Designation: C654M – 19

Standard Specification for Porous Concrete Pipe (Metric)[1]

This standard is issued under the fixed designation C654M; 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 This specification is the metric counterpart of Specification C654.

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
C497M Test Methods for Concrete Pipe, Concrete Box Sections, Manhole Sections, or Tile (Metric)
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 August 2019. Originally approved in 1980. Last previous edition approved in 2015 as C654M – 15. DOI: 10.1520/C0654M-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**

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.

TABLE 1 Physical and Dimensional Requirements of Porous Concrete Pipe

Internal Designated Diameter, *D*	Minimum[A] Wall Thickness, *T*	Minimum Laying Length[A]	Minimum Socket Depth, L_s	Minimum Strength Three-Edge-Bearing	Minimum Infiltration
mm	mm	mm	mm	kN/m	L/s·m
100	25	600	25	14.5	0.8
150	25	600	25	16.0	1.0
200	32	600	32	19.0	1.5
250	35	600	35	20.5	2.0
300	38	600	38	22.0	2.5
375	44	600	44	25.5	3.0
450	50	600	50	29.0	3.5
525	57	600	57	32.0	4.0
600	63	600	63	35.0	4.5

[A] Normally the minimum laying length is 600 mm in length, but if the owner has no objections, then 450-mm length pipe up to 300 mm in diameter shall be acceptable.

TABLE 2 Physical and Dimensional Requirements of Extra-Strength Porous Concrete Pipe

Internal Designated Diameter, *D*	Minimum[A] Wall Thickness, *T*	Minimum Laying Length[A]	Minimum Socket Depth, L_s	Minimum Strength Three-Edge-Bearing	Minimum Infiltration
mm	mm	mm	mm	kN/m	L/s·m
150	32	600	32	32.0	1.0
200	38	600	38	38.0	1.5
250	41	600	41	41.0	2.0
300	50	600	50	44.0	2.5
375	57	600	57	46.5	3.0
450	63	600	63	46.5	3.5

[A] Normally the minimum laying length is 600 mm in length, but if the owner has no objections, then 450-mm length pipe up to 300 mm in diameter shall be acceptable.

TABLE 3 Permissible Variations in Dimensions of Porous Concrete Pipe

	Limits of Permissible Variation			
Internal Designated Diameter,	Wall Thickness,[A]	Length, Two Opposite Sides	Length,	Depth of Socket,[A]
mm	mm	mm	mm/m	mm
100	–2	6	–20	–3
150	–2	6	–20	–3
200	–2	8	–20	–6
250	–2	10	–20	–6
300	–2	10	–20	–6
375	–2	11	–20	–6
450	–2	13	–20	–6
525	–3	14	–20	–6
600	–3	14	–31	–6

[A] The minus sign (–) indicates that the plus variation is not limited.

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