



Designation: D628/D628M – 95 (Reapproved 2017)

Standard Specification for Asbestos Tubular Sleeving¹

This standard is issued under the fixed designation D628/D628M; 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.

1. Scope

1.1 This specification covers woven and braided asbestos tubular sleeving having a minimum of 75 mass % of asbestos fiber, excluding the mass of other inorganic strands which may be present.

1.2 The values stated in either SI units or inch-pound units are to be regarded separately as standard. The values stated in each system may not be exact equivalents; therefore, each system shall be used independently of the other. Combining values from the two systems may result in non-conformance with the standard.

1.3 **Warning**—Breathing of asbestos dust is hazardous. Asbestos and asbestos products present demonstrated health risks for users and for those with whom they come into contact. In addition to other precautions, when working with asbestos-cement products, minimize the dust that results. For information on the safe use of chrysotile asbestos, refer to “Safe Use of Chrysotile Asbestos: A Manual on Preventive and Control Measures.”²

1.4 The following safety hazards caveat pertains only to the test methods, Section 13, described in this specification. *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. For specific safety hazard, see 1.3.*

1.5 *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.*

¹ This specification is under the jurisdiction of ASTM Committee C17 on Fiber-Reinforced Cement Products and is the direct responsibility of Subcommittee C17.03 on Asbestos - Cement Sheet Products and Accessories.

Current edition approved June 1, 2017. Published July 2017. Originally approved in 1941. Last previous edition approved in 2009 as D628/D628M – 95(2009)^{ε1}. DOI: 10.1520/D0628_D0628M-95R17.

² Available from The Asbestos Institute, Online, http://www.chrysotile.com/en/sr_use/manual.htm.

2. Referenced Documents

2.1 ASTM Standards:³

- D76 Specification for Tensile Testing Machines for Textiles
- D123 Terminology Relating to Textiles
- D299 Specification for Asbestos Yarns
- D1118 Test Method for Magnetic Rating of Asbestos Fiber and Asbestos Textiles
- D1682 Test Method for Breaking Load and Elongation of Textile Fabric (Withdrawn 1992)⁴
- D1777 Test Method for Thickness of Textile Materials
- D1910 Methods of Test for Construction Characteristics of Woven Fabrics; Replaced by D 3773, D 3774, D 3775, D 3776, D 3882, D 3883 (Withdrawn 1981)⁴
- D1918 Test Method for Asbestos Content of Asbestos Textiles
- D2100 Specification for Asbestos Textiles Used for Electrical Insulating Purposes
- D2946 Terminology for Asbestos and Asbestos-Cement Products
- E177 Practice for Use of the Terms Precision and Bias in ASTM Test Methods

3. Terminology

3.1 For definitions of other textile terms used in this specification, refer to Terminology D123. For asbestos terms, refer to Terminology D2946.

3.2 Definitions:

3.2.1 *asbestos fiber, n*—the hydrous magnesium silicate serpentine mineral designated as chrysotile and having an empirical formula $\text{Mg}_3\text{Si}_2\text{O}_5(\text{OH})_4$.

3.2.2 *atmosphere for testing, n*—for asbestos textiles, air maintained at a relative humidity of $50 \pm 2\%$ at $21 \pm 1^\circ\text{C}$.

3.2.3 *sleeving, n*—in textiles, woven or braided fabric of tubular form.

³ 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.

⁴ The last approved version of this historical standard is referenced on www.astm.org.

4. Classification

4.1 *Classes*—The classes of asbestos tubular sleeving are based on the nature of the yarns from which they are braided or woven.

4.1.1 *Class A*—Tubular sleeving constructed of asbestos yarns containing no reinforcing strands.

4.1.2 *Class B*—Tubular sleeving constructed of asbestos yarns containing wire reinforcement.

4.1.3 *Class C*—Tubular sleeving constructed of asbestos yarns containing organic reinforcing strands.

4.1.4 *Class D*—Tubular sleeving constructed of asbestos yarns containing nonmetallic inorganic reinforcing strands.

4.1.5 *Class E*—Tubular sleeving constructed of two or more of the yarns used in sleeving of Classes A through D.

4.2 *Grades*—The grades of asbestos tubular sleeving are based on the mass % of asbestos content as stated in [Table 1](#).

4.3 Electrical Insulation Classification:

4.3.1 Asbestos tubing as made for the electrical industry is furnished in three types, classified on the basis of magnetic rating determined by Test Method [D1118](#), which serve to identify performance limits.

Type II—Magnetic Rating 0.75 maximum

Type IV—Magnetic Rating 2.00 maximum

Type VI—Magnetic Rating 4.00 maximum

4.3.2 *Type II* is intended only for special applications where the asbestos is of primary importance as electrical insulation used on magnet wire and when used primarily as a dielectric.

4.3.3 *Type IV* is intended for use where the asbestos is of secondary importance as electrical insulation and where it is applied in combination with other materials of comparably higher dielectric strength, as in the construction of heat and flame resistant electrical insulating walls over unit conductors of electric cables.

4.3.4 *Type VI* is intended for use where the asbestos is of minor importance as a dielectric, as in the construction of filler, or heat and flame resistant walls of electric cables, or when used as a lining for control enclosures (arc chutes) subject to exposure to electric arcs.

5. Ordering Information

5.1 The following information may be specified on the order:

5.2 *Dimensions*, including inside diameter, wall thickness, and the number of ends per bobbin.

5.3 *Materials and Manufacture*, including the number of carriers, the yarn number, and the class, grade, and type.

5.4 *Length per Unit Mass (Weight)*.

5.5 *Limits on the Number of Knots and Imperfections*.

5.6 *Braided or Woven Construction*.

5.7 *With or Without Any Surface Treatment*, such as dust suppressant or sizing treatment.

5.8 *Quantity Required*, expressed in length of tubing.

5.9 See Section [16](#).

6. Materials and Manufacture

6.1 *Yarn*—Tubular asbestos sleeving shall be uniformly braided or woven from a specified grade of asbestos yarn with or without reinforcement.

6.2 *Wire Reinforcement*—The wire reinforcement may be brass, copper, zinc, nickel, nichrome, inconel, monel, or other metal or alloy as specified in the order.

6.3 *Organic Reinforcement*—The organic reinforcement may be cotton, nylon, rayon, or other spun or filament yarn(s) as specified in the order.

6.4 *Inorganic Reinforcement*—The inorganic reinforcement may be glass, or other ceramic or vitreous, spun or filament yarn(s) as specified in the order.

7. Chemical Composition

7.1 The asbestos content shall comply with the grade designation as in [Table 1](#).

8. Physical Properties

8.1 Tubing for electrical insulation shall conform to Specification [D2100](#).

8.2 The magnetic rating shall comply with the classification type in [4.3](#).

9. Mechanical Properties

9.1 *Tensile (Breaking) Strength*:

9.1.1 *Braided Sleeving*—Tensile (breaking) strength is not a requirement.

9.1.2 *Woven Sleeving*—The tensile (breaking) strength (breaking load) of woven asbestos tubular sleeving shall be as agreed upon between the purchaser and the seller.

10. Dimensions, Mass, and Permissible Variations

10.1 *Inside Diameter*—The tolerances for the inside diameter of asbestos tubular sleeving shall be as agreed upon by the purchaser and the seller.

10.2 *Wall Thickness*—The wall thickness of asbestos tubular sleeving shall be within the following limits:

Nominal Wall Thickness, mm [in.]	Permissible Limits, mm [in.]
0.8 [$\frac{1}{32}$]	0.25 [± 0.010]
1.6 [$\frac{1}{16}$]	0.35 [± 0.015]
3.2 [$\frac{1}{8}$]	0.75 [± 0.030]

10.3 *Mass per Unit Length*—The mass of asbestos tubular sleeving shall be within $\pm 10\%$ of the specified mass.

10.4 *Fabric Count*:

10.4.1 *Woven Sleeving*—The number of warp ends per unit of length and the number of filling picks per unit of length in

TABLE 1 Grades of Asbestos Tubular Sleeving

Grade	Asbestos Content, mass %
Commercial	75 up to but not including 80
Underwriters	80 up to but not including 85
A	85 up to but not including 90
AA	90 up to but not including 95
AAA	95 up to but not including 99
AAAA	99 to 100 inclusive

woven asbestos tubular sleeving shall be within $\pm 10\%$ of the specified fabric count.

10.4.2 Braided Sleeving—The number of picks or cross-overs per unit of length in braided asbestos tubular sleeving shall be within $\pm 10\%$ of the specified fabric count.

10.5 Yarn Number (Cut)—The yarn number (cut) shall be as specified and shall conform to the requirements stated in Specification **D299**.

11. Sampling

11.1 Divide the material to be tested into lots as specified in **Table 2**. From each lot, take a lot sample of three rolls or spools randomly selected. Cut one specimen of at least 1 m [1 yd] from each roll or spool in the lot sample.

12. Specimen Preparation

12.1 Condition all specimens (without preconditioning) for a minimum of 4 h, or until the specimen shows no progressive change in mass of more than 0.1 % after an exposure of 0.5 h, in an atmosphere having a relative humidity of $50 \pm 2\%$ at $21 \pm 1^\circ\text{C}$.

13. Test Methods

MENSURATION

13.1 Scope—This test method covers the determination of inside diameter, wall thickness, mass per unit length (weight), fabric count, yarn number, number of carriers, number of ends on bobbin, and number of imperfections for asbestos tubing.

13.2 Significance and Use—The mensuration results identify the tubing with regard to all its significant dimensions. They are used to determine the suitability of given asbestos tubing for specific applications.

13.3 Apparatus:

13.3.1 Mandrels—Smooth cylindrical tubes or rods within 0.25 mm [0.010 in.] of the specified diameter, with a smooth rounded end, and at least 300 mm [1 ft] in length.

13.3.2 Steel Tape or Rigid Rule, graduated in 1-mm [$\frac{1}{32}$ -in.] increments at least 600 mm [2 ft] in length.

13.3.3 Slide Caliper, graduated to 1 mm [$\frac{1}{32}$ in.].

13.3.4 Gage, deadweight type, equipped with a dial graduated to read directly to 0.025 mm [0.001 in.], having a circular presser foot with a diameter of 9.5 ± 0.025 mm [0.375 ± 0.001 in.]. The presser foot and moving parts connected therewith shall be weighted so as to apply a total load of 1.67 ± 0.03 N [6 ± 0.1 ozf] equivalent to 23 kPa [3.4 psi] to the specimen (see **Note 1**).

NOTE 1—Table A1 of Method **D1777** lists some of the suppliers of apparatus of this type.

13.4 Hazards—Warning—see **1.3**.

13.5 Procedure:

13.5.1 Inside Diameter:

13.5.1.1 General Procedure—Determine the inside diameter of sleeving by the use of a mandrel of the specified diameter, as described in **13.3.1**. Slip the test specimen over the rounded end of the mandrel for a distance of approximately 300 mm [1 ft]. If the sleeving is of proper size, the specimen shall fit smoothly and snugly and shall show no undue disturbance of the construction due to forcing the specimen onto the mandrel. The procedure described in **13.5.1.2** may be used as an optional method for sleeving over 75 mm [3 in.] in inside diameter.

13.5.1.2 Optional Procedure for Sleeving over 75 mm [3 in.] Inside Diameter—For testing sleeving over 75 mm [3 in.] inside diameter, place the test specimen in a relaxed condition and smooth out any wrinkles. Do not distort the construction of the specimen. Measure to the nearest 1 mm [$\frac{1}{32}$ in.] the width of the specimen by use of a steel tape or rigid rule, as described in **13.3.2**. Measure the wall thickness as directed in **13.5.2**. Calculate the inside diameter using **Eq 1**:

$$\text{Inside diameter} = [2(w - 2t)]/\pi \quad (1)$$

where:

w = outside flat width of specimen, and
 t = wall thickness of specimen.

13.5.2 Wall Thickness:

13.5.2.1 General Procedure—Insert a mandrel as specified in **13.3.1** of the nominal inside diameter of the sleeving into the specimen and measure the outside diameter with a slide caliper as described in **13.3.3**, to the nearest 1 mm [$\frac{1}{32}$ in.]. Calculate the wall thickness using **Eq 2**:

$$\text{Thickness} = (S - M)/2 \quad (2)$$

where:

S = outside diameter of the mandrel, plus two layers of the specimen, and
 M = outside diameter of the bare mandrel.

13.5.2.2 Make three measurements on each specimen and record the average of the nine thickness measurements.

13.5.2.3 The optional procedure described in **13.5.2.4** may be used for sleeving over 75 mm [3 in.] inside diameter.

13.5.2.4 Optional Procedure for Sleeving over 75 mm [3 in.] Inside Diameter—For testing sleeving having an inside diameter over 75 mm [3 in.], slit the test specimens and measure the thickness of the sleeving as directed in Method **D1777**, using a gage as described in **13.3.4**. Make three thickness measurements on each specimen. Record the average of the nine thickness measurements.

13.5.3 Mass per Unit Length:

13.5.3.1 Procedure—Cut a specimen not less than 600 mm [2 ft] long from each sample taken for test. Measure the length of the specimen to the nearest 1 mm [$\frac{1}{16}$ in.], using the steel tape or rigid rule. Make sure the specimen is free of tension, wrinkles, and folds. Weigh the specimen to the nearest 1 g [0.1 oz]. Use the average length and mass to calculate the average mass per unit length kg/100 m [lb/100 ft].

13.5.4 Fabric Count:

TABLE 2 Lot Sizes for Sampling

Inside Diameter		Lot (or fraction thereof)	
mm	[in.]	kg	[lb]
13 and under	[0.5 and under]	50	[100]
over 13 to 25	[over 0.5 to 1]	150	[300]
over 25 to 150	[over 1 to 6]	300	[600]
over 150	[over 6]	500	[1000]

13.5.4.1 *Braided Sleeving*—Determine the number of picks or crossovers of the yarn per unit of length by laying the sleeving on a flat surface and counting the crossovers of the single or multiple end yarns over a 75-mm [3-in.] length at five different places along the specimen.

13.5.4.2 *Woven Sleeving*—Determine the fabric count of the woven sleeving as directed in Test Method D3775.

13.6 Precision and Bias:

13.6.1 Precision:

13.6.1.1 *Repeatability*—The intralaboratory single-operator repeatability, (2S) as defined in Practice E177, obtained on any specimen of Underwriters' grade, type IV, plain (non-metallic) asbestos tubing with a thickness of 1.6 mm, an inside diameter of 12 mm and a mass per unit length (weight) of 5.65 kg/100 m is as follows:

Inside diameter	±16 % or ±1.9 mm
Wall thickness	±9 % or ± 0.15 mm
Mass per unit length (weight)	±13 % or ±43.5 kg/100 m
Carriers	100 % repeatable
Ends on bobbin	100 % repeatable
Yarn number	as in Specification D299
Imperfections	100 % repeatable

13.6.1.2 *Reproducibility*—Reproducibility has not yet been determined in accordance with the requirements of ASTM.

13.6.2 *Bias*—Bias cannot be established for lack of a referee test method except for the determinations of carriers, inside diameter, wall thickness, mass per unit length, fabric count, ends on bobbin, and imperfections for which there is zero bias and that may be used as referee methods.

NOTE 2—The precision and accuracy of the procedures in Specification D628 for yarn number, test specimen content, breaking strength, and magnetic rating are as specified in the specific test method for those properties.

13.7 *Determination of the Properties of Asbestos Yarn*—Proceed as in Specification D299.

13.8 *Determination of Electromagnetic Properties*—Proceed as in Specification D2100 and Test Method D1118.

13.9 *Determination of Asbestos Content*—Proceed as in Test Method D1918.

TENSILE (BREAKING) STRENGTH BREAKING (LOAD)

13.10 *Scope*—This test method covers the determination of the tensile strength, or breaking load, of asbestos tubular sleeving.

13.11 *Significance and Use*—The tensile strength, or breaking load of asbestos tubular sleeving, gives an evaluation of its resistance to traction loads. It may be used to determine the suitability of these products for processes and applications where they may be subject to pulling.

13.12 Apparatus:

13.12.1 *Tensile Testing Machine*—A constant-rate-of-traverse machine that can be operated at 300 ± 12 mm [12 ± 0.5 in.]/min and meets the requirements of Specification D76. If agreed upon by the purchaser and the seller, a CRE, constant-rate-of-extension machine, that can be operated at 12 ± 0.5 in. [305 ± 12 mm]/min, and meeting the requirements of Specification D76 may be used.

13.13 *Hazards*—Refer to 13.4.

13.14 *Procedure for Woven Tubing*—Slit the specimen longitudinally and determine the breaking load in the warp direction only. Use the grab test or the 25-mm [1-in.] ravelled strip test, whichever is applicable, as directed in Test Methods D1682. Use a testing machine as described in 13.5.3.1, operated at 5 ± 0.2 mm/s [12 ± 0.5 in./min].

13.15 *Precision and Bias*—Refer to Test Methods D1682.

14. Report

14.1 State that the specimens were tested as directed in ASTM Specification D628. Describe the material or product sampled and the method of sampling used.

14.2 Report the following information:

14.2.1 Average inside diameter,

14.2.2 Average wall thickness,

14.2.3 Average calculated mass in pounds per 100 ft [or kilograms per 100 m],

14.2.4 Average picks per unit of length for braided sleeving,

14.2.5 Average picks per unit of length for woven sleeving,

14.2.6 Properties of the asbestos yarn, if determined as in 13.7.

14.2.7 Asbestos content of each specimen tested and the average of all tested,

14.2.8 Average breaking strength for woven tubing, and

14.2.9 Average magnetic rating for tubing to be used for electrical insulation.

15. Rejection and Rehearing

15.1 The purchaser and the seller may agree on a procedure to establish conformance, including control charts furnished by the seller, a sequential-sampling plan, or the double-sampling plan outlined in 15.2.

15.2 In the absence of a control-chart or sequential-sampling plan, proceed as directed in 15.3 through 15.5.

15.3 If the test results for the lot conform to the tolerances for all characteristics specified in 5.1 through 10.5, consider the lot to be a valid delivery.

15.4 If the test results for one or more characteristics do not conform to the tolerances, take a new laboratory sample from either the original lot sample or a new lot sample. Test the new sample for the characteristic(s) that did not conform to the tolerances in the first test, and average the results of the first and the second samples as if all results were from one test of double the original number of specimens. If the new average(s) conform(s) to the specified tolerances, consider the lot to be a valid delivery.

15.5 If the test results obtained as directed in 15.4 do not conform to the specified tolerances, consider the lot to be a nonvalid delivery.

16. Packaging

16.1 Braided asbestos sleeving is normally furnished on spools or reels of approximately 5, 10, or 25 kg [10, 25, or 50 lb]. D1682-kg [10-lb] package may consist of a maximum of

two pieces; a 10-kg [25-lb] package a maximum of three pieces; and a 25-kg [50-lb] package a maximum of five pieces.

16.2 Woven asbestos sleeving is normally furnished in rolls of approximately 8, 15, and 30-m [25, 50, and 100-ft] lengths. No roll shall contain more than two pieces.

16.3 Woven and braided asbestos sleeving packages shall contain no pieces shorter than the lengths listed in the following table:

Inside Diameter, mm [in.]	Shortest length, m [ft]
Up to and including 15 [$\frac{1}{2}$]	8 [25]
Over 15 [$\frac{1}{2}$] up to and including 40 [$1\frac{1}{2}$]	6 [20]
Over 40 [$1\frac{1}{2}$] up to and including 75 [3]	5 [15]
Over 75 [3]	3 [10]

ASTM International 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, are entirely their own responsibility.

This standard is subject to revision at any time by the responsible technical committee and must be reviewed every five years and if not revised, either reapproved or withdrawn. Your comments are invited either for revision of this standard or for additional standards and should be addressed to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend. If you feel that your comments have not received a fair hearing you should make your views known to the ASTM Committee on Standards, at the address shown below.

This standard is copyrighted by ASTM International, 100 Barr Harbor Drive, PO Box C700, West Conshohocken, PA 19428-2959, United States. Individual reprints (single or multiple copies) of this standard may be obtained by contacting ASTM at the above address or at 610-832-9585 (phone), 610-832-9555 (fax), or service@astm.org (e-mail); or through the ASTM website (www.astm.org). Permission rights to photocopy the standard may also be secured from the Copyright Clearance Center, 222 Rosewood Drive, Danvers, MA 01923, Tel: (978) 646-2600; <http://www.copyright.com/>

At least 75 % of the quantity ordered shall be furnished as one-piece packages.

17. Keywords

17.1 asbestos; classification; sleeving; testing; tubing