



Designation: C654 – 19

Standard Specification for Porous Concrete Pipe¹

This standard is issued under the fixed designation C654; 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 (ϵ) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This specification covers porous nonreinforced concrete pipe for use in underdrains.

1.2 A complete metric companion to this specification has been developed—654M; therefore, no metric equivalents are presented in this specification.

1.3 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.*

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, Concrete Box Sections, 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](#)
[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 of two classes identified as “Standard-Strength Porous Nonreinforced Concrete Pipe” and “Extra-Strength Porous Nonreinforced Concrete Pipe.”

5. Basis of Acceptance

5.1 The acceptability of the pipe shall be determined by the results of the strength and porosity or rate of infiltration tests, and by inspection to determine whether the pipe conforms to this specification as to design and freedom from defects.

5.2 The pipe shall be acceptable under the strength tests when they have met the requirements as prescribed in Section [10](#).

5.3 *Acceptance as to Infiltration Properties*—Pipe shall be acceptable under the infiltration test when all test pipe conform to the test requirements as prescribed in Section [10](#).

6. Materials

6.1 *Concrete*—The concrete shall consist of cementitious materials, mineral aggregates, admixtures, 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](#).

¹ This specification is under the jurisdiction of ASTM Committee [C13](#) on Concrete Pipe and is the direct responsibility of Subcommittee [C13.01](#) on Non-Reinforced Concrete Sewer, Drain and Irrigation Pipe.

Current edition approved July 15, 2019. Published July 2019. Originally approved in 1970. Last previous edition approved in 2015 as C654 – 15. DOI: 10.1520/C0654-19.

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.

*A Summary of Changes section appears at the end of this standard

TABLE 1 Physical and Dimensional Requirements of Porous Concrete Pipe

Internal Designated Diameter, <i>D</i>	Minimum ^A Wall Thickness, <i>T</i>	Minimum Laying Length ^A	Minimum Socket Depth, <i>L_s</i>	Minimum Strength Three-Edge-Bearing	Minimum Infiltration
in.	in.	in.	in.	lbf/ft	gal/min-ft
4	1	24	1	1000	4
6	1	24	1	1100	6
8	1¼	24	1¼	1300	8
10	1⅝	24	1⅝	1400	10
12	1½	24	1½	1500	12
15	1¾	24	1¾	1750	15
18	2	24	2	2000	18
21	2¼	24	2¼	2200	21
24	2½	24	2½	2400	24

^A Normally the minimum laying length is 24 in. in length, but if the owner has no objections, then 18-in. length pipe up to 12 in. in diameter shall be acceptable.

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,

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 requirement 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 I) 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** and **Table 2** and **Fig. 1**. Wall thickness used shall be not less than the value shown, except as affected by the tolerance herein specified.

8. Joints

8.1 The joints 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 7.

9. Manufacture

9.1 *Mixture*—The aggregates shall be sized, graded, proportioned, and 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.

9.2 *Curing*—Pipe shall be subjected to any one of the methods of curing described in 9.2.1 through 9.2.3, or to any other method or combination of methods approved by the owner that will give satisfactory results. The pipe shall be cured for a sufficient length of time so that the concrete will develop the specified strength requirement at 28 days or less.

9.2.1 *Steam Curing*—Pipe shall be placed in a curing chamber, free from outside drafts, and cured in a moist atmosphere maintained by the injection of steam for such time and at such temperature as needed to enable the pipe to meet the strength requirements. The curing chamber shall be constructed as to allow full circulation of steam around the entire pipe.

9.2.2 *Water Curing*—Concrete pipe shall be water-cured by covering with water-saturated material or by a system of perforated pipes, mechanical sprinklers, porous hose, or by any other approved method that will keep the pipe moist during the specified curing period.

9.2.3 The manufacturer has the option to combine the methods described in 9.2.1 and 9.2.2 provided the specified strength is attained.

9.3 Specials:

9.3.1 *General Requirements*—Special shapes or fittings such as wyes, tees, bends, and adapters for use with concrete pipe conforming to this specification shall be made of porous or nonporous concrete in such manner as will provide strength at least equal to the class of the adjacent pipe to which they are joined; and shall conform to all other requirements specified for pipe of corresponding class and internal diameter, except minimum infiltration. Joints shall be the same type as used in the adjoining pipe.