



AMERICAN NATIONAL
STANDARD

ANSI/ASTM C 700 - 77

PLAINTIFF'S EXHIBIT

CT-1283

AMERICAN SOCIETY FOR TESTING AND MATERIALS

1916 Race St., Philadelphia, Pa., 19103

Reprinted from the Annual Book of ASTM Standards, Copyright ASTM
If not listed in the current combined index, will appear in the next edition

Standard Specification for VITRIFIED CLAY PIPE, EXTRA STRENGTH, STANDARD STRENGTH, AND PERFORATED¹

This Standard is issued under the fixed designation C 700; 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.

This specification has been approved for use by agencies of the Department of Defense and for listing in the DoD Index of Specifications and Standards.

1. Scope

1.1 This specification establishes the criteria for acceptance of extra strength and standard strength vitrified clay pipe and fittings to be used for the conveyance of sewage, industrial wastes, and storm water; and extra strength perforated and standard strength perforated vitrified clay pipe to be used for underdrainage, filter fields, leaching fields, and similar subdrainage installations.

NOTE 1—The values stated in U.S. customary units are to be regarded as the standard.

NOTE 2—Attention is called to ASTM Recommended Practice C 12, for Installing Vitrified Clay Pipe Lines;¹ ASTM Specification C 425, for Compression Joints for Vitrified Clay Pipe and Fittings;² and ASTM Tentative Recommended Practice C 828, for Low-Pressure Air Test of Vitrified Clay Pipe Lines (4 to 12-in.).³

2. Definitions

2.1 Clay, fire clay, shale, and surface clay are as defined in ASTM Definitions C 43, Terms Relating to Structural Clay Products.²

3. Materials and Manufacture

3.1 Vitrified clay pipe shall be manufactured from fire clay, shale, surface clay, or a combination of these materials that, when formed into pipe and fired to suitable temperatures, yields a product that is strong, durable, serviceable, free of objectionable defects, and conforms to this specification.

4. Physical and Chemical Requirements

4.1 Crushing Strength:

4.1.1 Pipe shall meet the crushing strength requirements of Table 1.

4.1.2 The number of specimens to be tested shall not exceed 0.5 % of the number of pipe of each size furnished, except that no less than two specimens shall be tested.

4.1.3 If any of the test specimens fail to meet the requirements, the manufacturer will be allowed a retest on two additional specimens for each one that failed. The pipe will be acceptable if all the specimens for retest meet the requirement.

4.1.4 If, subsequent to an initial pipe strength failure, the accuracy of the testing machine is questioned, at the request of the manufacturer, the machine may be recalibrated and a retest made or a retest may be made upon a machine of known accuracy.

4.2 Absorption:

4.2.1 The absorption of vitrified clay pipe shall not exceed 8 percent.

4.2.2 If any of the test specimens fail to meet the absorption requirements, a retest will be allowed, and the pipe accepted as provided in 4.1.3.

4.3 Hydrostatic Pressure Test:

4.3.1 As an alternative to the absorption test, the manufacturer may, at his option, apply a hydrostatic pressure test to all of the pipes subject to test in each size and run of the pipe.

4.3.2 When the pipe is subjected to an

¹ This specification is under the jurisdiction of ASTM Committee C-4 on Vitrified Clay Pipe. Current edition approved Nov. 25, 1977. Published January 1978. Originally published as C 700 - 71 T. Last previous edition C 700 - 75.

² Annual Book of ASTM Standards, Part 16.



internal hydrostatic pressure of 10 psi (68.9 kPa) for the elapsed time shown in the following table, there shall be no leakage on the exterior of the pipe. Moisture appearing on the surface of the pipe in the form of beads adhering to the surface shall not be considered leakage. However, moisture which starts to run on the pipe shall be construed as leakage regardless of quantity.

Hydrostatic Pressure Test Times	
Thickness of Barrel, in. (mm)	Test Time, min
Up to and including 1 (25)	7
Over 1 (25) and including 1 1/2 (38)	9
Over 1 1/2 (38) and including 2 (51)	12
Over 2 (51) and including 2 1/2 (64)	15
Over 2 1/2 (64) and including 3 (76)	18
Over 3 (76)	21

4.3.3 If any of the test specimens fail to meet the hydrostatic requirements, a retest will be allowed, and the pipe accepted as provided in 4.1.3.

4.4 Acid Resistance:

4.4.1 This test is used to determine the resistance of pipe to the action of acids encountered in sanitary sewers. The test shall be performed only when specified.

4.4.2 The pipe of each size and shipment shall be acceptable if the acid-soluble matter, from specimens representing such pipe, does not exceed 0.25 %. Failure of any of the specimens to meet the test shall result in the rejection of all the pipe represented by the specimen tested.

5. Sizes and Dimensions

5.1 Sizes and dimensions of pipe are as described in Table 2 (U. S. customary units) and Table 2A (SI units).

5.2 The inside diameter shall not vary from a true circle by more than 3 % of its nominal diameter.

5.3 The average inside diameter shall be determined by taking any two 90-deg (1.6-rad) opposing measurements and averaging the readings.

6. Straightness

6.1 Pipe shall not deviate from straight by more than 1/16 in./ft (5 mm/m) of length when the maximum offset is measured from the concave side of the pipe.

6.2 Measurement shall be taken by placing a straight X-edge on the concave side of the

pipe's full length of the barrel, being sure not to include spigot joint material or socket, and measuring the maximum distance between the straightedge and concave side of the pipe.

7. Glaze

7.1 Unless otherwise specified, the manufacturer may supply either glazed or unglazed pipe. On glazed pipe, the glaze shall be a continuously uniform layer that is substantially free of imperfections. Not more than 10 % of the inner surface of any pipe barrel may be free of glaze. There shall be no well defined crazing or hairline cracks.

7.2 Glazing is not required on the outer surface of the pipe at the spigot, for a longitudinal distance equal to the depth of the socket. Glaze may be entirely absent from the inside of the socket.

7.3 When a ceramic glaze is used, it need only be applied to the inside of the pipe.

8. Blisters

8.1 Pipe of nominal sizes from 3 to 18 in., shall have no blister with a dimension exceeding 3 in. (76 mm), and no blister or pimple shall project more than 1/8 in. (3 mm) above the surface of the pipe.

8.2 Pipe of nominal sizes over 18 in., shall have no blister exceeding 2 in./ft (166 mm/m) of internal diameter, and no blister or pimple shall project above the surface of the pipe more than 1/8 in./ft (10 mm/m) of internal diameter.

8.3 Pipe shall have no broken blisters.

9. Fractures and Cracks

9.1 There shall be no fractures or cracks passing through the barrel or socket, except that a single crack at the spigot end of the pipe not exceeding 75 % of the depth of the socket, or a single fracture in the socket not exceeding 3 in. (76 mm) around the circumference nor 2 in. (50 mm) lengthwise may be permitted.

9.2 Chips or fractures on the interior of the pipe shall not exceed 2 in. (50 mm) in length, 1 in. (25 mm) in width, and a depth of one fourth of the thickness of the barrel.

10. Finish of Ends

10.1 The ends of pipe shall be square with their longitudinal axes, within the tolerances

provided in Table 2.

10.2 The inner surface of the socket and the outer surface of the spigot shall be scored with triangular or semicircular-shaped circumferential indentations about $\frac{1}{8}$ in. (3 mm) in depth. The minimum number of scorings shall be as follows:

Size of Pipe, in. (mm)	Number of Scorings, min
3 to 6 (75 to 150)	1
8 and 10 (200 and 250)	2
12 to 36 (300 to 900)	3

10.3 Scoring may be eliminated when it is conducive to the proper application of the joint to be used.

11. Perforations

11.1 Perforations shall be circular and cleanly cut, $\frac{1}{4}$ in. (6 mm) in diameter, arranged approximately 3 in. (76 mm) center to center in rows parallel to the longitudinal axis of the pipe. Rows shall be arranged in two equal groups on each side of the vertical center line of the pipe. The lowermost rows of perforations shall be separated by an arc of 90 deg (1.6 rad) measured across the bottom of the pipe. The uppermost rows of perforations shall be separated by an arc of 200 deg (3.5 rad), measured across the top of the pipe. Spacing of rows between these limits shall be uniform. The total number of rows of perforations is shown in Table 3.

11.2 The spigot end of bell-and-spigot perforated pipe shall not be perforated for a distance equal to the depth of the socket.

12. Fittings

12.1 Fittings shall correspond in all respects with the dimensions specified for pipe of the corresponding size. Dimensional tolerances of fittings shall be the same as for straight pipe. All fittings shall conform to the requirements for pipe described in Sections 8 through 10.

12.2 Slants shall have their spigot ends cut at an angle of approximately 60 deg (1.0 rad) or 45 deg (0.8 rad) with the longitudinal axis.

12.3 Curves shall have arcs of approxi-

mately 90 deg (1.6 rad), 45 deg (0.8 rad), 30 deg (0.5 rad), or 22.5 deg (0.4 rad) as required.

12.4 Fittings shall be made to such lengths as will accommodate the jointing system provided. Tee and wye fittings shall be furnished with spurs of the size specified, securely and completely fastened to the barrel of the fitting in the process of manufacture. The spurs of tee fittings shall have their axes perpendicular to the longitudinal axis of the fitting. The spur of the wye fittings shall have their axes at angles of approximately 60 deg (1.0 rad), or 45 deg (0.8 rad) to the longitudinal axis of the fitting, measured from the socket or bell end of the fitting. The barrel of each spur shall be of sufficient length to permit making a proper joint.

12.5 Channel pipe and channel fittings shall be approximate half sections of the corresponding size of straight pipe and fittings.

13. Test Methods

13.1 Perform tests in accordance with Methods C 301.

14. Inspection

14.1 All pipe shall be subject to inspection by a competent inspector employed by the purchaser. Inspection may be made at the factory or promptly at the point of delivery. All pipe accepted may be plainly marked by the inspector. Rejected pipe shall not be defaced, but shall be replaced by the manufacturer or seller without additional cost, with pipe that meets the requirements of this specification.

15. Marking

15.1 Each length of pipe shall bear the initials or name of the manufacturer, and the location of the plant. The words "Extra Strength" or the symbol "ES" shall be included, when applicable, to identify the class of pipe. The markings shall be indented on the exterior of the pipe, and shall be plainly legible for identification.

TABLE 1 Minimum Crushing Strength (3-Edge Bearing Strength)

Nominal Size, in.	Extra Strength Vitrified Clay Pipe		Standard Strength Vitrified Clay Pipe		Perforated Vitrified Clay Pipe			
					Extra Strength		Standard Strength	
	lbf/linear ft	kN/linear m	lbf/linear ft	kN/linear m	lbf/linear ft	kN/linear m	lbf/linear ft	kN/linear m
3	2000	29.2	1200	17.5	1250	18.2	1000	14.6
4	2000	29.2	1200	17.5	1600	23.4	1000	14.6
6	2000	29.2	1200	17.5	1600	23.4	1000	14.6
8	2200	32.1	1400	20.4	1600	23.4	1000	14.6
10	2400	35.0	1600	23.4	1600	23.4	1100	16.1
12	2600	37.9	1800	26.3	1800	26.3	1200	17.5
15	2900	42.3	2000	29.2	2200	32.1	1400	20.4
18	3300	48.2	2200	32.1	2640	38.5	1700	24.8
21	3850	56.2	2400	35.0	3100	45.2	2000	29.2
24	4400	64.2	2600	37.9	3520	51.4	2400	35.0
27	4700	68.6	2800	40.9	...	...	...	...
30	5000	73.0	3300	48.2	...	...	...	...
33	5500	80.3	3600	52.5	...	...	...	...
36	6000	87.6	4000	58.4	...	...	...	...
39	6600	96.3	...	...	...	...	...	...
42	7000	102.2	...	...	...	...	...	...

TABLE 2 Dimensions of Vitrified Clay Pipe (U. S. Customary Units)

Nominal Size, in. ⁴	Laying Length Limit of Minus Variation, in./ft	Difference in Length of Two Opposite Sides max, in.	Limit of Minus Variations in Average Inside Diameter, in.
3	1/4	1/8	1/8
4	1/4	1/8	1/8
6	1/4	1/8	1/4
8	1/4	1/8	1/8
10	1/4	1/8	3/8
12	1/4	1/8	1/2
15	1/4	1/2	1/2
18	1/4	1/2	1 1/8
21	1/4	1/2	1 1/8
24	3/8	1/2	1 1/8
27	3/8	1/2	1 1/8
30	3/8	1/2	1 1/8
33	3/8	1/2	1 1/8
36	3/8	1 1/8	1 1/8
39	3/8	1/2	1 1/8
42	3/8	1/2	1 1/8

⁴ Specifiers should be aware that all pipe sizes are not universally available.

TABLE 2A Dimensions of Vitrified Clay Pipe (SI Units)

Nominal Size, mm. ⁴	Laying Length Limit of Minus Variation, mm/m	Difference in Length of Two Opposite Sides max, mm	Limit of Minus Variations in Average Inside Diameter, mm
75	20	8	4
100	20	8	4
150	20	9	4
200	20	11	5
250	20	11	6
300	20	11	7
375	20	13	9
450	20	13	11
525	20	14	13
600	30	14	15
675	30	16	17
750	30	16	19
825	30	16	21
900	30	17	22
975	30	19	22
1050	30	23	22

⁴ Specifiers should be aware that all pipe sizes are not universally available.

TABLE 3 Perforation Spacing for Perforated Vitified Clay Pipe

Nominal Size, in.	Rows of Perfora- tions	Perforations per Row			
		2 ft (0.61 m)	3 ft (0.91 m)	4 ft (1.22 m)	5 ft (1.52 m)
4	4	7	9	11	13
6	4	7	9	11	13
8	4	7	9	11	13
10	6	7	9	11	13
12	6	7	9	11	13
15	6		10	14	17
18	8		10	14	17
21	8		10	14	17
24	8		10	14	17

The American Society for Testing and Materials takes no position respecting the validity of any patent rights asserted in connection with any item mentioned in this standard. Users of this standard are expressly advised that determination of the validity of any such patent rights, and the risk of infringement of such rights, is entirely their own responsibility.