



Designation: **C654M—11** C654M – 15

Standard Specification for Porous Concrete Pipe (Metric)¹

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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.

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, 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 and Shotcrete
- [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*:

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.

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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.

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, ~~or slag-modified portland~~ 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 *Ground-Granulated Blast-Furnace Slag (GGBFS)*—~~Slag Cement—GGBFS-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~~ blast-furnace slag cement only,

6.2.4.3 ~~Slag-modified portland~~ Portland-pozzolan cement only,

6.2.4.4 ~~Portland-pozzolan~~ 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 ~~and ground-granulated blast-furnace slag, or~~ portland-limestone cement and slag cement,

6.2.4.7 A combination of portland cement, fly ash (not to exceed 25 % of the total cementitious weight) ~~and ground-granulated blast-furnace slag (not to exceed 25 % of the total cementitious weight)~~ 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 and Blends*—~~Admixtures~~—Owner is not prohibited from obtaining the record of mix design used. ~~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 *Synthetic Fibers*—~~Collated fibrillated virgin polypropylene fibers are not prohibited~~ Synthetic fibers and nonsynthetic fibers shall be allowed to be used, at the manufacturer's option, in concrete pipe as a nonstructural manufacturing material. ~~Only Type III synthetic fibers~~ 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.

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 |
|----------------------------------------|-----------------------------------------------|------------------------------------|--------------------------------------------|-------------------------------------|----------------------|
| 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.