



## Designation: **A716 – 08 A716 – 08 (Reapproved 2014)**

# Standard Specification for Ductile Iron Culvert Pipe<sup>1</sup>

This standard is issued under the fixed designation A716; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

## 1. Scope

1.1 This specification covers 14 to 64-in. ductile-iron culvert pipe centrifugally cast.

1.2 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.3 The following safety hazards caveat pertains only to the test methods portions, Sections 6 and 7, of this specification: *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*<sup>2</sup>

[E8 Test Methods for Tension Testing of Metallic Materials](#)

[E23 Test Methods for Notched Bar Impact Testing of Metallic Materials](#)

2.2 *ANSI/AWWA Standards:*

[C 150/A21.50 Thickness Design of Ductile-Iron Pipe](#)<sup>3</sup>

[C 151/A21.51 Ductile-Iron Pipe Centrifugally Cast, for Water](#)<sup>3</sup>

2.3 *AASHTO Standard:*

[AASHTO T-99 Moisture Density Relations of Soils Using a 5.5-lb \(2.5-kg\) Rammer 12-in. \(305-mm\) Drop](#)<sup>4</sup>

## 3. General Requirements

3.1 The pipe shall be manufactured of ductile iron that meets the requirements of Sections 6 and 7. See [Table 1](#) for pipe thicknesses and weights; see also [Fig. 1](#).

3.2 The pipe shall be provided with suitable joints, such as push-on or other types of joints that prevent lateral displacement. Plain-end pipe for use with suitable couplings may be furnished.

3.3 Unless otherwise specified, pipe shall have a nominal length of 18 or 20 ft (5.5 or 6.1 m). A maximum of 20 % of the total number of pipe of each size specified in an order may be furnished as much as 24 in. (610 mm) shorter than the nominal laying length, and an additional 10 % may be furnished as much as in 6 in. (152 mm) shorter than the nominal laying length.

## 4. Tolerances or Permitted Variations

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

4.2 *Thickness*—Minus thickness tolerances of pipe shall not exceed those shown below:

<sup>1</sup> This specification is under the jurisdiction of ASTM Committee [A04](#) on Iron Castings and is the direct responsibility of Subcommittee [A04.12](#) on Pipes and Tubes. Current edition approved Oct. 1, 2008. Published October 2008. Originally approved in 1975. Last previous edition approved in 2003 as [A716 – 03; A716 – 08](#). DOI: [10.1520/A0716-08-10.1520/A0716-08R14](#).

<sup>2</sup> For referenced ASTM standards, visit the ASTM website, [www.astm.org](#), or contact ASTM Customer Service at [service@astm.org](#). For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

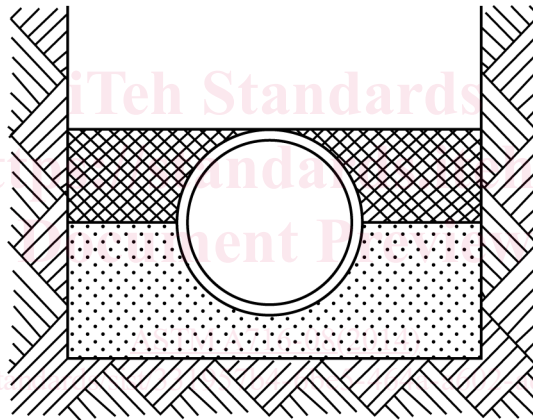
<sup>3</sup> Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, [http://www.ansi.org](#).

<sup>4</sup> Available from American Association of State Highway and Transportation Officials (AASHTO), 444 N. Capitol St., NW, Suite 249, Washington, DC 20001, [http://www.transportation.org](#).

**TABLE 1 Standard Wall Thickness<sup>A</sup> and Weight of Push-On Joint Ductile-Iron Culvert Pipe**

Nominal Diam., in.	Pressure Class	Nominal Thickness, in. (mm)	Maximum Depth of Cover, Ft. (m)	18-ft (5.5mm) Laying Length, Weight per Length, lb (kg)	20-ft (6.1 mm) Laying Length, Weight per Length, lb (kg)
14	250	0.28 (7.1)	41 (12.5)	770 (349)	855 (388)
16	250	0.30 (7.6)	41 (12.5)	940 (426)	1040 (472)
18	250	0.31 (7.9)	40 (12.2)	1090 (494)	1205 (547)
20	250	0.33 (8.4)	40 (12.2)	1290 (585)	1425 (646)
24	200	0.33 (8.4)	37 (11.3)	1550 (703)	1710 (776)
30	150	0.34 (8.6)	33 (10.1)	2000 (907)	2210 (1002)
36	150	0.38 (9.7)	33 (10.1)	2675 (1213)	2955 (1340)
42	150	0.41 (10.4)	32 (9.8)	3415 (1549)	3765 (1708)
48	150	0.46 (12.4)	33 (10.1)		4805 (2180)
54	150	0.51 (13.0)	33 (10.1)		6035 (2737)
60	150	0.54 (13.7)	33 (10.1)		6930 (3143)
64	150	0.56 (14.2)	33 (10.1)		7680 (3484)

<sup>A</sup> Nominal thickness is based on the minimum Pressure Class ductile iron pipe available installed in Type 5 trench condition in accordance with ANSI/AWWA C150/A21.50, as shown in Fig. 1, with a maximum ring deflection of 5 % and maximum ring stress of 48,000 psi (331 MPa). Wall thickness of pipe to serve at other depths of cover may be calculated in accordance with ANSI/AWWA C150/A21.50, allowing 5 % maximum ring deflection.



NOTE 1—Pipe is bedded to its centerline in compacted granular material with a minimum of 4 in. (102 mm) under the pipe. Compacted granular or select<sup>A</sup> material is used to the top of the pipe. (Material is compacted to approximately 90 % Standard Proctor in accordance with AASHTO Standard T-99.)

<sup>A</sup> Loose soil or select material is defined as native soil excavated from the trench, free of rocks, foreign material, and frozen earth.

**FIG. 1 Type 5 Trench**

Nominal Size, in.	Minus Tolerance, in. (mm)
14 to 42	0.07 (1.8)
48	0.08 (2.0)
54 to 64	0.09 (2.3)

NOTE 1—An additional minus tolerance of 0.02 in (0.05 mm) shall be permitted along the barrel of the pipe for a distance not to exceed 12 in. (305 mm).

4.3 *Weight*—The weight of any single pipe shall not be less than the tabulated weight by more than 5 %.

**5. Coating**

5.1 All pipe shall be coated inside and outside with an asphaltic or equivalent material approximately 1 mil (0.025 mm) thick. 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.

**6. Acceptance Tests**

6.1 The standard acceptance tests for the physical characteristics of the pipe shall be as follows:

6.2 *Tension Test*—Unless otherwise specified by the purchaser, a tension test specimen shall be cut longitudinally or circumferentially from the midsection of the pipe wall. In case of dispute, the specimen shall be cut longitudinally. This specimen shall be machined and tested in accordance with Fig. 2 and Test Methods E8. The yield strength shall be determined by the 0.2 % offset, half-of-pointer, or extension-under-load methods. If check tests are to be made, the 0.2 % offset method shall be used. All specimens shall be tested at room temperature  $70 \pm 10^{\circ}\text{F}$  ( $21 \pm 6^{\circ}\text{C}$ ).

6.2.1 *Acceptable Values*—The acceptance values for test specimens shall be as follows:

Grade of iron	60-42-10
Minimum tensile strength, psi (MPa)	60 000 (413.7)
Minimum yield strength, psi (MPa)	42 000 (289.6)
Minimum elongation, %	10

6.3 *Charpy Impact Test*—Tests shall be made in accordance with Test Methods E23, except that dimensions of the specimens shall be 0.500 in. (12.70 mm) by full thickness of pipe wall. Unless otherwise specified by the purchaser, the Charpy notched impact test specimen shall be in accordance with Fig. 3, except that it may be cut circumferentially. In case of dispute, the specimen shall be cut in accordance with Fig. 3. If the pipe wall thickness exceeds 0.40 in. (10.2 mm), the Charpy impact specimen may be machined to a nominal thickness of 0.40 in. (10.2 mm). In all tests, impact values are to be corrected to a standard wall thickness,  $t_s = 0.40$  in. (10.2 mm), by calculation as follows:

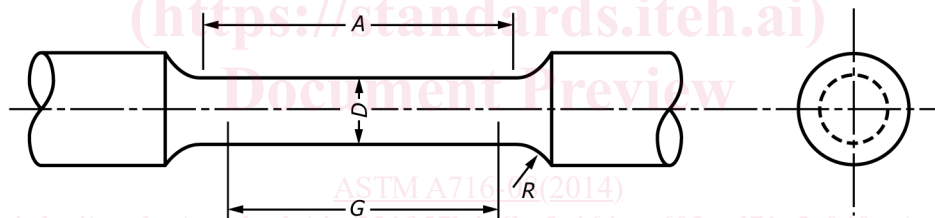
$$\text{Impact value (corrected)} = \frac{t_s}{t} \times \text{impact value (actual)}$$

where:

$t$  = the thickness of the specimen, in. (mm).

The Charpy impact test machine anvil shall not be moved to compensate for the variation of cross-section dimensions of the test specimen.

6.3.1 *Acceptance Value*—The corrected acceptance value for notched impact test specimens shall be a minimum of 7 ft-lbf (9.49 J) for tests conducted at  $70 \pm 10^{\circ}\text{F}$  ( $21 \pm 6^{\circ}\text{C}$ ).



NOTE 1—The reduced section (A) may have a gradual taper from the ends toward the center with the ends not more than 0.005 in. (0.13 mm) larger in diameter than the center on the standard specimen and not more than 0.003 in. (0.08 mm) larger in diameter than the center on the small size specimens.

NOTE 2—If desired, on the small size specimens the length of the reduced section may be increased to accommodate an extensometer. However, reference marks for the measurement of elongation should nevertheless be spaced at the indicated gage length (G).

NOTE 3—The gage length and fillets shall be as shown, but the ends may be of any form to fit the holders of the testing machine in such a way that the load shall be axial. If the ends are to be held in grips it is desirable, if possible to make the length of the grip section great enough to allow the specimen to extend into the grips a distance equal to two thirds or more of the length of the grips.

Dimension	Standard Specimen		Small-Size Specimens Proportional to Standard		
	0.50-in. (12.7-mm) Round	0.350-in. (8.89-mm) Round	0.250-in. (6.35-mm) Round	0.175-in. (4.45-mm) Round	0.125-in. (3.18-mm) Round
G	2.000 ± 0.005 (50.80 ± 0.13)	1.400 ± 0.005 (35.56 ± 0.13)	1.000 ± 0.005 (25.40 ± 0.13)	0.700 ± 0.005 (17.78 ± 0.13)	0.500 ± 0.005 (12.70 ± 0.13)
D	0.500 ± 0.010 (12.70 ± 0.25)	0.350 ± 0.007 (8.89 ± 0.18)	0.250 ± 0.005 (6.35 ± 0.13)	0.175 ± 0.005 (4.44 ± 0.13)	0.125 ± 0.005 (3.18 ± 0.13)
R, min	3/8 (9.5)	1/4 (6.4)	3/16 (4.8)	3/32 (2.4)	3/32 (2.4)
A, min	2 1/4 (57.2)	1 3/4 (44.4)	1 1/4 (31.8)	3/4 (19)	5/8 (15.9)
T <sup>A</sup>	0.71 and greater (18.0)	0.50 to 0.70 (12.7 to 17.8)	0.35 ± 0.49 (8.9 to 12.4)	0.25 to 0.34 (6.4 ± 8.6)	0.18 to 0.24 (4.6 to 6.1)

<sup>A</sup> Thickness of the section from the wall of the pipe from which the tension specimen is to be machined.

FIG. 2 Tension-Test Specimen

6.4 *Sampling*—At least one tension specimen shall be taken during each casting period of approximately 3 h. At least one  $70 \pm 10^{\circ}\text{F}$  ( $21 \pm 6^{\circ}\text{C}$ ) Charpy impact specimen shall be taken during each operating hour. Specimens shall be selected to properly represent extremes of pipe diameters and wall thicknesses.