ANSI/AWWA C111/A21.11-17
(Revision of ANSI/AWWA C111/A21.11-12)

American Water Works Association

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AWWA Standard

Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

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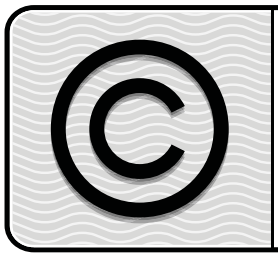

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA C111/A21.11.*

I. Introduction.

I.A. *Background.* Cast-iron pipe was originally made with flanged joints, using lead gaskets. Improved joints of this type are still used for many aboveground plant installations and other specialized applications.

The bell-and-spigot joint was developed in 1785 and extensively used until the 1950s. This joint was assembled by caulking yarn or braided hemp into the base of the annular bell cavity and then pouring molten lead into the remaining space inside the bell. Upon solidification, the lead was compacted by caulking, thus effecting a watertight seal. Materials other than lead have also been used to confine yarn or hemp in the base of the bell cavity.

The mechanical joint was developed for gas industry use in the late 1920s but has since been used extensively in the water industry. This joint has standardized dimensions and uses the basic principle of the stuffing box and gland, with a rubber gasket being compressed by the gland.

The roll-on joint was developed in 1937 and was used for approximately 20 years before its manufacture was discontinued. Assembly of this joint involved a compressed rubber gasket rolled under a restriction ring, followed by caulked square braided jute. The remainder of the joint was packed with a bituminous compound.

The push-on joint was developed in 1956 and represented an important advancement in the water distribution field. This joint consists of a single rubber gasket placed in a groove inside the socket at the bell end of the pipe. After lubricating the joint in accordance with the manufacturer's instructions, the plain end of the pipe is pushed through the gasket, compressing it and forming a pressure-tight seal. Assembly of the push-on joint is simple and fast. Large bell holes are not required for this joint, and it can be assembled under wet-trench conditions or even underwater.

Several special joints are available. These joints include ball and socket for submarine or stream crossings, plain-end coupled, threaded and coupled, and other variations of restrained joints

I.B. *History.* American National Standards Committee A21 on Cast-Iron Pipe and Fittings was organized in 1926 under the sponsorship of the American Gas

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

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 cosecretariats were AGA, AWWA, and NEWWA, with AWWA serving as administrative secretariat. In 1984, the committee became an AWWA committee titled AWWA Standards Committee A21 on Ductile-Iron Pipe and Fittings.

The present scope of Committee A21 activity is to develop standards and manuals that address ductile-iron pressure pipe for water supply service and ductile-iron and gray-iron fittings for use with this pipe. These standards and manuals include design, dimensions, materials, coatings, linings, joints, accessories, and methods of inspection and testing.

The work of Committee A21 is conducted by subcommittees. The scope of Subcommittee 2, Joints for Pipe and Fittings, is to examine present A21 standards that describe joints for ductile-iron pressure pipe and ductile-iron and gray-iron fittings to determine what is needed to bring them up to date. These examinations should include related matters concerning joints for ductile-iron pressure pipe and ductile-iron and gray-iron fittings.

ANSI/AWWA C111/A21.11 was initially approved on July 16, 1953. The standard was subsequently reviewed, revised, and reissued in 1964, 1972, 1980, 1985, 1990, 1995, 2000, and 2007. This tenth edition was approved by the AWWA Board of Directors on Jan. 14, 2017.

During 1979, Committee A21 reached an agreement on a proposed new requirement for the marking of bolts and nuts that was generally acceptable to the bolt manufacturing industry. The significance of this change and other considerations led to approval of the 1980 revision.

The major changes in the 1980 edition were (1) inclusion of metric conversions; (2) inclusion of reduced ductile-iron mechanical-joint pipe bell thicknesses that are compatible with pipe barrel thicknesses; (3) inclusion of tee-head bolts with reduced shank diameters that are properly sized to accept rolled threads; (4) minimum elongation increased to 5 percent for ductile-iron glands; (5) deletion of the 2-in. and 2½-in. sizes; and (6) marking requirements for the tee-head bolts and nuts.

A 1984 addendum was issued to increase the thread length on ⅝-in. × 3-in. and ¾-in. × 3½-in. tee-head bolts by ¼ in. and to permit polygon-shaped bells on fittings.

The major revisions in the 1985 edition included the addition of Sec. 11-1.3, Modifications to Push-on and Mechanical Joints; revision of Sec. 11-2.5 defining the manufacturer as the party that produces joints according to this standard; and the addition

of Sec. 11-2.7 defining the owner. Sec. 11-8.1 was revised to permit the use of either ductile-iron or gray-iron glands unless otherwise specified by the purchaser. Note 8 was added under Figure 11.1 to permit ductile-iron glands with reduced flange thicknesses between the bolt holes. Sec. 11-7.4.1 and Sec. 11-8.3.1 were revised to delete natural rubber as a gasket material, and Sec. 11-9, Performance Requirements, was revised to cover both push-on joints and modified mechanical joints.

The major revisions in the 1990 edition of this standard were as follows:

A section on permeation was added and designated as Sec. 11-4. The previous Sec. 11-4, General Requirements, was changed to Sec. 11-5, and subsequent sections were changed accordingly.

Sec. 11-5.2 was revised to include flanged joints.

Sec. 11-8.1 was revised to require cast markings identifying the country where cast.

Sec. 11-8.4.1 and 11-9.3.1 were revised to identify styrene butadiene rubber (SBR) as the standard material for gaskets and to indicate the availability of other elastomers for special service applications. These sections were also revised to require molding or permanently marking the name of the country where molded on the gasket.

Tables 11.3 and 11.4 and Figures 11.3 and 11.4 were revised to adjust the thread length on the bolts. Also, the method of dimensioning the bolt thread length was revised.

Appendix B, Metric Dimensions, was eliminated, along with tables and figures exclusively for metric measure. Metric conversion formulas were added in notes to tables and figures for direct conversion of US customary units.

Appendix B, Flanged-Joint Bolts, Gaskets, and Installation, was added to include flanged joints.

The major revisions in the 1995 edition of this standard were as follows:

1. The acceptance clause (Sec. I.C) was revised to approved wording.
2. A statement that addresses physical requirements of elastomers other than SBR was added to Sec. 4.3.4.1.
3. A statement was added to Sec. 4.2.2 allowing flange joints in 12-in. and smaller sizes to be rated for 350 psi with the use of special gaskets the rating of which is supported by performance testing as described in Sec. 4.5.
4. Sec. 1.1, Figure 1, and Table 2 were revised to delete mechanical-joint pipe larger than 24 in.
5. A plus tolerance was added to the bell flange thickness (L) for pipe and C110 fittings and added to the dimensions across the centerlines of the bolt holes ($K1$ and $K2$) in Table 2.

6. Dimensions were added to Table 2 for ANSI/AWWA C153/A21.53 fittings for 18- through 24-in. sizes.

7. Figures 11.3 and 11.4 and Tables 11.3 and 11.4 from the previous revision were combined into Figure 3 and Table 5, respectively.

8. Sec. 4.3.5, Sec. A.1, and Sec. B.1 were revised to require compliance of fasteners to Public Law 101-592, the "Fastener Quality Act."

9. Dimensional data were added to Table B.1 for 60- and 64-in. flange gaskets.

There were no major changes in the 2000 edition.

The major revisions to the 2007 edition were as follows:

1. Added requirement for materials to comply with the Safe Drinking Water Act and other federal requirements to Sec. 4.1.

2. Added requirement for joints to withstand the combined working pressure and surge allowance specified in pipe or fitting standards to Sec. 4.3.2.

3. Table 2: Added plus tolerance to *K*1 dimension for fitting sizes 3 in. through 24 in. for ANSI/AWWA C153 compact fittings; deleted note allowing 350-psi (2.41-MPa) rating with special gaskets; added bolt length information for pipe and ANSI/AWWA C153 compact fittings; added *L* dimension for ANSI/AWWA C153 compact fittings sizes 30 in. through 48 in.; deleted note requiring *N* dimension conformance for glands.

4. Added Sec. 4.6, Special Requirements for the Flanged Joint.

5. Added requirement for design qualification of major modifications for mechanical and push-on joints that have been in service for less than 10 years and a requirement to retain the testing records for 10 years to Sec. 4.7.1.

The major revisions to the 2012 edition of this standard were as follows:

1. The scope of the standard was revised and other applicable sections throughout the standard were updated to include wastewater and reclaimed water.

2. A new section, 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. Table 4 and Table 8: Deleted reference to ASTM D 572, Standard Test Method for Rubber Deterioration by Heat and Oxygen, and added reference to ASTM D 573, Standard Test Method for Rubber—Deterioration in an Air Oven. Modified minimum aging requirements to reflect revised test method.

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.
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 C111 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.

* Persons outside the United States should contact the appropriate authority having jurisdiction.
† NSF International, 789 North Dixboro Road, Ann Arbor, MI 48105.
‡ Both publications available from National Academy of Sciences, 500 Fifth Street, NW, Washington, DC 20001.

II. Special Issues.

II.A. *Advisory Information on Product Application.* The following special service requirements should be noted:

1. Sec. 4.4.3 provides for tapped holes in the bells of mechanical joints for stud bolts. This option is intended for use when headed bolts or slotted holes will not suffice (for example, when the bell is to be embedded in a concrete wall).

2. Although this standard does not stipulate orientation of bolt holes in the flanges of the mechanical joint, at times it is convenient or necessary to have the bolt holes oriented. The normal, but not universal, practice is to have bolt holes straddle the vertical centerline of the fitting, valve, and hydrant. (The vertical centerline of a fitting is determined when the fitting is in the position to change the direction of the fluid flowing in a horizontal plane. With standard base bends and standard base tees, the vertical centerline is determined when the fitting is in a position to change the direction of the fluid flowing in a vertical plane.) If orientation is necessary, it should be stated on the purchase order.

NOTE: Push-on joints for ductile-iron pipe and ductile-iron and gray-iron fittings are designed so that negative pressure cannot pull the gasket into the pipe. Testing has been performed to confirm this design parameter for joint-sealing capability under the condition of negative pressure within the pipe.

3. Attention is directed to an apparent conflict among ANSI/AWWA C110/A21.10, ANSI/AWWA C115/A21.15, and ASME B16.1 with regard to pressure ratings for flanges.

In ANSI/AWWA C110/A21.10, flanged fittings are rated for 150 psi or 250 psi* (1.03 MPa or 1.72 MPa) working pressure depending on the material (gray iron or ductile iron) and the size of the fitting. Flanges provided according to ANSI/AWWA C115/A21.15 are rated for water service of 250 psi* (1.72 MPa) or greater working pressure.

ANSI/AWWA C110/A21.10 and ANSI/AWWA C115/A21.15 flanges, which are adequate for water service of 250 psi* (1.72 MPa) or greater working pressure, have bolt circles and bolt holes identical to Class 125 ASME B16.1 flanges, and also match Class 125 ASME B16.1 flanges for service temperatures of –20°F to 150°F (–6.7°C to 65.6°C). These flanges are rated only for 150 psi to 200 psi (1.03 MPa to 1.38 MPa), depending on the flange size, class or grade of iron, and fluid temperature.

ASME B16.1 also contains the details of a Class 250 flange that is heavier, has a raised face and a larger bolt circle, and uses larger-sized bolts than the Class 125 B16.1

* Some sizes may be rated for 350 psi (2.41 MPa) with the use of special gaskets.

flange and the flanges specified in ANSI/AWWA C115/A21.15 and ANSI/AWWA C110/A21.10. This Class 250 ASME B16.1 flange will not match the Class 125 ASME B16.1 flange or ANSI/AWWA C115/A21.15 and ANSI/AWWA C110/A21.10 flanges.

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, 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.

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. To ensure product compliance with standard requirements, third- party certifying bodies such as Underwriters Laboratories may be used.

III.A. *Purchaser Options and Alternatives.* The following information should be provided by the purchaser.

1. Standard used—that is, ANSI/AWWA C111/A21.11, Standard for Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings, of latest revision.
2. Details of other federal, state or provincial, and local requirements (Sec. 4.1).
3. For applications other than potable water, whether compliance with NSF/ANSI 61, Drinking Water System Components—Health Effects, is required (Sec. 4.1.2).
4. Mechanical-joint, flanged-joint, and push-on joint pipe and fittings may generally be purchased with or without joint accessories (Sec. 4.3.4).
5. Special requirements for the mechanical joint (Sec. 4.4).
6. Special elastomer gaskets, if required for wastewater, reclaimed water, or other special service applications (Sec. 4.4.4).
7. Purchaser must request drawings of the joint and gasket, if desired (Sec. 4.5.1).
8. Special flange bolt hole orientations, if required (Sec. 4.6.3.2).
9. Inspection (Sec. 5.1.1).
10. Certification and test records (Sec. 5.2).
11. Information on bolts and nuts, if required (Sec. 6.1.2).

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

IV. Major Revisions. The major revisions in this edition of this standard are as follows:

1. Table 2 and Table 3 were amended to include 54-, 60-, and 64-in. mechanical-joint bell and gasket dimension.

2. Appendix D was added describing the effects of chloramines on ductile-iron pipe gasket elastomers.

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.

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AWWA Standard

Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard describes rubber-gasket joints of the following types for ductile-iron pressure pipe and ductile-iron and gray-iron fittings, valves, hydrants, and other appurtenances for potable water, raw water, nonaggressive wastewater, and reclaimed water supply service.

1. Mechanical joint. The mechanical joint is designed for pipe in sizes 3 in. through 24 in. (80 mm through 600 mm), and fittings in sizes 3 in. through 64 in. (80 mm through 1,600 mm).*

2. Push-on joint. The push-on joint is designed for pipe and fittings in sizes 3 in. through 64 in. (80 mm through 1,600 mm).

3. Flanged joint. The flanged joint is designed for pipe and fittings in sizes 3 in. through 64 in. (80 mm through 1,600 mm).

4. Modifications to push-on and mechanical joints. Modifications to the designs shown in this standard, including but not limited to segmented or special

*Metric conversions are direct conversions of US customary units and are not those specified in International Organization for Standardization (ISO) standards.