



Standard Specification for Concrete Pipe for Irrigation or Drainage¹

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1. Scope

1.1 This specification covers nonreinforced concrete pipe to be used for the conveyance of irrigation water with working pressures, including hydraulic transients, as shown in [Table 1](#) and for use in drainage.

1.2 A complete SI companion to Specification C118 has been developed—C118M; therefore, no SI equivalents are presented in this specification.

NOTE 1—This specification is for manufacturing and purchase only and does not include requirements for bedding, backfill, installation, or field repairs. The owner is cautioned that he must correlate field conditions with the characteristics of the pipe specified and provide inspection during installation.

2. Referenced Documents

2.1 ASTM Standards:²

- [C33/C33M Specification for Concrete Aggregates](#)
- [C150/C150M Specification for Portland Cement](#)
- [C260/C260M Specification for Air-Entraining Admixtures for Concrete](#)
- [C494/C494M Specification for Chemical Admixtures for Concrete](#)
- [C497 Test Methods for Concrete Pipe, Manhole Sections, or Tile](#)
- [C595/C595M Specification for Blended Hydraulic Cements](#)
- [C618 Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete](#)
- [C822 Terminology Relating to Concrete Pipe and Related Products](#)
- [C989/C989M Specification for Slag Cement for Use in Concrete and Mortars](#)
- [C1017/C1017M Specification for Chemical Admixtures for Use in Producing Flowing Concrete](#)
- [C1116/C1116M Specification for Fiber-Reinforced Concrete](#)

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² 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.

C1602/C1602M Specification for Mixing Water Used in the Production of Hydraulic Cement Concrete

3. Terminology

3.1 *Definitions*—For definitions of terms relating to concrete pipe, see Terminology [C822](#).

4. Classification

4.1 Pipe manufactured according to this specification shall be known as “ASTM Standard Concrete Irrigation Pipe,” “ASTM Standard Concrete Drainage Pipe,” or “ASTM Heavy-Duty Concrete Drainage Pipe.”

5. Basis of Acceptance

5.1 The acceptability of the pipe shall be determined by the results of the tests prescribed in this specification, if and when required and by inspection to determine whether the pipe conforms to this specification as to design and freedom from defects.

6. Materials

6.1 *Concrete*—The concrete shall consist of cementitious materials, mineral aggregates, admixture, if used, and water.

6.2 Cementitious Materials:

6.2.1 *Cement*—Cement shall conform to the requirements for portland cement of Specification [C150/C150M](#) or shall be portland blast-furnace slag cement, portland-limestone cement, or portland-pozzolan cement conforming to the requirements of Specification [C595/C595M](#), except that the pozzolan constituent in the Type IP portland-pozzolan cement shall be fly ash.

6.2.2 *Fly Ash*—Fly ash shall conform to the requirements of Specification [C618](#), Class F or Class C.

6.2.3 *Slag Cement*—Slag cement shall conform to the requirements of Grade 100 or 120 of Specification [C989/C989M](#).

6.2.4 *Allowable Combinations of Cementitious Materials*—The combination of cementitious materials used in the concrete shall be one of the following:

6.2.4.1 Portland cement only;

6.2.4.2 Portland blast-furnace slag cement only;

6.2.4.3 Portland-pozzolan cement only;

6.2.4.4 Portland-limestone cement only;

6.2.4.5 A combination of portland cement or portland-limestone cement and fly ash;

TABLE 1 Standard Dimensions, Working Pressure, and Test Requirements for Standard Concrete Irrigation Pipe^A

Internal Designated Diameter, in.	Thickness of Wall, T, in.	Working Pressure, ^B ft	Minimum Internal Hydrostatic Test Pressure, psi	Minimum Three-Edge-Bearing Load, lbf/linear ft
6	7/8	30	50	1300
8	1	30	50	1350
10	1 1/8	30	50	1400
12	1 1/4	25	45	1500
14	1 3/8	25	45	1600
15	1 1/2	25	45	1650
16	1 1/2	25	45	1700
18	1 3/4	25	45	1800
20	2	25	40	1850
21	2 1/8	25	40	1900
24	2 1/4	25	40	2000

^AFor hydrostatic test requirements, refer to 10.5.

^BHigher working pressures are not prohibited up to a maximum of 40 ft for 6 through 8-in. diameters, 35 ft for 10 through 12-in. diameters, and 30 ft for 14-in. through 24-in. diameters. In these cases, the strength of the pipe shall be increased to give a minimum of at least four times the design working pressure when tested as specified in 10.5.

6.2.4.6 A combination of portland cement or portland-limestone cement and slag cement;

6.2.4.7 A combination of portland cement or portland-limestone cement, fly ash and slag cement; or

6.2.4.8 A combination of portland-pozzolan cement and fly ash.

6.3 *Aggregates*—Aggregates shall conform to the requirements of Specification C33/C33M, except that the requirements for gradation shall not apply.

6.4 *Admixtures*—The following admixtures and blends are allowable:

6.4.1 Air-entraining admixture conforming to Specification C260/C260M.

6.4.2 Chemical admixture conforming to Specification C494/C494M;

6.4.3 Chemical admixture for use in producing flowing concrete conforming to Specification C1017/C1017M; and

6.4.4 Chemical admixture or blend approved by the owner.

6.5 *Fibers*—Synthetic fibers and nonsynthetic fibers shall be allowed to be used, at the manufacturer's option, in concrete pipe as a nonstructural manufacturing material. Synthetic fibers (Type II and Type III) and nonsynthetic fiber (Type 1) designed and manufactured specifically for use in concrete and conforming to the requirements of Specification C1116/C1116M shall be accepted.

6.6 *Water*—Water used in the production of concrete shall be potable or nonpotable water that meets the requirements of Specification C1602/C1602M.

7. Design

7.1 *Design Tables*—Design requirements shall be in accordance with Table 1 for standard concrete irrigation pipe or with the applicable part of Table 2 for concrete drainage pipe. Wall thicknesses used shall be not less than the values shown, except as affected by the tolerances herein specified and by the provision for alternative design.

TABLE 2 Physical Test Requirements for Standard and Heavy-Duty Concrete Drainage Pipe^A

Internal Designated Diameter, in.	Standard Drainage Pipe		Heavy-Duty Drainage Pipe	
	Thickness of Wall, in.	Minimum Three-Edge-Bearing Load, lbf/linear ft	Thickness of Wall, in.	Minimum Three-Edge-Bearing Load, lbf/linear ft
4	3/4	1200	3/4	1400
5	3/4	1250	3/4	1400
6	7/8	1300	7/8	1400
8	1	1350	1	1500
10	1 1/8	1400	1 1/8	1550
12	1 1/4	1500	1 1/4	1700
14	1 3/8	1600	1 1/2	1850
15	1 1/2	1650	1 1/2	1980
16	1 1/2	1700	1 5/8	2100
18	1 3/4	1800	2	2340
20	2	1850	2 1/4	2500
21	2 1/8	1900	2 1/4	2680
24	2 1/4	2000	2 1/2	3000

^AFor absorption test requirements, refer to 10.4.

7.2 *Modified Design*—Manufacturers shall submit to the owner for approval prior to manufacture, wall thicknesses other than those shown in Table 1 or Table 2. Such pipe shall meet all of the test and performance requirements specified by the owner in accordance with Section 10.

7.3 *Laying Lengths*—Unless otherwise specified by the owner when calling for bids, maximum lengths of individual units of drainage pipe shall not exceed 30 in. for sizes 4 in. through 6 in., 36 in. for sizes 8 in. through 15 in., and 48 in. for larger sizes.

8. Joints

8.1 The joints of both irrigation and drainage pipe shall be of such design and the ends of the concrete pipe sections so formed that the pipe can be laid together to make a continuous line of pipe compatible with the permissible variations given in Section 11.

8.1.1 The joints of concrete drain tile shall conform to 8.1 without the use of mortar or other jointing material and allow water to enter without permitting the entrance of deleterious amounts of solids.

9. Concrete Mixture

9.1 The aggregates shall be sized, graded, proportioned, and thoroughly mixed with such proportions of cementitious materials and water as will produce a homogeneous concrete mixture of such quality that the pipe will conform to the test and design requirements of this specification.

10. Physical Requirements

10.1 *Test Specimens*—Specimens for tests shall be full-size pipe, which shall in every respect conform to the inspection requirements prescribed in this specification.

10.2 *Number and Type of Tests Required:*

10.2.1 The specimens to be tested shall be selected at random by the owner at the place of manufacture, and shall be tested in advance of shipment. The manufacturer shall furnish specimens for purpose of tests, without charge, up to 0.5 % of the number of pipe of each size included in the order, except

that in no case shall less than two specimens be furnished, the manufacturer bearing all expense of testing each pipe. Should a larger number of specimens be tested upon demand of the owner or manufacturer, then the cost of such additional test specimens and the expense of testing shall be borne by the party making such demand.

10.2.2 The owner shall specify the proportion of irrigation pipe specimens that shall be subjected to the three-edge-bearing load tests, and the proportion that shall be subjected to the hydrostatic test.

10.2.3 All drainage pipe to be tested shall be subjected to the three-edge-bearing load tests, and one half of the number of pipe so tested shall be subjected to the Test Method A or Test Method B absorption test in accordance with Test Methods C497, or other absorption test approved by the owner.

10.3 *External Load Test Requirements*—The pipe, when tested in accordance with Test Methods C497 shall sustain the load prescribed in Table 1 or Table 2 for each respective size and class of pipe.

10.3.1 It is not prohibited to fill depressions of exterior surface irregularities with plaster of paris to equalize the bearing surfaces. If mutually agreed upon between the manufacturer and owner, other types of bearings such as hard rubber blocks or sand-filled high-pressure hose are acceptable. The user of this specification is advised that sand or other loose fine material may be spread along the length of the crown of the pipe to equalize the upper bearing.

10.3.2 The load shall be applied continuously until the strength specified in Table 1 or Table 2 is reached. The pipe shall not be allowed to stand under load longer than is required to apply the load and to observe and record it. The pipe shall be surface-dry when tested. Tests shall not be made on frozen pipe.

10.4 *Absorption Test*—Test specimens shall be subjected to the boiling absorption test in accordance with Test Methods C497. For Test Method A, three test specimens shall be taken from each pipe unit to be tested; one of the pieces shall be taken from one end of the pipe, another piece from the opposite end, and the third piece from near the center. For Test Method A, each test specimen shall be free of visible cracks, shall have a minimum area of not less than 20 in.² as measured on one surface. The average absorption of the three specimens shall be considered to be the absorption for that pipe. The absorption of concrete drainage pipe as determined by the boiling absorption test shall not exceed 9 % for Test Method A or 8.5 % for Test Method B.

10.5 *Hydrostatic Tests:*

10.5.1 Irrigation pipe, when tested in accordance with the hydrostatic test procedures of Test Methods C497, shall sustain an internal hydrostatic pressure of 10 psi for 10 min without excessive leakage through the wall of the pipe. Moisture appearing on the surface of the pipe in the form of patches or beads adhering to the surface shall not be considered as excessive leakage. Slow-forming beads of water from pinholes that result in minor dripping and slight pinhole spurts that will not interfere with the use of the pipe in service will not be cause for rejection.

10.5.2 The pipe shall not fail when, after completion of the portion of the test described in 10.5.1, the pressure is increased to the minimum hydrostatic pressure specified in Table 1.

10.6 *Retests*—Irrigation pipe shall be acceptable under the load and hydrostatic test requirements when all test specimens conform to the test requirements. Drainage pipe shall be acceptable under the load and absorption test requirements when all the test specimens conform to the test requirements. Should any of the initial test specimens fail to meet the test requirements, the manufacturer will be allowed a retest on two additional specimens for each initial specimen that failed, and the tested lot will be acceptable only if all retest specimens meet the test requirements. In the event these retest specimens do not fully conform to the test requirements, the entire lot shall be rejected without further test. The manufacturer shall bear all the expense of retesting.

11. Permissible Variations

11.1 *Internal Diameter*—The internal diameter shall not be less than the values shown in Table 1 and Table 2 by more than $\frac{3}{16}$ in. for pipe 4, 5, or 6 in. in diameter, by more than $\frac{1}{4}$ in. for pipe from 8 to 18 in. in diameter, and by not more than $\frac{5}{16}$ in. for pipe over 18 in. in diameter.

11.2 *Wall Thickness*—The minimum wall thickness of the pipe shall be not more than 5 %, or $\frac{1}{16}$ in., whichever is greater, less than the wall thickness specified in Table 1 or Table 2 for the applicable class of pipe, or as specified in an approved alternative design.

12. Workmanship and Finish

12.1 Pipe shall be substantially free of fractures and surface roughness.

13. Repairs

13.1 Pipe repaired because of occasional imperfections in manufacturing or accidental injury during handling will be acceptable if, in the opinion of the owner, the repairs are sound and properly finished and cured and the repaired pipe conforms to the requirements of this specification.

14. Inspection

14.1 The quality of all materials and the finished pipe shall be subject to inspection and approval by the owner.

15. Rejection

15.1 Individual pipe units shall be subject to rejection on account of failure to conform to any of the specification requirements or on account of any of the following:

15.1.1 Fractures or cracks passing through the wall except for an end crack that does not exceed the depth of the joint, or a fracture that at its deepest point does not exceed the depth of the joint nor extend more than 10 % around the circumference of the joint.

15.1.2 Defects that indicate mixing and molding, not in compliance with 9.1.

15.1.3 The complete absence of distinct web-like markings from the external surface of the pipe made by any process in

which the forms are removed immediately after the concrete has been placed, which is indicative of a deficiency of water in the concrete mix, unless all specimens submitted for test that do not have such web-like markings shall have passed the physical tests herein required.

16. Product Marking

16.1 The letter “H” shall be stamped with waterproof ink, or other permanent manner, on all heavy-duty concrete drainage pipe.

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17. Keywords

17.1 absorption; acceptance criteria; concrete; design; drainage; hydrostatic; irrigation; joints; manufacture; nonreinforced; pipe; pressure; tests; three-edge bearing