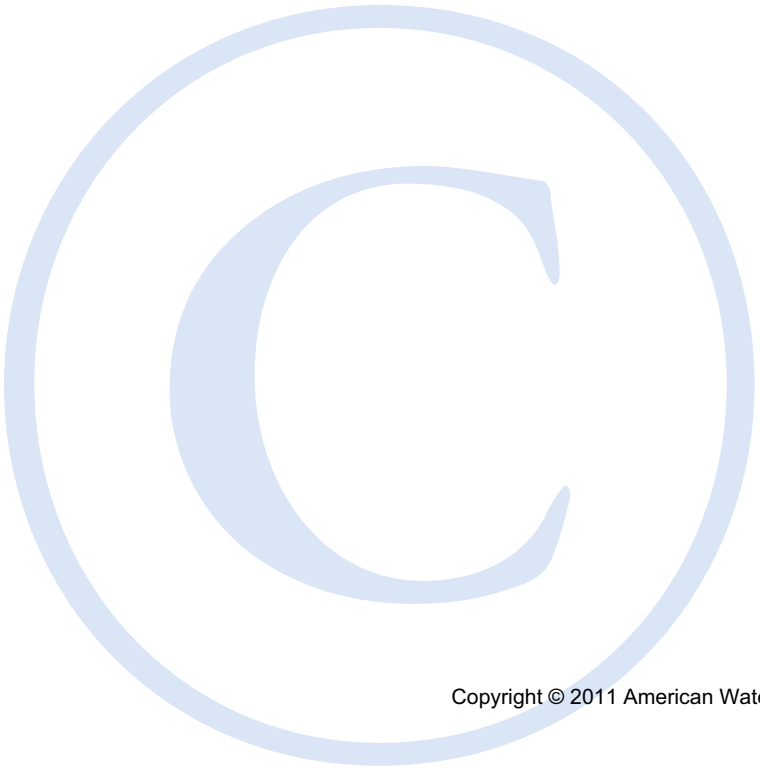
1. The scope of the standard was revised to include wastewater and reclaimed water (Sec. 1.1).

2. A new Sec. 4.1.2, Certification, was added to include a requirement for NSF/ANSI 61 certification on products if they will be in contact with potable water.

3. Standards Council language was added for a new section on permeation (Sec. 4.1.3)

4. Descriptions of asphaltic coating and lining were revised in Sec. 4.5.1, Outside coating, and Sec. 4.5.3, Asphaltic lining.

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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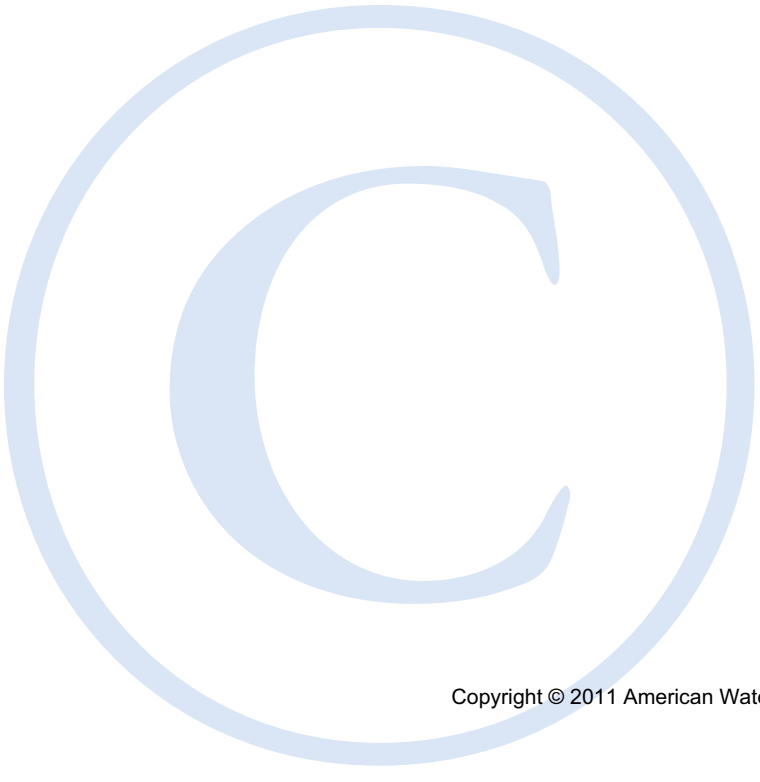


ANSI/AWWA C115/A21.15-11
(Revision of ANSI/AWWA C115/A21.15-05)

American Water Works Association

AWWA Standard

Flanged Ductile-Iron Pipe With Ductile-Iron or Gray-Iron Threaded Flanges

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes 3-in. through 64-in. (80-mm through 1,600-mm) flanged ductile-iron pipe with ductile-iron or gray-iron threaded flanges for potable water, wastewater, and reclaimed water service. Flanged pipe and flanges are rated for a maximum working pressure of 250 psi (1,720 kPa). However, 24-in. (600-mm) and smaller flanged joints with ductile-iron flanges may be rated for a maximum working pressure of 350 psi (2,413 kPa), as noted in the footnote of Table 1.

Sec. 1.2 Purpose

The purpose of this standard is to provide the minimum requirements for flanged ductile-iron pipe with ductile-iron or gray-iron threaded flanges.

Sec. 1.3 Application

This standard or sections of this standard can be referenced in documents for purchasing and receiving flanged ductile-iron pipe. This standard can be used as a guide for casting, fabricating, and inspecting flanged ductile-iron pipe. The stipulations of this standard apply when this document has been referenced and only to flanged ductile-iron pipe with ductile-iron or gray-iron threaded flanges.

SECTION 2: REFERENCES

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

ANSI*/AWWA C104/A21.4—Cement–Mortar Lining for Ductile-Iron Pipe and Fittings.

ANSI/AWWA C110/A21.10—Ductile-Iron and Gray-Iron Fittings.

ANSI/AWWA C111/A21.11—Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.

ANSI/AWWA C151/A21.51—Ductile-Iron Pipe, Centrifugally Cast.

ANSI/AWWA C207—Steel Pipe Flanges for Waterworks Service—Sizes 4 In. Through 144 In. (100 mm Through 3,600 mm).

ASME† B1.20.1—Pipe Threads, General Purpose, Inch.

ASME B16.1—Cast-Iron Pipe Flanges and Flanged Fittings.

ASME B16.5—Pipe Flanges and Flanged Fittings: NPS ½ through 24. (Note: This standard includes class 150, 300, 400, 600, 900, 1,500, and 2,500 flanges.)

NSF/ANSI 61, Drinking Water System Components—Health Effects.

Shigley, Joseph. *Mechanical Engineering Design*. McGraw-Hill. New York, NY.

SECTION 3: DEFINITIONS

The following definitions shall apply in this standard:

1. *Ductile iron:* A cast ferrous material in which a major part of the carbon content occurs as free graphite in a substantially nodular or spheroidal form.

2. *Fabricator:* The party, other than the manufacturer, that fabricates products.

3. *Gray iron:* A cast ferrous material in which a major part of the carbon content occurs as free graphite in the form of flakes interspersed throughout the metal.

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

* American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.
† ASME International, Three Park Avenue, N.W., New York, NY 10016.

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

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

7. *Purchaser's representative:* The representative of the purchaser, authorized to inspect on behalf of the purchaser to determine whether or not the flanged pipe meets the requirements of this standard.

8. *Reclaimed water:* Wastewater that becomes suitable for beneficial use as a result of treatment.

9. *Supplier:* The party that supplies materials or services. A supplier may or may not be the manufacturer.

10. *Wastewater:* A combination of the liquid and water-carried waste from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and stormwater that may be present.

SECTION 4: REQUIREMENTS

Sec. 4.1 Material

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

4.1.2 *Certification.* Products intended for contact with potable water shall be certified to the requirements of NSF/ANSI 61. Certification shall be accomplished by a certification organization accredited by the American National Standards Institute (ANSI).

4.1.3 *Permeation.* The selection of materials is critical for potable water, wastewater, and reclaimed 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 used in jointing gaskets and packing glands, are subject to permeation by low-molecular-weight organic solvents or petroleum products. If a potable water, wastewater, or reclaimed 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 material, and so on, *before* selecting materials for use in that area.

Sec. 4.2 Pipe Barrel

4.2.1 *Manufacturing standards.* Ductile-iron pipe barrels shall conform to the requirements of ANSI/AWWA C151/A21.51.

4.2.2 *Nominal thicknesses.* The nominal wall thicknesses of ductile-iron flanged pipe shall not be less than those shown in Table 1.

4.2.3 *Pipe threads.* Threads on the pipe barrel shall be taper pipe threads in accordance with ASME B1.20.1, adapted to the ductile-iron pipe outside diameters (OD) shown in Table 1.

Table 1 Ductile-iron pipe for use with threaded flanges

Nominal Pipe Size *in.*	Maximum Working Pressure *psi*	Pipe Nominal Thickness* *in.*	Pipe OD *in.*	Weight—*lb*		
				Pipe Barrel per ft	One Solid Flange† Only	One Hollow-Back Flange† Only
3	250‡	0.31	3.96	10.9	7	5
4	250‡	0.32	4.80	13.8	11	9
6	250‡	0.34	6.90	21.4	14	11
8	250‡	0.36	9.05	30.1	27	18
10	250‡	0.38	11.10	39.2	32	27
12	250‡	0.40	13.20	49.2	47	38
14	250‡	0.42	15.30	60.1	72	50
16	250‡	0.43	17.40	70.1	90	66
18	250‡	0.44	19.50	80.6	90	73
20	250‡	0.45	21.60	91.5	115	92
24	250‡	0.47	25.80	114.4	160	127
30	250	0.51	32.00	154.4	240	176
36	250	0.58	38.30	210.3	350	275
42	250	0.65	44.50	274.0	500	—
48	250	0.72	50.80	346.6	625	—
54	250	0.81	57.56	441.9	670	—
60	250	0.83	61.61	485.0	1,035	—
64	250	0.87	65.67	542.0	1,510	—

Metric conversions: Dimensions: in. × 25.4 = mm; Pressure rating: psi × 6.895 = kPa; Weight: lb × 0.4536 = kg.
NOTE: The nominal thicknesses of ductile-iron flanged pipe shall not be less than those shown in this table.
*Nominal thicknesses of 3- to 54-in. pipe correspond to Special Thickness Class 53, and nominal thicknesses of 60- and 64-in. pipe correspond to Pressure Class 350, as shown in ANSI/AWWA C151/A21.51.
†Flange weights shown are for information only. See manufacturer's catalog.
‡Flange joints with ductile iron flanges in the 24-in. and smaller sizes may be rated for 350 psi (2,413 kPa) with the use of special gaskets whose rating is supported by performance testing as described in Sec. 4.5 of ANSI/AWWA C111/A21.11. Check with manufacturer.

Sec. 4.3 Flanges

4.3.1 *Dimensions.* Flanges shall conform to the dimensions shown in Table 2 or 3 and Figure 1 or 2. Unless otherwise specified by the purchaser, 3-in. through 36-in. (80-mm through 900-mm) flanges may be either solid or hollow-back. Flanges 42 in. through 64 in. (1,050 mm through 1,600 mm) are solid only.

Table 2 Solid gray- or ductile-iron flange dimensions

Nominal Pipe Size *in.*	OD *in.*	BC *in.*	T *in.*	Weight* One Flange Only *lb*	Bolt Hole Diameter *in.*	Bolt Diameter and Length† *in.*	Min Length† Stud Bolts *in.*	Number of Bolts
3	7.50	6.00	0.75 ± 0.12	7	¾	⅝ × 2½	2¼	4
4	9.00	7.50	0.94 ± 0.12	11	¾	⅝ × 3	2½	8
6	11.00	9.50	1.00 ± 0.12	14	⅞	¾ × 3½	3	8
8	13.50	11.75	1.12 ± 0.12	27	⅞	¾ × 3½	3	8
10	16.00	14.25	1.19 ± 0.12	32	1	⅞ × 4	3¼	12
12	19.00	17.00	1.25 ± 0.12	47	1	⅞ × 4	3¼	12
14	21.00	18.75	1.38 ± 0.19	72	1⅛	1 × 4½	3¾	12
16	23.50	21.25	1.44 ± 0.19	90	1⅛	1 × 4½	3¾	16
18	25.00	22.75	1.56 ± 0.19	90	1¼	1⅛ × 5	4¼	16
20	27.50	25.00	1.69 ± 0.19	115	1¼	1⅛ × 5	4¼	20
24	32.00	29.50	1.88 ± 0.19	160	1⅜	1¼ × 5½	4½	20
30	38.75	36.00	2.12 ± 0.25	240	1⅜	1¼ × 6½	5	28
36	46.00	42.75	2.38 ± 0.25	350	1⅝	1½ × 7	5¾	32
42	53.00	49.50	2.62 ± 0.25	500	1⅝	1½ × 7½	6	36
48	59.50	56.00	2.75 ± 0.25	625	1⅝	1½ × 8	6⅛	44
54	66.25	62.75	3.00 ± 0.25	670	2	1¾ × 8½	6⅞	44
60	73.00	69.25	3.12 ± 0.25	1,035	2	1¾ × 9	7	52
64‡	80.00	76.00	3.38 ± 0.25	1,510	2	1¾ × 9	7¼	52

Metric conversions: Dimensions: in. × 25.4 = mm; Weight: lb × 0.4536 = kg.

*Flange weights shown are for information only. See manufacturer's catalog.

†With maximum flange thicknesses and minimum-length bolts, bolt ends may be recessed as many as two threads short of nut faces. This condition has existed for several years. This is an acceptable condition and will not adversely affect the strength or serviceability of the joint. *Mechanical Engineering Design* notes that engagement of only three threads is required; however, it is recommended that at least half the threads of the nut be engaged.

‡The dimensions of 64-in. flanges correspond with applicable dimensions of 66-in. class E flanges in ANSI/AWWA C207, and 64-in. ductile-iron flanges can be connected to those flanges.

Table 3 Hollow-back ductile-iron flange dimensions

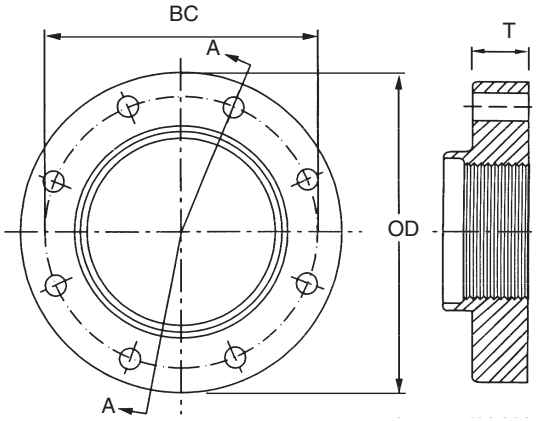
Nominal Pipe Size *in.*	OD *in.*	BC *in.*	T *in.*	T1 Min. *in.*	T2 Min. *in.*	T3 Min. *in.*	T4 Min. *in.*	Weight* One Ductile-Iron Flange Only *lb*	Bolt Hole Diameter *in.*	Bolt Diameter and Length† *in.*	Min. Length† Stud Bolts *in.*	Number of Bolts
3	7.50	6.00	0.75 + 0.12	0.38	0.24	0.20	0.21	5	¾	⅝ × ½	2¼	4
4	9.00	7.50	0.94 + 0.12	0.44	0.24	0.20	0.24	9	¾	⅝ × 3	2½	8
6	11.00	9.50	1.00 + 0.12	0.50	0.25	0.25	0.28	11	⅞	¾ × 3½	3	8
8	13.50	11.75	1.12 + 0.12	0.56	0.25	0.25	0.28	18	⅞	¾ × 3½	3	8
10	16.00	14.25	1.19 + 0.12	0.59	0.25	0.25	0.32	27	1	⅞ × 4	3¼	12
12	19.00	17.00	1.25 + 0.12	0.62	0.25	0.32	0.32	38	1	⅞ × 4	3¼	12
14	21.00	18.75	1.38 + 0.19	0.69	0.25	0.35	0.35	50	1⅛	1 × 4½	3¾	12
16	23.50	21.25	1.44 + 0.19	0.72	0.25	0.35	0.35	66	1⅛	1 × 4½	3¾	16
18	25.00	22.75	1.56 + 0.19	0.78	0.25	0.37	0.37	73	1¼	1⅛ × 5	4¼	16
20	27.50	25.00	1.69 + 0.19	0.84	0.25	0.37	0.37	92	1¼	1⅛ × 5	4¼	20
24	32.00	29.50	1.88 + 0.19	0.94	0.25	0.44	0.37	127	1⅜	1¼ × 5½	4½	20
30	38.75	36.00	2.12 + 0.25	1.06	0.25	0.44	0.51	176	1⅜	1¼ × 6½	5	28
36	46.00	42.75	2.38 + 0.25	1.18	0.25	0.44	0.51	275	1⅝	1¼ × 7	5¾	32

(Not Applicable for Gray-Iron Flanges)

Metric conversions: Dimensions: in. × 25.4 = mm; Weight: lb × 0.4536 = kg.

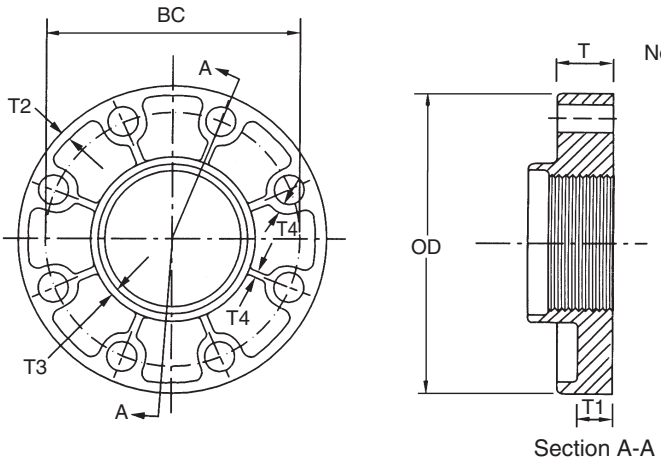
*Flange weights shown are for information only. See manufacturer's catalog.

†With maximum flange thicknesses and minimum-length bolts, bolt ends may be recessed as many as two threads short of nut faces. This condition has existed for several years. This is an acceptable condition and will not adversely affect the strength or serviceability of the joint. *Mechanical Engineering Design* notes that engagement of only three threads is required; however, it is recommended that at least half of the threads of the nut be engaged.



NOTE: Facing: Flanges are flat-faced and are fabricated smooth or with shallow serrations.
Back facing: Flanges may be back-faced or spot-faced for compliance with the flange thickness tolerances.
Flanges: The flanges are adequate for water service of 250 psi (1,720 kPa) or greater working pressure. The bolt circle and bolt holes of these flanges match those of ASME B16.1, class 125 flanges, and can be joined with class 125 flanges or with ASME B16.5, class 150 flanges, none of which are compatible with ASME B16.1, class 250 flanges (see Foreword).

Figure 1 Solid flange details (see Table 2)



NOTE: Facing: Flanges are flat-faced and are fabricated smooth or with shallow serrations.
Flanges: The flanges are adequate for water service of 250 psi (1,720 kPa) or greater working pressure. The bolt circle and bolt holes of these flanges match those of ASME B16.1, class 125 flanges, and can be joined with class 125 flanges or with ASME B16.5, class 150 flanges, none of which are compatible with ASME B16.1, class 250 flanges (see Foreword).
Hollow-back flanges shall be ductile iron only.

Figure 2 Hollow-back flange details (see Table 3)

4.3.2 *Flange threads.* Flanges shall have an internal taper pipe thread in accordance with ASME B1.20.1, adapted to the ductile-iron pipe OD shown in Table 1.

4.3.3 *Material properties.* Unless otherwise specified by the purchaser, solid flanges may be cast of either ductile iron or gray iron. Hollow-back flanges shall be ductile iron only. Flanges shall conform to the respective chemical and physical properties for gray-iron and ductile-iron fittings, according to ANSI/AWWA C110/A21.10.

4.3.4 *Bolt holes.* Bolt holes shall be in accordance with the dimensions shown in Table 2 or 3. The bolt holes shall be equally spaced. If specified by the

purchaser, flanges shall be drilled and tapped for studs. Stud bolts shall have the same dimensions as shown for regular bolts in Tables 2 and 3, except shorter lengths may be provided as shown.

Sec. 4.4 Fabrication

4.4.1 *Assembly.* Both flange and pipe threads shall be clean before applying thread compound. The thread compound shall give adequate lubrication and sealing properties to provide pressure-tight joints. Threaded flanges shall be individually fitted and machine tightened on the threaded pipe at the point of fabrication.

NOTE: Flanges are not interchangeable in the field.

4.4.2 *Pipe threads.* Threads may extend beyond the shroud or hub of the flange.

4.4.3 *Facing.* Flange and pipe ends shall be faced after final tightening of the flange. Flanges shall be flat-faced and shall be fabricated smooth or with shallow serrations. Flanges may be back-faced or spot-faced for compliance with the flange thickness tolerance described in this standard. Bearing surfaces for bolting shall be parallel to the flange face within 3°.

4.4.4 *Flange alignment.* Unless otherwise specified, when pipe is provided with two flanges, the bolt holes shall be aligned. Misalignment of corresponding bolt holes of the two flanges shall not exceed 0.12 in. (3.05 mm) measured from like points on the bolt holes. The machined flange faces shall be perpendicular to the pipe centerline and shall be parallel such that any two face-to-face dimensions 180° apart at the flange OD shall not differ by more than 0.06 in. (1.5 mm).

4.4.5 *Finished pipe length.* Flanged pipe shall be provided in the lengths specified by the purchaser. When pipe is fabricated with two flanges, the face-to-face dimensions shall be the specified length ±0.12 in. (±3.05 mm). The overall length of flange and plain-end pipe shall be the specified length ±0.25 in. (±6.35 mm).

4.4.6 *Finished pipe/flange weight.* The actual weight of any single pipe shall not be less than the calculated weight by more than 10 percent. The weight of any single flange shall not be less than the flange manufacturer's tabulated weight by more than 10 percent.

Sec. 4.5 Coatings and Linings

4.5.1 *Outside coating.* Unless otherwise specified by the purchaser, the outside coating of all pipe shall be an asphaltic cutback, asphaltic emulsion, modified asphaltic, or a hybrid asphaltic coating approximately 1 mil (25 μm) thick. The

finished coating* shall be continuous, smooth, neither brittle when cold nor sticky when exposed to the sun, and shall adhere strongly to the pipe.

4.5.2 *Cement–mortar linings.* If specified by the purchaser, cement–mortar linings shall be provided in accordance with ANSI/AWWA C104/A21.4.

4.5.3 *Asphaltic lining.* If specified by the purchaser, asphaltic cutback, asphaltic emulsion, modified asphaltic, or hybrid asphaltic linings shall be approximately 1 mil (25 μm) thick, and shall conform to all appropriate requirements for seal coat in ANSI/AWWA C104/A21.4.

4.5.4 *Flange coatings.* A rust-preventive coating shall be applied to the machined faces of the flanges. The rust-preventive coating shall be soluble in solvent for ready removal before pipe installation. Unless otherwise specified, the back of the flanges and the bolt holes shall be coated with standard outside coating (Sec. 4.5.1).

4.5.5 *Special coatings and linings.* For special conditions, other types of coatings and linings may be available. Special coating and lining requirements shall be specified by the purchaser. Uncoated or unlined pipe are recommended when special coatings or linings are to be applied unless otherwise recommended by the coating or lining manufacturer.

Sec. 4.6 Marking

The length and weight shall be shown on each pipe. The flange manufacturer's mark, size, and the letters "DI" (if ductile iron) or "GI" (if gray iron) shall be cast or stamped on the flanges. These markings shall be cast or stamped on the back face of the flange. If the fabricator is other than the flange manufacturer, the fabricator's mark shall be stamped with a metal die on each flange after assembly. The fabricator's mark shall be located on the OD of the flange close to the size marking.

SECTION 5: VERIFICATION

Sec. 5.1 Quality Control and Inspection

5.1.1 *Freedom from defects.* Flanged pipe shall be clean and sound without defects that would impair its service. Repairing defects by welding or other methods will not be allowed if these repairs will adversely affect the serviceability

* The adherent qualities of asphaltic coating to ductile-iron pipe render such piping unsuitable for the subsequent application of special coatings (Sec. 4.5.5). Asphaltic coating is difficult to remove once applied, and attempts to do so by such methods as sand or shot blasting may damage the pipe surface.

of the flanged pipe or its ability to comply with the strength requirements of this standard.

Sec. 5.2 Inspection by Purchaser

5.2.1 *In-plant inspection.* If in-plant inspection is stipulated by the purchaser (see foreword, Sec. III.A, Purchaser Options and Alternatives, item 3h), the purchaser's representative shall have free access to those parts of the facility where the flanged pipe is fabricated that are necessary for inspection purposes regarding products described in this standard. Gauges necessary for inspection shall be made available as well as any assistance necessary for the handling of pipe.

Sec. 5.3 Affidavit of Compliance

The purchaser may require an affidavit from the manufacturer, supplier, or fabricator that the flanged pipe provided complies with applicable requirements of this standard.

SECTION 6: DELIVERY

This standard has no applicable information for this section. See Sec. II.C of the foreword for general information concerning delivery requirements.

APPENDIX A

Bolts and Nuts, Gaskets, and Installation

This appendix is for information only and is not part of ANSI/AWWA C115/A21.15.

The bolts and gaskets to be used with flanged pipe are to be selected by the purchaser with consideration for the particular pressure-service and installation requirements.

SECTION A.1: BOLTS AND NUTS*

Size, length, and number of bolts are shown in Tables 2 and 3 of ANSI/AWWA C115/A21.15. Bolts conform to ASME† B18.2.1, Square and Hex Bolts and Screws (Inch Series) Including Hex Cap Screws and Lag Screws. Nuts conform to ASME B18.2.2, Square and Hex Nuts (Inch Series). Bolts may have either square or hex heads and either hex or heavy hex nuts. Bolts and nuts used with gray-iron flanges should have standard square or heavy hex bolts and heavy hex nuts. Bolts and nuts are threaded in accordance with ASME B1.1, Unified Inch Screw Threads (UN and UNR Thread Form), class 2A, external, and class 2B, internal. Bolts and nuts of low-carbon steel conforming to the chemical and mechanical requirements of ASTM‡ A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength, are suitable for use with the flanges described in ANSI/AWWA C115/A21.15 when used with the rubber gaskets described in this appendix. Higher-strength (Grade A) bolts and higher torque values should not be used with gray-iron flanges.

SECTION A.2: GASKETS

Unless otherwise specified by the purchaser, gaskets shall be synthetic rubber, either ring or full face, and ⅛-in. (3.18-mm) thick. Gaskets should conform to the dimensions shown in Table A.1. When considering the use of gaskets

* These requirements apply when applicable to both square or hex head bolts or to stud bolts.
† ASME International, Three Park Avenue, New York, NY 10016.
‡ ASTM International, 100 Barr Harbor Drive, West Conshohocken, PA 19428.

Table A.1 Flange gasket details

Nominal Pipe Size *in.*	ID *in.*	OD *in.*	ID *in.*	OD *in.*	BC *in.*	Bolt Hole Diameter *in.*	Number of Holes
3	3	5 3/8	3	7 1/2	6	3/4	4
4	4	6 7/8	4	9	7 1/2	3/4	8
6	6	8 3/4	6	11	9 1/2	7/8	8
8	8	11	8	13 1/2	11 3/4	7/8	8
10	10	13 3/8	10	16	14 1/4	1	12
12	12	16 1/8	12	19	17	1	12
14	14	17 3/4	14	21	18 3/4	1 1/8	12
16	16	20 1/4	16	23 1/2	21 1/4	1 1/8	16
18	18	21 5/8	18	25	22 3/4	1 1/4	16
20	20	23 7/8	20	27 1/2	25	1 1/4	20
24	24	28 1/4	24	32	29 1/2	1 3/8	20
30	30	34 3/4	30	38 3/4	36	1 3/8	28
36	36	41 1/4	36	46	42 3/4	1 5/8	32
42	42	48	42	53	49 1/2	1 5/8	36
48	48	54 1/2	48	59 1/2	56	1 5/8	44
54	54	61	54	66 1/4	62 3/4	2	44
60	60	67 1/2	60	73	69 1/4	2	52
64	64	74 1/4	64	80	76	2	52

Metric conversions: Dimensions: in. × 25.4 = mm

thinner than 1/8 in. (3.18 mm) or gaskets of materials other than synthetic rubber, the purchaser should contact the pipe manufacturer or fabricator concerning the suitability of the gasket for a particular application. Also available for most sizes are specially designed gaskets, either ring or full-faced, employing one or more annular rings molded into the gasket to improve joint performance. By using these or other special gaskets, it may be possible to obtain a pressure rating greater than 350 psi (2,413 kPa) in the 24-in. (600-mm) and smaller sizes and greater than 250 psi (1,720 kPa) in the 30-in. (750-mm) and larger sizes. Contact the pipe manufacturer or fabricator for details.

SECTION A.3: INSTALLATION

The purchaser is responsible for the design, assembly, and installation of the flanged piping system. The following suggestions are for general guidance:

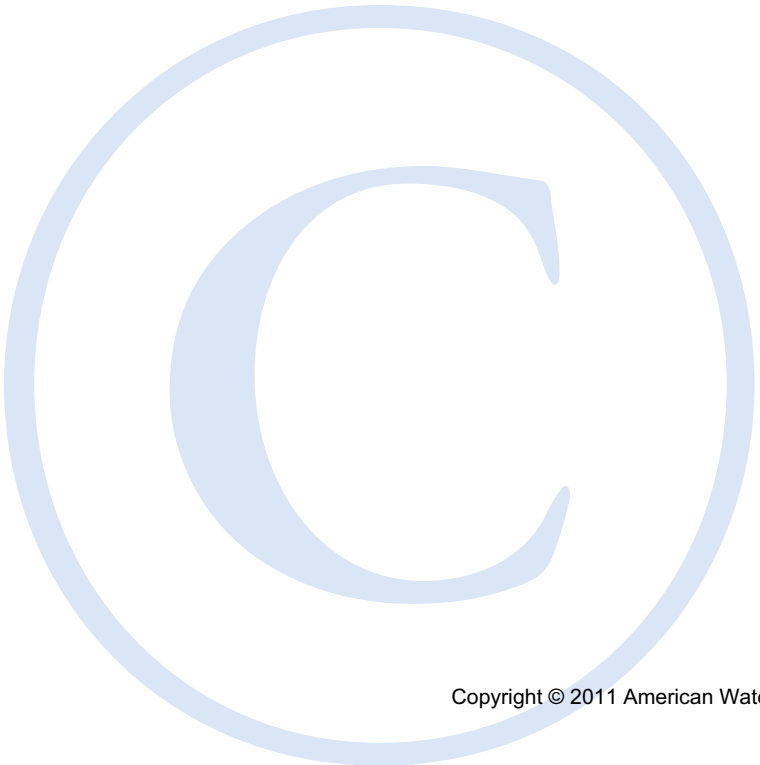
1. The use of flanged joints underground is generally not recommended because of the rigidity of the joint.

2. Flanged faces should bear uniformly on the gasket, and the bolts should be tightened in a progressively crisscrossed pattern, such as by tightening the bottom bolt first; then, the top bolt; next, the bolts at either side; and finally, the remaining bolts. This process should be repeated until all bolts are adequately tightened.

3. Users of flanged piping should be careful to prevent bending or torsional strains from being applied to flanges or flanged appurtenances. Piping systems must be designed so that piping connected to flanges is properly anchored, supported, or restrained to prevent breakage of flanges and flanged fittings or appurtenances.

4. Ring gaskets are recommended for 14-in. (350-mm) and larger sizes if flat gaskets are used.

5. Impact wrenches cannot be used in many cases when assembling flanged joints due to the many variations of flange shroud diameters and impact wrench socket dimensions, in combination with nut configurations (heavy or regular hex).



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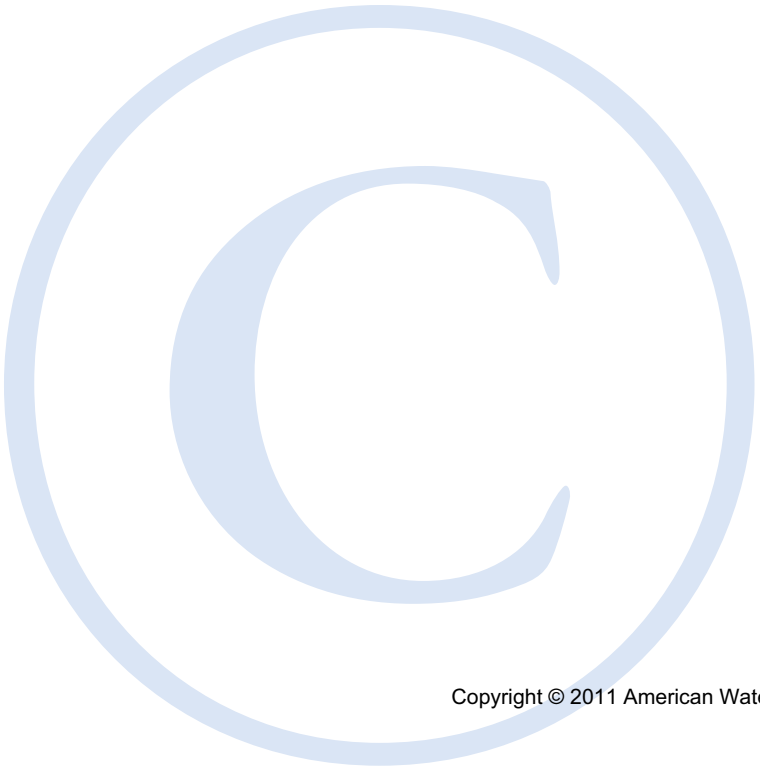

APPENDIX B

Typical Pipe and Flange Thread Construction

This appendix is for information only and is not part of ANSI/AWWA C115/A21.15.

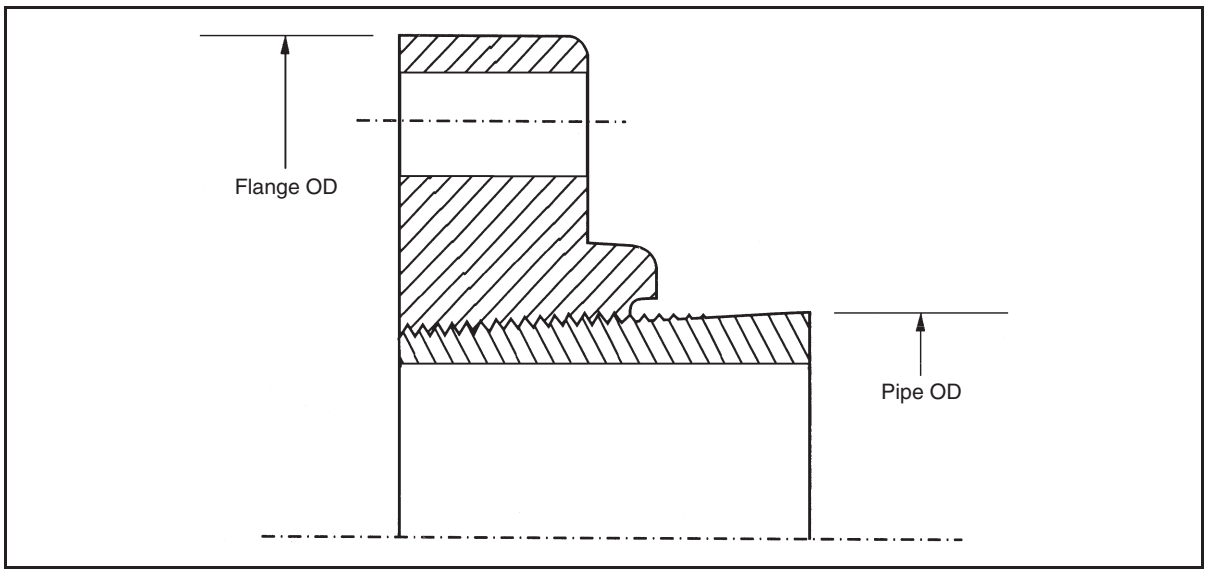

Figure B.1 Typical pipe and flange thread construction

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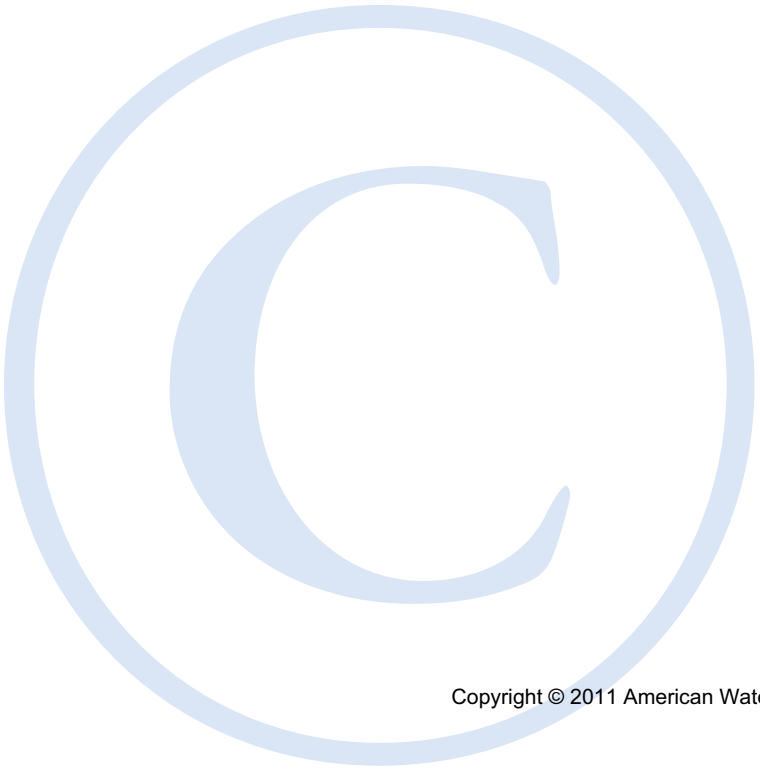

APPENDIX C

Wall Pipe

This appendix is for information only and is not part of ANSI/AWWA C115/A21.15.

SECTION C.1: SERVICE

Flanged ductile-iron pipe may be further fabricated to produce wall pipe. Wall pipe employs wall collars whose primary function is to control seepage along the outside of the pipe through the concrete wall. These collars are commonly referred to as waterstops or seep rings. They are not designed for thrust restraint. Collars for thrust restraint require different design considerations and are not discussed in this standard. During construction, wall pipes are generally placed into forms, and concrete is poured and properly consolidated around the pipe to create the embedded wall pipe. Joining pipes may be attached after forms are removed.

SECTION C.2: DIMENSIONS

Recommended minimum wall-collar diameters and thicknesses are shown in Table C.1. If length tolerances are critical, such as for installation of wall pipe completely inside forms, this should be specified by the purchaser.

SECTION C.3: MATERIAL AND FABRICATION

Collars may be fabricated from steel or ductile iron. Collars may be attached to pipe barrels by welding, heat-shrinking, or other means. Field welding of wall collars is not normally recommended. A watertight seal should be achieved between the collar and the pipe barrel.

SECTION C.4: INSTALLATION

Flanges of the wall pipe may be set at a distance from the surface of the wall or may be set flush to the wall surface as shown in Figure C.1. When flanges are

Table C.1 Collar dimensions

Nominal Pipe Size, *in.*	Minimum Collar OD, *in.*	Maximum Collar OD, *in.*
3	6.50	0.250
4	7.40	0.250
6	9.50	0.250
8	12.00	0.250
10	14.05	0.250
12	16.25	0.250
14	18.35	0.250
16	20.95	0.250
18	23.05	0.375
20	25.50	0.375
24	29.85	0.375
30	36.50	0.375
36	43.00	0.375
42	49.50	0.500
48	55.90	0.500
54	62.65	0.500
60	66.70	0.500
64	72.75	0.500

Metric conversions: Dimensions: in. × 25.4 = mm

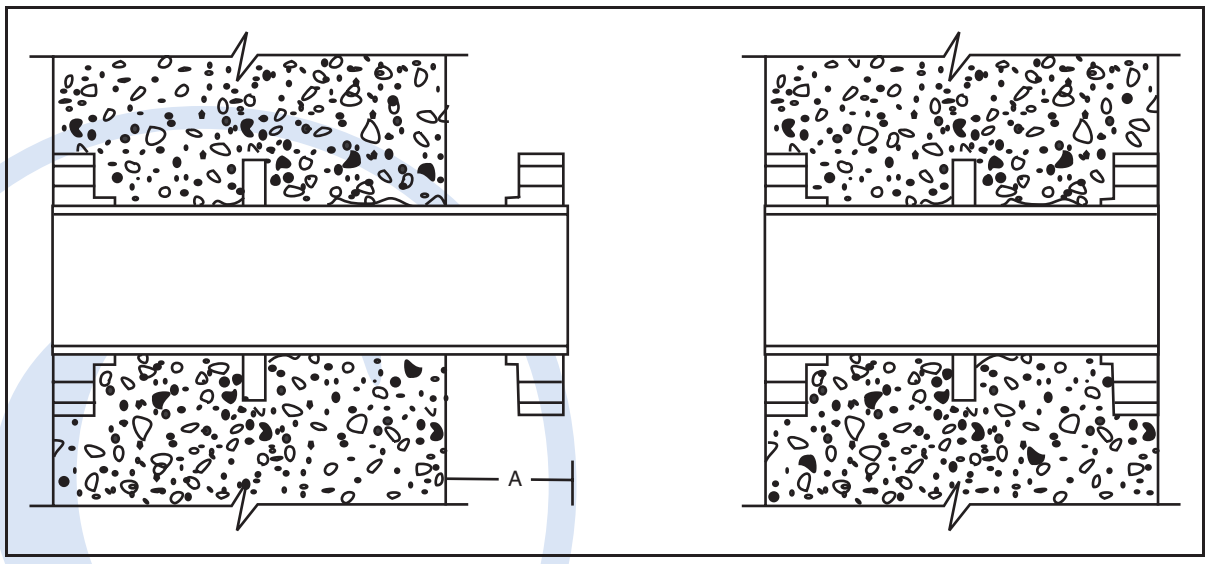

Figure C.1 Typical flanged wall pipe installations (see Table C.2 for "A" dimensions)

Table C.2 Suggested minimum "face-to-wall" dimensions

Diameter *in.*	A *in.*	Diameter *in.*	A *in.*	Diameter *in.*	A *in.*
3	1.75	14	3.00	36	5.25
4	2.25	16	3.00	42	6.00
6	2.25	18	3.25	48	6.50
8	2.50	20	3.50	54	7.25
10	2.50	24	3.75	60	7.25
12	2.50	30	4.75	64	7.25

Metric conversions: Dimensions: in. × 25.4 = mm

set outside the wall for connection with standard length bolts, the suggested minimum "face-to-wall" clearances shown in Table C.2 should be considered. Flanged wall pipe with flanges set flush to the wall surface should have bolt holes tapped for studs to facilitate connections. Appurtenances with tapped holes should not be connected to wall pipe with tapped holes.

In order that flanged piping may be correctly connected to embedded wall pipes, it is necessary that the flanged wall pipe be positioned in the wall such that the bolt holes straddle the horizontal and vertical centerlines.

AWWA is the authoritative resource for knowledge, information, and advocacy to improve the quality and supply of water in North America and beyond. AWWA is the largest organization of water professionals in the world. AWWA advances public health, safety, and welfare by uniting the efforts of the full spectrum of the entire water community. Through our collective strength, we become better stewards of water for the greatest good of people and the environment.

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