ANSI/AWWA C207-13
(Revision of AWWA C207-07)

American Water Works Association

The Authoritative Resource on Safe Water®

AWWA Standard

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

Effective date: June 1, 2013.
First edition approved by AWWA Board of Directors June 17, 1955.
This edition approved Jan. 20, 2013.
Approved by American National Standards Institute March 26, 2013.

6666 West Quincy Avenue
Denver, CO 80235-3098
T 800.926.7337
www.awwa.org

Advocacy
Communications
Conferences
Education and Training
Science and Technology
Sections

AWWA Standard

This document is an American Water Works Association (AWWA) standard. It is not a specification. AWWA standards describe minimum requirements and do not contain all of the engineering and administrative information normally contained in specifications. The AWWA standards usually contain options that must be evaluated by the user of the standard. Until each optional feature is specified by the user, the product or service is not fully defined. AWWA publication of a standard does not constitute endorsement of any product or product type, nor does AWWA test, certify, or approve any product. The use of AWWA standards is entirely voluntary. This standard does not supersede or take precedence over or displace any applicable law, regulation, or codes of any governmental authority. AWWA standards are intended to represent a consensus of the water supply industry that the product described will provide satisfactory service. When AWWA revises or withdraws this standard, an official notice of action will be placed on the first page of the Official Notice section of *Journal - American Water Works Association*. The action becomes effective on the first day of the month following the month of *Journal - American Water Works Association* publication of the official notice.

American National Standard

An American National Standard implies a consensus of those substantially concerned with its scope and provisions. An American National Standard is intended as a guide to aid the manufacturer, the consumer, and the general public. The existence of an American National Standard does not in any respect preclude anyone, whether that person has approved the standard or not, from manufacturing, marketing, purchasing, or using products, processes, or procedures not conforming to the standard. American National Standards are subject to periodic review, and users are cautioned to obtain the latest editions. Producers of goods made in conformity with an American National Standard are encouraged to state on their own responsibility in advertising and promotional materials or on tags or labels that the goods are produced in conformity with particular American National Standards.

CAUTION NOTICE: The American National Standards Institute (ANSI) approval date on the front cover of this standard indicates completion of the ANSI approval process. This American National Standard may be revised or withdrawn at any time. ANSI procedures require that action be taken to reaffirm, revise, or withdraw this standard no later than five years from the date of ANSI approval. Purchasers of American National Standards may receive current information on all standards by calling or writing the American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036; (212) 642-4900, or emailing info@ansi.org.

ISBN-13, print: 978-1-58321-942-3
ISBN-10, print: 1-58321-942-0
eISBN-13, electronic: 978-1-61300-231-5
eISBN-10, electronic: 1-61300-231-9

Committee Personnel

The Steel Water Pipe Manufacturers Technical Advisory Committee (SWPMTAC) Task Group on updating AWWA C207, which developed this standard, had the following personnel at the time:

Mike Vanderbosch, *Chair*
Brent Keil, *Vice-Chair*

General Interest Members

S.A. Arnaout, Hanson Pressure Pipe Inc., Dallas, Texas	(AWWA)
D. Acquistapace, Pacific Coast Flange, Mound House, Nev.	(AWWA)
H.H. Bardakjian, Manufacturer's Consultant, Glendale, Calif.	(AWWA)
E. Bird, Smith-Blair Inc., Texarkana, Texas	(AWWA)
S. Bradberry, Ford-Meter Box Co., Pell City, Ala.	(AWWA)
B. Card, Manufacturer's Consultant, Sugar Hill, Ga.	(AWWA)
A. Collins, JCM Industries, Nash, Texas	(AWWA)
K. Couture, American SpiralWeld Pipe Company, Birmingham, Ala.	(AWWA)
J. Crandall, Garlock, Palmyra, N.Y.	(AWWA)
D. Dechant, Manufacturer's Consultant, Aurora, Colo.	(AWWA)
R. Deremiah, Hanson Pressure Pipe Inc., Dallas, Texas	(AWWA)
M. Fite, Pacific Coast Flange, Mound House, Nev.	(AWWA)
J. Forni, Jifco Inc., Livermore, Calif.	(AWWA)
B.D. Keil, Northwest Pipe Company, Pleasant Grove, Utah	(AWWA)
G. Kohlbeck, Felker Brothers, Marshfield, Wis.	(AWWA)
M. Langenhan, Total Piping Solutions Inc., Olean, N.Y.	(AWWA)
J.L. Luka, American SpiralWeld Pipe Company, Columbia, S.C.	(AWWA)
J. Olmos, Ameron, Rancho Cucamonga, Calif.	(AWWA)
B. Payne, CAB Inc., Nacogdoches, Texas	(AWWA)
D. Piontek, Total Piping Solutions Inc., Olean, N.Y.	(AWWA)
R.N. Satyarthi, Baker Coupling Company Inc., Los Angeles, Calif.	(AWWA)
D. Seals, JCM Industries, Nash, Texas	(AWWA)
K.L. Shaddix, Smith-Blair Inc., Texarkana, Texas	(AWWA)
C. Shelley, Victaulic, Atlanta, Ga.	(AWWA)
B.P. Simpson, American SpiralWeld Pipe Company, Birmingham, Ala.	(AWWA)
G. Tate, Viking Johnson, Hitchin, U.K.	(AWWA)
N. Thogersen, Romac Industries Inc., Bothell, Wash.	(AWWA)

M. Vanderbosch, CAB Inc., Nacogdoches, Texas (AWWA)
B. Vanderploeg, Consultant, Portland, Ore. (AWWA)

The AWWA Standards Committee on Steel Pipe, which reviewed and approved this standard, had the following personnel at the time of approval:

John H. Bambei Jr., *Chair*
Dennis Dechant, *Vice-Chair*
John Luka, *Secretary*

General Interest Members

W.R. Brunzell, Brunzell Associates Ltd., Skokie, Ill. (AWWA)
R.J. Card, Lockwood Andrews & Newnam, Sugar Hill, Ga. (AWWA)
R.L. Coffey, HDR Engineering Inc., Omaha, Neb. (AWWA)
H.E. Dunham, MWH Americas Inc., Bellevue, Wash. (AWWA)
S.N. Foellmi, Black & Veatch Corporation, Irvine, Calif. (AWWA)
R.L. Gibson, Freese and Nichols Inc., Fort Worth, Texas (AWWA)
M.B. Horsley,* Black & Veatch Corporation, Kansas City, Mo. (AWWA)
J.K. Jeyapalan, Pipeline Consultant, New Milford, Conn. (AWWA)
R.A. Kufaas, Norske Corrosion & Inspection Services Ltd., Surrey, B.C. (AWWA)
J.L Mattson, Corrosion Control Technologies, Sandy, Utah (AWWA)
W.J. Moncrief,* HDR Engineering Inc., San Diego, Calif. (AWWA)
E.N. Olson,† Standards Council Liaison, Brown and Caldwell, Gold Hill, Ore. (AWWA)
R. Ortega,* Lockwood Andrews & Newnam, Houston, Texas (AWWA)
E.S. Ralph,† Standards Engineer Liaison, AWWA, Denver, Colo. (AWWA)
A.E. Romer, AECOM, Orange, Calif. (AWWA)
J.R. Snow,* MWH Americas Inc., Denver, Colo. (AWWA)
H.R. Stoner, Consultant, North Plainfield, N.J. (AWWA)
C.C. Sundberg, CH2M HILL Inc., Issaquah, Wash. (AWWA)
W.R. Whidden, Woolpert, Orlando, Fla. (AWWA)

* Alternate
† Liaison, nonvoting

Producer Members

S.A. Arnaout, Hanson Pressure Pipe Inc., Dallas, Texas (AWWA)
H.H. Bardakjian, Consultant, Glendale, Calif. (AWWA)
R.R. Carpenter, American Cast Iron Pipe Company, Birmingham, Ala. (AWWA)
D. Dechant, Dechant Infrastructure Services, Aurora, Colo. (AWWA)
W.B. Geyer, Steel Plate Fabricators Association, Lake Zurich, Ill. (SFPA)
B.D. Keil, Northwest Pipe Company, Pleasant Grove, Utah (AWWA)
J.L. Luka,*American SpiralWeld Pipe Company, Columbia, S.C. (AWWA)
R.D. Mielke,* Northwest Pipe Company, Raleigh, N.C. (AWWA)
J. Olmos, Ameron International, Rancho Cucamonga, Calif. (AWWA)
G.F. Ruchti,* Steel Plate Fabricators Association, Punta Gorda, Fla. (SPFA)
D. Walker, Tnemec Co., Oakville, Ont. (AWWA)
J.A. Wise, Canus International Sales Inc., Surrey, B.C. (AWWA)

User Members

G.A. Andersen, New York City Bureau of Water Supply, Little Neck, N.Y. (AWWA)
J.H. Bambei Jr., Denver Water Department, Denver, Colo. (AWWA)
B. Cheng, Metro Vancouver, Burnaby, B.C. (AWWA)
R.V. Frisz, US Bureau of Reclamation, Denver, Colo. (USBR)
G. George, Tacoma Water, Tacoma, Wash. (AWWA)
T.J. Jordan, Metropolitan Water District of Southern California, La Verne, Calif. (AWWA)
M. McReynolds,* Metropolitan Water District of Southern California, La Mirada, Calif. (AWWA)
G. Oljaca,* Metro Vancouver, Burnaby, B.C. (AWWA)
G.P. Stine, San Diego County Water Authority, Escondido, Calif. (AWWA)
N.A. Wigner, Los Angeles Department of Water & Power, Los Angeles, Calif. (AWWA)
J.V. Young, City of Richmond, Richmond, B.C. (AWWA)

* Alternate

This page intentionally blank.

Contents

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

This page intentionally blank.

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) (150-psi [1,034-kPa] primary pressure rating). The ratings were far higher than those ordinarily needed for water service.

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

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

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

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

will always have flanges of large outside diameter, which cannot be reduced because of 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 in. through 48 in. (150 mm through 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," 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 development history of the flange dimensions found within the standard. After five 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. It is worthwhile to mention that 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% 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 M11. 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 under the title "Tentative Standard Specifications for Steel Pipe Flanges" in 1952. That edition covered diameters from 6 in. to 48 in. (150 mm to 1,200 mm) and pressures through 150 psi (1,034 kPa). In 1954, a committee composed of Taylor Forge, Armco, Bethlehem, and consulting engineers revised the existing standard to include diameters through 96 in. (2,400 mm) and pressures to 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 and revised the maximum test pressure to 125 percent of the flange rating, 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 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 Class 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 Class D and E have been included in a new appendix B for information purposes only. This edition was approved on Jan. 20, 2013.

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 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.

* Persons outside the United States should contact the appropriate authority having jurisdiction.
† NSF International, 789 N. Dixboro Road, Ann Arbor, MI 48105.
‡ American National Standards Institute, 25 West 43rd Street, Fourth Floor, New York, NY 10036.

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.

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. Thus, 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. It should be noted that thickness and dimensional design of ring flanges have been based on references given in the background section of this foreword, as well as industry standard 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.

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

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:

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

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—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.

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

1. A summary of the five years of research of the Steel Pipe Special Flange Task Group regarding the development history of the flange dimensions in the standard was added to the Foreword at the end of Sec. I.A, Background.

2. Hub-type, slip-on flanges were deleted from the scope of the standard (Sec. 1.1), because they are not commonly used in the water industry.

3. The title of Sec. 1.3.2 was changed from Pressure "ratings" to Pressure "limits," and large portions of the section were deleted and rewritten because the information was redundant with the information provided in the tables.

4. A statement was added in Sec. 1.3.2.1, noting that the standard does not take into account external moments resulting from the pipe acting as a beam.

5. Updated Section 2, References.

6. Added definitions for field test pressure, transient pressure, and working pressure to Section 3.

7. Added an elongation requirement to Sec. 4.1.3.1, Flange materials.

8. Sec. 4.1.4, Bolting materials, was rewritten.

9. The use of ASTM A307, grade B, for bolting requirements was deleted from Sec. 4.1.4; however, the design basis for the flange minimum thickness in Table 5, AWWA blind flange thickness, is 7,000-psi allowable bolt stress for Class B and D.

10. Sec. 4.1.5, Gaskets, was rewritten.

11. Added CFG and PTFE gaskets to Table 1.

12. Added notes 1 and 2 below Table 1 providing additional information on gasket materials.

13. Tolerances for hub flanges were deleted from Sec. 4.2.1 because hub flanges are no longer included in the standard.

14. Sec. 6.2, Affidavit of Compliance, was added.

15. Fig. 1, Attachment of flange, was revised to reflect the deletion of hub-type flanges from the standard.

16. Old Tables 3 and 4, AWWA standard steel hub flanges for Class D and E, were removed from the body of the standard and included in a new appendix B for information purposes only, because this type of flange was deleted from the scope of the standard.

17. Maximum pressure (test or transient) at 150% of pressure limits was added to Tables 2, 3, 4, and 5.

18. The format of Table 5, AWWA blind-flange thickness, was revised for consistency, and the footnotes were updated and expanded.

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 email at standards@awwa.org.

This page intentionally blank.

ANSI/AWWA C207-13
(Revision of ANSI/AWWA C207-07)

American Water Works Association
The Authoritative Resource on Safe Water®

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 material 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,