

American Water Works Association
ANSI/AWWA C151/A21.51-96
(Revision of ANSI/AWWA C151/A21.51-91)



AMERICAN NATIONAL STANDARD
FOR
**DUCTILE-IRON PIPE,
CENTRIFUGALLY CAST,
FOR WATER**



Secretariats
AMERICAN GAS ASSOCIATION
AMERICAN WATER WORKS ASSOCIATION

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AWWA Standard

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Foreword

This foreword is for information only and is not a part of ANSI/AWWA C151/A21.51.

I. Introduction

I.A. Background. The purpose of this standard is to provide information to specifiers and users of ductile-iron pipe on the minimum manufacturing requirements of this pipe. This standard includes requirements for laying lengths, dimensional and weight tolerances, marking, and plant tests. In addition to dimensional and weight tables, tables based on the design procedure in ANSI/AWWA C150/A21.50 are included on nominal thicknesses and standard classes of ductile-iron pipe required for various external load and internal pressure conditions as a convenience to the users of this standard.

Section III.A of this foreword lists certain purchaser options and alternatives that users of this standard should consider in purchaser specifications for ductile-iron pipe.

Although ANSI/AWWA C151/A21.51 is commonly referenced for ductile-iron pipe for services other than water, users are also directed to ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe.

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 Association (A.G.A), 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 A.G.A, AWWA, and NEWWA, with AWWA serving as administrative secretariat. In 1984, the committee became an AWWA committee with the name of 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 AWWA Committee A21. The committee remains cosponsored by A.G.A for gas-related activities.

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

The work of AWWA 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 when needed, and other matters pertaining to pipe standards.

The first edition of ANSI/AWWA C151/A21.51, Standard for Ductile-Iron Pipe for Water and Other Liquids, was issued in 1965, and revisions were issued in 1971, 1976, 1981, 1986, and 1991. Subcommittee 1 reviewed the 1991 edition and submitted a proposed revision to AWWA Committee A21 in 1995.

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 all direct and indirect drinking water additives. Other members of the original consortium included the American Water Works Association Research Foundation (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. 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, ANSI[†]/NSF[‡] 60, Drinking Water Treatment Chemicals—Health Effects, and ANSI/NSF 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 ANSI/NSF 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.

Appendix A, “Toxicology Review and Evaluation Procedures,” to ANSI/NSF 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 Appendix A procedures may not always be identical, depending on the certifier.

AWWA C151-96 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 all 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. *Advisory Information on Product Application.* Unless otherwise provided in the purchaser’s specifications, all pipe and accessories shall comply with this standard. Pipe and accessories not complying with this standard shall be replaced by the manufacturer at the agreed point of delivery. The manufacturer shall not be liable for shortages or damaged pipe after the pipe is accepted at the agreed point of

*Persons in Canada, Mexico, and non-North American countries should contact the appropriate authority having jurisdiction.

[†]American National Standards Institute, 11 W. 42nd St., New York, NY 10036.

[‡]NSF International, 3475 Plymouth Rd., Ann Arbor, MI 48106.

[§]Both publications available from National Academy of Sciences, 2102 Constitution Ave. N.W., Washington, DC 20418.

delivery, except as recorded on the delivery receipt or similar document by the carrier's agent.

III. Use of This Standard. AWWA has no responsibility for the suitability or compatibility of the provisions of this standard to any intended application by any user. Accordingly, each user of this standard is responsible for determining that the standard's provisions are suitable for and compatible with that user's intended application.

III.A. Purchaser Options and Alternatives. The following items should be covered in the purchaser's specifications:

1. Standard used—that is, ANSI/AWWA C151, Standard for Ductile-Iron Pipe, Centrifugally Cast, for Water, of latest revision.
2. Size, joint type, thickness or class, and laying length (see tables).
3. a. Special joints (Sec. 4.2.1).
b. Specifying ductile-iron gland, if required (Sec. 4.2.1).
4. Certification by manufacturer (Sec. 5.1.1.2).
5. Inspection by purchaser (Sec. 5.1.2).
6. a. Elimination of outside coating (Sec. 4.3.1).
b. Elimination of cement–mortar lining (Sec. 4.3.2). Experience has indicated that asphaltic inside coating is not complete protection against loss in pipe capacity caused by tuberculation. Cement–mortar linings are recommended for most waters.
- c. Special coatings and linings (Sec. 4.3.3).
7. Special marking on pipe (Sec. 4.6).
8. Orientation of impact-test specimen cut from pipe wall (Sec. 5.2.2.2).
9. Written transcripts of foundry records (Sec. 5.4).
10. Additional tests (Sec. 5.5).

III.B. Modification to Standard. Any modification to the provisions, definitions, or terminology in this standard must be provided in the purchaser's specifications.

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

1. The format has been changed to AWWA standard style.
2. The acceptance clause (Sec. I.C) has been revised to approved wording.
3. Cement–mortar lining (Sec. 4.3.2) is now standard, unless otherwise specified (Sec. III.A.6.b).

V. Comments. If you have any comments or questions about this standard, please call the AWWA Standards and Materials Development Department, (303) 794-7711 ext. 6283, FAX (303) 795-1440, or write to the department at 6666 W. Quincy Ave., Denver, CO 80235.

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ANSI/AWWA C151/A21.51-96
(Revision of ANSI/AWWA C151/A21.51-91)

AMERICAN NATIONAL STANDARD FOR

DUCTILE-IRON PIPE,

CENTRIFUGALLY CAST,

FOR WATER

SECTION 1: GENERAL

Sec. 1.1 Scope

This standard covers 3-in. through 64-in. (76-mm* through 1,600-mm) ductile-iron pipe, centrifugally cast, for water, with push-on joints or mechanical joints. Requirements for pipe covered by this standard are discussed in the text and are shown in Tables 1 through 7 and Figures 1, 2, and 3. This standard may be used for pipe with such other types of joints as may be agreed on at the time of purchase.

Sec. 1.2 Purpose

The main purpose of this standard is to provide the minimum requirements for ductile-iron pipe, centrifugally cast, for water.

Sec. 1.3 Application

This standard can be referenced in specifications for ductile-iron pipe, centrifugally cast, for water. The stipulations of this standard apply when this document has been referenced and then only to ductile-iron pipe, centrifugally cast, for water.

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

SECTION 2: REFERENCES

This standard references the following documents. In their latest editions, these documents 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 C104/A21.4—American National Standard for Cement–Mortar Lining for Ductile-Iron Pipe and Fittings for Water.

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

ANSI/AWWA C150/A21.50—American National Standard for the Thickness Design of Ductile-Iron Pipe.

ANSI/AWWA C600—Standard for Installation of Ductile-Iron Water Mains and Their Appurtenances.

ANSI/AWWA C800—Standard for Underground Service Line Valves and Fittings.

ASTM[†] A746—Standard Specification for Ductile Iron Gravity Sewer Pipe.

ASTM E8—Standard Test Methods for Tension Testing of Metallic Materials.

ASTM E23—Standard Test Methods for Notched Bar Impact Testing of Metallic Materials.

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

3. *Mechanical joint*: The gasketed and bolted joint as detailed in the latest revision of ANSI/AWWA C111/A21.11.

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

5. *Push-on joint*: The single rubber-gasket joint as described in the latest revision of ANSI/AWWA C111/A21.11.

SECTION 4: REQUIREMENTS

Sec. 4.1 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 comprised of low molecular weight petroleum products or organic solvents or their vapors. Research has documented that pipe materials, such as polyethylene,

^{*}American National Standards Institute Inc., 11 W. 42nd St., New York, NY 10036.

[†]American Society for Testing and Materials, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.

polybutylene, polyvinyl chloride, and asbestos cement, and elastomers, such as used in jointing gaskets and packing glands, may be subject to permeation by lower 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 manufacturers regarding permeation of pipe walls, jointing materials, and so forth, **before** selecting materials for use in that area.

Sec. 4.2 General Requirements

4.2.1 *Mechanical or push-on joint requirements.* Pipe with mechanical joints or push-on joints shall conform to the applicable dimensions and weights shown in this standard and to the applicable requirements of the latest revision of ANSI/AWWA C111/A21.11. Unless otherwise required by the purchaser, the mechanical-joint glands shall be cast iron in accordance with ANSI/AWWA C111/A21.11, and bolts shall conform to the requirements of the same standard. Pipe with other types of joints shall comply with the joint dimensions and weights agreed on at the time of purchase but, in all other respects, the pipe shall fulfill the requirements of this standard.

4.2.2 *Laying-length requirements.* The nominal laying length of the pipe shall be as shown in Tables 1, 2, 3, and 4 of this standard. A maximum of 20 percent of the total number of pipe of each size specified in an order may be furnished in lengths that are as much as 24 in. (600 mm) shorter than the nominal laying length; an additional 10 percent may be furnished in lengths that are as much as 6 in. (150 mm) shorter than the nominal laying length.

Sec. 4.3 Coatings and Linings

4.3.1 *Outside coating.* The outside coating used under normal conditions shall be an asphaltic coating approximately 1 mil (25 μm) thick. The coating shall be applied to the outside of all pipe, unless otherwise specified. The finished coating shall be continuous and smooth, neither brittle when cold nor sticky when exposed to the sun, and shall be strongly adherent to the pipe.

4.3.2 *Cement-mortar linings.* The lining for use under normal conditions shall be a cement-mortar lining in accordance with the latest revision of ANSI/AWWA C104/A21.4, unless otherwise specified.

4.3.3 *Special coatings and linings.* For special conditions, other types of coatings and linings may be available. Special coatings and linings shall be specified by the purchaser. One special lining for pipe that is not cement-mortar lined is an asphaltic material as thick as practicable, at least 1 mil (25 μm), that conforms to all appropriate requirements for seal coat, as described in the latest revision of ANSI/AWWA C104/A21.4.

Sec. 4.4 Tolerances or Permitted Variations

4.4.1 *Dimensions.* The spigot end, bell, and socket of the pipe and the accessories shall be gauged with suitable gauges at sufficiently frequent intervals to ensure that the dimensions comply with the requirements of this standard. The smallest inside diameter (ID) of the sockets and the outside diameter (OD) of the spigot ends shall be tested with circular gauges. Other socket dimensions shall be gauged as may be appropriate.

4.4.2 *Thickness.* Minus thickness tolerances of pipe shall not exceed those shown in the following table:

Size		Maximum Minus Tolerance	
<i>in.</i>	<i>(mm)</i>	<i>in.</i>	<i>(mm)</i>
3–8	(76–203)	0.05	(1.3)
10–12	(254–305)	0.06	(1.5)
14–42	(356–1,067)	0.07	(1.8)
48	(1,219)	0.08	(2.0)
54–64	(1,400–1,600)	0.09	(2.3)

An additional minus tolerance of 0.02 in. (0.5 mm) shall be permitted along the barrel of the pipe for a distance not to exceed 12 in. (300 mm).

4.4.3 *Weight.* The weight of any single pipe shall not be less than the tabulated weight by more than 6 percent for pipe 12 in. (305 mm) or smaller in diameter, or by more than 5 percent for pipe larger than 12 in. (305 mm) in diameter.

Sec. 4.5 Weighing Pipe

Each pipe shall be weighed before the application of any lining or coating other than the asphaltic coating, and the weight shown on the outside or inside of the bell or spigot end.

Sec. 4.6 Marking Pipe

The weight, class, or nominal thickness, and casting period shall be shown on each pipe. The manufacturer's mark, country where cast, year in which the pipe was produced, and the letters "DI" or "DUCTILE" shall be cast or metal stamped on the pipe, and letters and numerals on pipe sizes 14 in. (356 mm) and larger shall be not less than ½ in. (13 mm) in height. When required in the purchaser's specifications, initials not exceeding four in number shall be cast or stamped on the pipe. All required markings shall be clear and legible, and all cast or metal-stamped marks shall be on or near the bell.

SECTION 5: VERIFICATION

Sec. 5.1 Inspection

5.1.1 *Inspection and certification by manufacturer.*

5.1.1.1 Quality control and inspection. Unless otherwise provided in the purchaser's specifications, the manufacturer shall establish the necessary quality control and inspection practice to ensure compliance with this standard.

5.1.1.2 Manufacturer's statement. The manufacturer shall, if required by the purchaser's specifications, furnish a sworn statement that the inspection and all specified tests have been made and that all results thereof comply with the requirements of this standard.

5.1.1.3 Freedom from defects. All pipe shall be clean, sound, and without defects that could impair service. Repair of defects by welding or other methods shall not be

allowed if such repairs could adversely affect the serviceability of the pipe or its capability to meet the strength requirements of this standard.

5.1.2 *Inspection by purchaser.*

5.1.2.1 Purchaser's obligations. If the purchaser desires to inspect pipe at the manufacturer's plant, the purchaser shall so state in the purchaser's specifications and describe the conditions (such as time and the extent of inspection) under which the inspection shall be made.

5.1.2.2 Manufacturer's obligations. The representative of the purchaser shall have free access to those areas of the manufacturer's plant that are necessary to determine compliance with this standard. The manufacturer shall make available to the representative of the purchaser such gauges as are necessary for inspection. The manufacturer shall provide the representative of the purchaser with assistance as needed for handling of pipe.

Sec. 5.2 Test Procedures

5.2.1 *Hydrostatic test.* Each pipe shall be subjected to a hydrostatic test of not less than 500 psi (3,450 kPa). This test may be performed either before or after the outside coating and inside coating have been applied, but shall be performed before the application of a cement-mortar lining or a special lining.

The pipe shall be under the full test pressure for at least 10 s. Suitable controls and recording devices shall be provided so that the test pressure and duration are adequately determined. Any pipe that leaks or does not withstand the test pressure shall be rejected.

In addition to the hydrostatic test before application of a cement-mortar lining or special lining, the pipe may be retested, at the manufacturer's option, after the application of such a lining.

5.2.2 *Acceptance tests.* The standard acceptance tests for the physical characteristics of the pipe shall be as follows:

5.2.2.1 *Tensile test.* Unless otherwise specified by the purchaser, a tensile-test specimen shall be cut longitudinally or circumferentially from the midsection of the pipe wall. In case of dispute, the test specimen shall be cut longitudinally. This specimen shall be machined and tested as shown in Figure 1 of this standard and in accordance with ASTM E8. The yield strength shall be determined by the 0.2-percent offset, half-of-pointer, or extension-under-load method. If check tests are to be made, the 0.2-percent offset method shall be used. All specimens shall be tested at room temperature ($70^{\circ}\text{F} \pm 10^{\circ}\text{F}$ [$21^{\circ}\text{C} \pm 6^{\circ}\text{C}$]).

5.2.2.1.1 *Acceptance values.* The acceptance values for test specimens shall be as follows:

Grade of iron: 60-42-10

1. Minimum tensile strength: 60,000 psi (413.7×10^3 kPa).
2. Minimum yield strength: 42,000 psi (289.6×10^3 kPa).
3. Minimum elongation: 10 percent.

5.2.2.2 *Impact test.* Tests shall be made in accordance with ASTM E23, except that dimensions of the specimens shall be 0.500 in. (12.7 mm) by full thickness of pipe wall. Unless otherwise specified by the purchaser, the notched impact-test specimen shall be in accordance with Figure 2 of this standard except that it may be cut circumferentially. In case of dispute, the specimen shall be cut in accordance with Figure 2. If the pipe-wall thickness exceeds 0.40 in. (10.2 mm), the impact specimen may be machined to a nominal thickness of 0.40 in. (10.2 mm). In all tests,