



Standard Specification for Non-Asbestos Fiber-Cement Conduit¹

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1. Scope

1.1 This specification covers non-asbestos fiber-cement conduit for use in electric-power systems and communication systems. The service is for both underground and exposed conditions.

1.2 The values stated in SI units are to be regarded as the standard. The values stated in parentheses are provided for information only.

1.3 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:

C 150 Specification for Portland Cement²

C 500 Test Methods for Asbestos-Cement Pipe³

C 595 Specification for Blended Hydraulic Cements²

C 1154 Terminology for Non-Asbestos Fiber-Reinforced Cement Products³

2.2 Military Standard:

MIL-STD-129 Marking for Shipment and Storage⁴

2.3 Federal Standard:

No. 123 Marking for Domestic Shipment (Civilian Agencies⁴)

2.4 Other Standards:

Uniform Freight Classification Rules⁵

National Motor Freight Classification Rules⁶

3. Terminology

3.1 *Definitions*—Refer to Terminology C 1154.

3.1.1 *conduit, n*—fiber-cement pipe used to protect wires for electric-power or communication systems, for both underground and exposed situations.

¹ This specification is under the jurisdiction of ASTM Committee C-17 on Fiber-Reinforced Cement Products and is the direct responsibility of Subcommittee C17.02 on Non-Asbestos Fiber-Cement Products.

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² *Annual Book of ASTM Standards*, Vol 04.01.

³ *Annual Book of ASTM Standards*, Vol 04.05.

⁴ Available from Standardization Documents Order Desk, Bldg. 4 Section D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

⁵ Available from the Uniform Classification Commission, Room 1106, 222 S. Riverside Plaza, Chicago, IL 60606.

⁶ Available from National Motor Freight Inc., 1616 P St., NW, Washington, DC 20036.

3.1.2 *coupling*—component made from a larger diameter pipe of the same type or Type II and of the same class or a higher class, or produced otherwise to yield at least equal performance, for joining fiber-cement pipe that when properly installed, forms a silt-tight joint, allows alignment corrections and slight changes in direction, and provides an assembled joint equivalent in serviceability and strength to the pipe sections.

3.1.3 *fittings*—fittings such as adapters, reducers, increasers, bends, and bell ends, for use in laying fiber-cement conduit as described in Section 5 and made to such dimensions as will provide equivalent strength and silt-tight joints when assembled with the conduit.

3.1.4 *lot*—lot as used herein is defined as each 1000 lengths of conduit or less, of a given class, type, and size manufactured on one machine during a 24-h period.

4. Classification

4.1 The classes of conduit shall be as follows:

4.1.1 *Class B*—Intended for use encased in concrete after installation, and

4.1.2 *Class C*—Intended for use without concrete encasement, or for exposed services.

4.2 The types of conduit shall be known as Type I and Type II corresponding to the chemical requirements given in Section 6 of this specification. For a more thorough understanding and as a guide to the chemical resistance of fiber-cement conduit, reference is made to Test Methods C 500.

NOTE 1—To assist the purchaser in choosing the type of conduit most suitable for his use, the following descriptions of usage may be considered:

4.2.1 *Type I*—For use where nonaggressive water and soil of moderate sulfate content are expected to come in contact with the conduit, and

4.2.2 *Type II*—For use where moderately aggressive water or water and soil of high sulfate content, or both, are expected to come in contact with the conduit.

4.3 The conduit shall be furnished in 40, 50, 75, 100, and 150-mm (1.5, 2, 3, 4, 5, and 6-in.) nominal sizes and shall have a circular cross section.

5. Materials and Manufacture

5.1 Fiber-cement conduit shall be composed of an intimate mixture of an inorganic hydraulic binder (see Specification C 150) or a calcium silicate binder (see Specification C 595)

formed by the chemical reaction of a siliceous material and a calcareous material reinforced by organic fibers, inorganic non-asbestos fibers, or both. Process aids, fillers and pigments which are compatible with fiber-reinforced cement are not prohibited from being added. All material shall be of laminar construction formed under pressure to a homogeneous structure and cured to meet the physical and chemical requirements of this specification.

6. Chemical Composition

6.1 When tested in accordance with Test Methods C 500, the amount of uncombined calcium hydroxide shall not exceed 1.0 % for Type II conduit.

NOTE 2—There are no chemical requirements for Type I conduit.

7. Mechanical Properties

7.1 Flexural Strength:

7.1.1 Each 3048- or 3962-mm (10 or 13-ft) standard length and each 2896 mm (9.5 ft) or longer random length conduit shall have sufficient flexural strength to withstand, without failure, the total load prescribed in Table 1, when tested in accordance with 7.1.1.1.

7.1.1.1 The specimen shall be mounted longitudinally on “V” blocks, preferably of hard wood or of steel, 50 mm (2 in.) long, 2 rad (120°) angle of “V,” faces 130 by 50 mm (5 by 2 in.), and the load applied through a rectangular block, 50 mm (2 in.) in width, at the center of the span. The spans between the faces of supporting blocks shall be as given in Table 1 for the particular class of conduit. The breaking loads, the average of at least two specimens from each length, shall not be less than those given in Table 1 for the particular class of conduit.

7.2 *Crushing Strength*—Crushing tests shall be conducted before shipment. Conduit of 300-mm (1-ft) lengths cut from the unmachined portion of the conduit shall have the minimum crushing strength prescribed in Table 2, when tested in accordance with Test Methods C 500.

8. Dimensions, Mass, and Tolerances

8.1 The average inside diameter measured at the end of the conduit shall be ±3 mm (±0.1 in.) of the nominal inside diameter.

8.2 The bore of the conduit shall pass freely through a mandrel 1 m (3 ft) long and 6 mm (0.25 in.) less in diameter than the nominal inside diameter of the conduit.

8.3 The inner dimensions of the bends shall be such that a ball 10 mm (0.4 in.) less in diameter than the nominal inside diameter of the conduit, shall pass freely through them.

TABLE 2 Crushing Strength Requirements

| Nominal Diameter | | Minimum Crushing Loads | | | |
|------------------|-------|------------------------|-------|---------|-------|
| | | Class B | | Class C | |
| mm | (in.) | kN | (lbf) | kN | (lbf) |
| 40 | 1.5 | 2.2 | 500 | 5.3 | 1200 |
| 50 | 2 | 2.2 | 500 | 5.3 | 1200 |
| 75 | 3 | 2.2 | 500 | 5.3 | 1200 |
| 100 | 4 | 2.2 | 500 | 5.3 | 1200 |
| 130 | 5 | 2.2 | 500 | 4.0 | 900 |
| 150 | 6 | 2.2 | 500 | 3.6 | 800 |

8.4 Couplings and coupling areas of the conduit shall be machined or otherwise finished to such dimensions as will provide silt-tight joints when assembled with proper accessories and put into the service for which the conduit is intended.

8.5 The standard lengths of conduit shall be 1.5, 2, 3, 4 or 5 m ± 25 mm (5, 6.5, 10, 13, or 16 ft ± 1 in.). At least 85 % of the total length of any one class, type, and size shall be furnished in standard lengths, and the remaining 15 % in random lengths if not less than 1.5 m (5 ft) for standard 3 and 4-m (10 and 13-ft) lengths, or less than 1 m (3 ft) for standard 2 and 1.5-m (6.5 and 5 ft) lengths.

9. Workmanship, Finish and Appearance

9.1 Machined ends of the conduit that receive the coupling shall be free of dents and gouges that will affect the silt-tightness of the joint.

9.2 Each conduit shall be free of bulges, dents, and tears on the inside surface that result in a variation of more than 5 mm (0.2 in.) from the adjacent unaffected portions of the surface.

9.3 All inside edges of the conduit shall be rounded and smooth. The ends of each length of conduit shall be at right angles to the axis of the conduit.

10. Sampling

10.1 Test all material under this specification after immersion under water at 23 ± 4°C (73 ± 7°F) for a minimum of 24 h for the crushing tests and in a normal air-dried condition in equilibrium with atmospheric humidity for the flexural tests.

NOTE 3—When sampling from continuous production, these tests may be conducted on dry, equilibrium, or saturated specimens, provided a relationship can be established between this testing and the specified values.

10.2 For the flexural test, two specimens shall be cut from one full length of conduit from each lot. (**Warning**—When cutting fiber-cement products minimize the dust that results. Prolonged or frequent breathing of significant airborne concentrations of cement or crystalline silica dust is hazardous. When such dusts are generated, effective measures shall be taken to prevent inhalation.)

10.3 For the crushing test, two specimens shall be cut from one full length of conduit from each lot.

10.4 When uncombined calcium hydroxide tests are requested (Section 6), one sample shall be taken from each lot of conduit. The sample to be tested may be taken from any one of the specimens selected for the crushing test.

11. Inspection

11.1 All material furnished under this specification shall

TABLE 1 Flexural Strength Requirements

| Nominal Inner Diameter | | Test Span (Free Span) | | Class B Applied Test Load | | Class C Applied Test Load | |
|------------------------|-------|-----------------------|-------|---------------------------|-------|---------------------------|-------|
| mm | (in.) | mm | (in.) | kN | (lbf) | kN | (lbf) |
| 40 | 1.5 | 760 | 30 | 2.70 | 600 | 3.80 | 850 |
| 50 | 2 | 760 | 30 | 2.70 | 600 | 3.80 | 850 |
| 75 | 3 | 762 | 30 | 2.70 | 600 | 3.80 | 850 |
| 100 | 4 | 762 | 30 | 4.40 | 980 | 5.60 | 1260 |
| 130 | 5 | 1219 | 48 | 4.90 | 1100 | 6.70 | 1500 |
| 150 | 6 | 1372 | 54 | 5.80 | 1300 | 8.90 | 2000 |

conform to the physical and chemical requirements stated herein and may be subject to factory inspection by the purchaser. All conduit shall be inspected by the manufacturer for compliance to dimensional tolerances and workmanship. The manufacturer shall accept to certify that his product conforms to the requirements of this specification.

11.2 On orders requiring inspection by the purchaser, the manufacturer shall arrange the time of testing so that the purchaser or his authorized inspector may be present to witness such tests at the purchaser's expense. The conduit to be tested will already have passed the routine inspection and testing of this specification. The number of tests to be conducted for flexural strength and crushing strength shall be limited to a maximum of one sample per each 1000 standard lengths of each size, type, and class of conduit on the order. If uncombined calcium hydroxide tests are required, the numbers of tests shall be one for each size, type, and class of pipe on the order. When specified by the purchaser, the purchaser or his authorized inspector will select the conduit to be tested.

12. Rejection and Rehearing

12.1 Failure of any specimen tested for flexural and crushing strength to withstand 75 % of the load specified in Section 7 shall be cause for rejection of the lot from which the test specimen was taken. When any specimen tested for flexural or crushing strength withstands over 75 % but under 100 % of the load specified in Section 7, one specimen shall be cut from

each of two additional conduits of the same lot. Failure of either of these additional specimens to meet the strength requirements of Section 7 shall be cause for rejection of the entire lot from which the original sample was taken.

12.2 If the results of the uncombined calcium hydroxide test show the sample failed to meet the specification requirements, two additional specimens shall be selected and sampled for test. The failure of one of these two additional samples to meet the specification requirements of Section 6 shall be cause for rejection of the lot.

13. Product Marking

13.1 Each standard and random length of conduit shall be marked by the manufacturer with the trade name, nominal size, type, class, and the date of manufacture, in alkali resistant ink or indelible paint. Each carton containing coupling sleeves shall be marked by the manufacturer with the nominal size, type, and class for the conduit with which it shall be used.

14. Packaging

14.1 Conduit and couplings shall be prepared for commercial shipment so as to ensure acceptance by common or other carriers.

14.2 Refer also to S1.1.

15. Keywords

15.1 conduit; fiber-cement

SUPPLEMENTARY REQUIREMENTS

The following supplementary requirements shall apply when material is supplied under this specification for U.S. Government procurement:

S1. Packaging

S1.1 Unless otherwise specified in the contract, the material shall be packaged in accordance with the producer's standard practice which will be acceptable to the carrier at lowest rates. Containers and packing shall comply with Uniform Freight Classification Rules or National Motor Freight Classification Rules. Marking for shipment of such material shall be in accordance with Fed. Std. No. 123 for civil agencies and MIL-STD-129 for military agencies.

S2. Responsibility for Inspection

S2.1 Unless otherwise specified in the contract or purchase order, the producer is responsible for the testing of all material to ensure compliance with the requirements specified herein. Except as otherwise specified in the contract or order, the producer will use suitable facilities for the performance of the inspection and test requirements specified herein, unless disapproved by the purchaser. The purchaser shall have the right to perform any of the inspections and tests set forth in this specification where such inspections are deemed necessary to ensure that material conforms to prescribed requirements.

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