



Standard Specification for Glass Fiber Greige Braided Tubular Sleeving¹

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1. Scope

1.1 This specification covers the requirements for continuous glass filament greige braided tubular sleeving and is suitable for use as electrical insulation and for structural and mechanical applications.

1.2 This specification is intended to assist ultimate users by designating the types of these products that are typical in the industry.

1.3 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 nonconformance with the standard.

1.4 *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:

- D 76 Specification for Tensile Testing Machines for Textiles²
- D 123 Terminology Relating to Textiles²
- D 350 Test Methods for Flexible Treated Sleeving Used for Electrical Insulation³
- D 374 Test Methods for Thickness of Solid Electrical Insulation³
- D 578 Specification for Glass Fiber Strands²
- D 579 Specification for Greige Woven Glass Fabrics²
- D 1059 Test Method for Yarn Number Based on Short-Length Specimens²
- D 1423 Test Method for Twist in Yarns by the Direct-Counting Method²
- D 1776 Practice for Conditioning Textiles for Testing²
- D 1907 Test Method for Yarn Number by the Skein Method²

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² *Annual Book of ASTM Standards*, Vol 07.01.

³ *Annual Book of ASTM Standards*, Vol 10.01.

D 3773 Test Methods for Length of Woven Fabric⁴

D 3775 Test Method for Fabric Count of Woven Fabric⁴

D 4963 Test Method for Ignition Loss of Glass Strands and Fabrics⁴

2.2 ANSI Standard:

ANSI/ASQC Z1.4 Sampling Procedures for Inspection by Attributes⁵

3. Terminology

3.1 Definitions:

3.1.1 *braid, n*—a narrow tubular or flat fabric produced by intertwining a single set of yarns according to a definite pattern (Maypole process).

3.1.2 *carrier, n*—in *braiding machinery*, that part of a braiding machine that holds the package of yarn, thread, or cord, and carries the yarn when the machine is operated.

3.1.3 *continuous filament yarn, n*—a yarn made of filaments that extend substantially throughout the length of the yarn.

3.1.4 *greige goods*—textile fabrics that have received no bleaching, dyeing, or finishing treatment after being produced by any textile process.

3.1.5 *sleeving*—braided, knitted, or woven fabric of cylindrical form having a width less than 100 mm (4 in.) (circumference less than 200 mm (8 in.)).

3.1.6 *tubing*—braided, knitted, or woven fabric of cylindrical form having a width of 100 mm (4 in.) or more (circumference of 200 mm (8 in.) or more).

3.1.7 For definitions of other textile terms used in this specification, refer to Terminology D 123.

CLASSIFICATION

4. Tubing Classifications

4.1 Glass fiber greige braided tubular sleeving is produced in one type and two styles within that type and uses yarns designated as directed in Specification D 578. The standard type and styles are:

4.1.1 *Type G*—Glass fiber greige braided tubular sleeving.

4.1.2 *Style A*—Glass fiber greige braided tubular sleeving having a nominal wall thickness of 0.20 mm (0.008 in.).

4.1.3 *Style B*—Glass fiber greige braided tubular sleeving having a nominal wall thickness of 0.15 mm (0.006 in.).

⁴ *Annual Book of ASTM Standards*, Vol 07.02.

⁵ Available from American National Standards Institute, 11 W. 42nd St., 13th Floor, New York, NY 10036.

REQUIREMENTS

5. Material

5.1 All yarns for braided tubular sleeving shall be electrical classification, continuous filament glass yarns, unless otherwise specified, have a “C” filament size designation which has a filament average diameter range from 4.00 to 4.74 μm (0.00016 to 0.000189 in.).

5.1.1 The fiber shall be free of any free alkali metal oxides, such as soda or potash, and foreign particles, dirt, and other impurities.

6. Yarn Number

6.1 The nominal yarn number of the yarns in the braided tubular sleeving shall be agreed upon between the purchaser and the supplier. The average yarn number shall fall within the interval: nominal yarn number ± 10 % of the nominal yarn number.

7. Strand Construction

7.1 The basis for specifying strand construction is given in Specification D 578. The construction of the component strands shall be agreed upon between the purchaser and the supplier.

8. Direction of Twist

8.1 Unless otherwise agreed upon between the purchaser and the supplier, the primary twist in the singles strands shall be “Z” twist and the final twist in the plied yarns shall be “S” twist.

9. Twist Level

9.1 The nominal twist in the component strands and the finished yarns shall be agreed upon between the purchaser and the supplier. The tolerances for the primary twist and the final twist shall conform to Table 1.

10. Ends Per Carrier

10.1 The nominal number of ends per carrier shall be agreed upon between the purchaser and the supplier. The observed number of ends per carrier shall not exceed that specified.

11. Number of Carriers

11.1 The nominal number of carriers shall be agreed upon between the purchaser and the supplier. The observed number

of carriers shall not be less than that specified.

12. Picks Per Unit Length

12.1 The nominal number of picks per centimetre (picks per inch) shall be agreed upon between the purchaser and the supplier. The observed number of picks per inch shall be within 1 pick per centimetre (3 picks per inch) of the specified value.

13. Inside Diameter

13.1 For braided tubular sleeving listed in Table 2, the nominal inside diameter shall conform to the requirements of Table 2. For sleeving not listed in Table 2, the nominal inside diameter shall be agreed upon between the purchaser and the supplier. The average inside diameter shall conform to the requirements of Table 3 unless otherwise agreed upon between the purchaser and the seller.

14. Wall Thickness

14.1 For braided tubular sleeving listed in Table 2, the nominal wall thickness shall conform to the requirements of Table 2. For sleeving not listed in Table 2, the nominal wall thickness shall be agreed upon between the purchaser and the supplier. The average wall thickness shall be within 0.03 mm (0.001 in.) of the nominal value.

15. Length Per Unit Mass

15.1 For braided tubular sleeving listed in Table 2, the nominal length per unit mass shall conform to the requirements of Table 2. For sleeving not listed in Table 2, the nominal length per unit mass shall be agreed upon between the purchaser and the supplier. The average length per unit mass shall be within the interval: nominal length per unit mass ± 10 % of the nominal length per unit mass.

16. Length Per Package

16.1 The nominal length of braided tubular sleeving on each package, such as a spool or serving tube, shall be no more than 108 m (120 yd) nor less than 72 m (80 yd) unless otherwise agreed upon between the purchaser and the supplier.

16.2 Unless otherwise agreed upon between the purchaser and the supplier, no piece of braided tubular sleeving shall be less than 14 m (15 yd) long and there shall be no more than three pieces in a package.

16.3 None of the sample tubes or serving spools shall contain more than the allowable pieces, and the combined length of all of the sample tubes or serving spools shall not be less than the combined length of those tubes or serving spools on the identification labels.

17. Ignition Loss

17.1 The organic content of greige braided tubular sleeving shall be at least 1.0 % and no greater than 4.0 % unless otherwise agreed upon between the purchaser and the supplier.

18. Visual Appearance

18.1 The braided tubular sleeving shall be generally uniform in quality and condition, clean, smooth, and free of foreign particles and defects detrimental to fabrication, appearance, or performance.

TABLE 1 Twist Tolerances

	Tolerances
Turns per Centimetre:	
From zero to 0.4, incl	±0.1 turn per centimetre
Over 0.4 and up to and including 4.0	±0.2 turn per centimetre
Over 4	±5.0 % of the specified average twist
Turns per Metre:	
From zero to 40, incl	±10 turns per metre
Over 40 and up to and including 400	±20 turns per metre
Over 400	±5.0 % of the specified average twist
Turns per Inch:	
From zero to 1, incl	± 0.25 turn per inch
Over 1 and up to and including 10	±0.5 turn per inch
Over 10	± 5.0 % of the specified average twist

TABLE 2 Physical Properties of Typical Continuous Filament Glass Type G Braided Tubular Sleaving

Industry Size Designation, in.	Inside Diameter		Wall Thickness		Length Per Unit Mass	
	mm	in.	mm	in.	m/kg	yd/lb
Style A:						
1/16	1.6	0.063	0.20	0.008	473	235
1/8	3.2	0.125	0.20	0.008	225	112
3/16	5.0	0.188	0.20	0.008	172	85
1/4	6.3	0.250	0.20	0.008	134	66
5/16	8.0	0.313	0.20	0.008	114	57
3/8	10.0	0.375	0.20	0.008	93	46
1/2	12.5	0.500	0.20	0.008	85	42
5/8	16.0	0.625	0.20	0.008	71	35
3/4	19.0	0.750	0.20	0.008	62	31
7/8	22.4	0.875	0.20	0.008	58	29
1	25.0	1.000	0.20	0.008	43	21
Style B:						
1/16	1.6	0.063	0.15	0.006	763	378
1/8	3.2	0.125	0.15	0.006	422	209
3/16	5.0	0.188	0.15	0.006	308	153
1/4	6.3	0.250	0.15	0.006	243	121
5/16	8.0	0.313	0.15	0.006	183	91
3/8	10.0	0.375	0.15	0.006	145	72
1/2	12.5	0.500	0.15	0.006	115	57

TABLE 3 Tolerances—Inside Diameter

Industry Size Designation, mm (in.)	Tolerance, mm	Tolerance, in.
1.6 (1/16)	+ 0.4 - 0	+ 0.015 - 0
3.2 (1/8)	+ 0.4 - 0	+ 0.015 - 0
5.0 (3/16)	+ 0.4 - 0	+ 0.015 - 0
6.3 (1/4)	+ 0.8 - 0	+ 0.031 - 0
8.0 (5/16)	+ 0.8 - 0	+ 0.031 - 0
10.0 (3/8)	+ 0.8 - 0	+ 0.031 - 0
Over 10.0 (3/8)	+ 1.6 - 0	+ 0.062 - 0

18.2 The braided tubular sleaving in the laboratory sample for the visual appearance shall be examined on both sides for the defects listed in Table 4, and the acceptable quality levels (AQLs) shall be 0.65 major and 2.5 total (major and minor combined) defects per hundred units of braided tubular sleaving unless otherwise agreed upon between the purchaser and the supplier.

SAMPLING AND CONDITIONING

19. Sampling

19.1 *Lot Size*—A lot is defined as a single shipment of a single type of braided tubular sleaving. A lot may constitute all or part of a single customer order.

19.2 *Lot Sample*—Unless otherwise agreed upon, take at random as a lot sample the number of tubes or serving spools

of braided tubular sleaving specified in ANSI/ASQC Z1.4 and a single sampling plan.

19.3 *Laboratory Sample*—As a laboratory sample, take the following samples:

19.3.1 For visual appearance and length of braided tubular sleaving, the tubes or serving spools in the lot sample serve as the laboratory sample.

19.3.2 For other properties, take at random from the tubes or serving spools in the lot sample the number of tubes or serving spools specified in Table 5.

19.4 *Test Specimens*—For visual appearance and braided tubular sleaving length, the tubes or serving spools in the lot sample serve as test specimens. For other properties, take material from the outside of each tube or serving spool in the laboratory sample as a source of test specimens required in the respective test methods in this specification after first discarding a minimum of 1 m (1 yd) from the very outside of the tube or serving spool.

20. Conditioning

20.1 Condition the laboratory samples for a period of at least 5 h in the atmosphere as specified in Practice D 1776. Test under the same conditions. Preconditioning is not required.

NOTE 1—Glass textiles are normally tested under either the atmosphere specified for textiles or for plastics depending on their end use.

TEST METHODS

21. Material

21.1 Accept the supplier certification that the material is of the correct classification as specified in Specification D 578.

TABLE 4 Visual Examination of Braided Tubular Sleaving

Defect ^A	Classification	
	Major	Minor
Holes, cuts, tears	X	
Spots or stains:		
12 mm (1/2 in.) or more in length	X	
Less than 12 mm (1/2 in.) in length		X
Tender or weak sections	X	
Broken or missing yarns	X	
Dirty yarns		X

^A Clearly visible at normal inspection distance of approximately 1 m or 3 ft.

TABLE 5 Sample Size Determination for Construction and Physical Properties

Lot Size in Units, m or yd	Sample Size, Number of Units
800 or less	2
801 up to and including 22 000	3
22 001 and over	5

Verify that the fiber is continuous filament, if not specified otherwise, during testing for strand construction as directed in Section 24. Determine the freedom from detrimental impurities during the inspection for fabric appearances as directed in Section 35.

22. Filament Diameter

22.1 Determine the filament diameter for the braided tubular sleeving yarns as directed in Specification D 578 by using 50 individual filaments from one yarn specimen from each of the selected tubes or serving spools in the laboratory sample.

23. Yarn Number-Sleeving Component Yarns

23.1 Determine the size-free yarn number in tex (or yards per pound) of the yarns in the braided tubular sleeving as directed in Test Method D 1907, Option 1, using a skein length of 1 m or 1 yd for each specimen and one specimen from each of the selected tubes or serving spools in the laboratory sample.

23.1.1 Precondition by placing test specimens in a muffle furnace and heat to $625 \pm 25^\circ\text{C}$ ($1157 \pm 45^\circ\text{F}$) for 15 min, then cool to room temperature for 15 min.

24. Strand Construction

24.1 Verify the number of singles strands and the number of plied or cabled strands on one test specimen from each of the selected tubes or serving spools in the laboratory sample while determining the twist direction or twist level. See Section 21.

25. Direction of Twist

25.1 Verify the direction of twist in each strand of the yarns of the braided tubular sleeving as directed in Test Method D 1423 for one test specimen from each of the selected tubes or serving spools in the laboratory sample.

26. Twist Level

26.1 Determine the twist level in each of the component strands in the braided tubular sleeving as directed in Test Method D 1423 upon five test specimens from each of the selected tubes or serving spools in the laboratory sample.

27. Ends Per Carrier

27.1 Verify the ends per carrier in the braided tubular sleeving for one test specimen from each of the selected tubes or serving spools in the laboratory sample. This is determined by cutting through a length of braided tubular sleeving at right angles to the axis of the braided sleeving and then counting the number of cut yarn ends observed in each weave of the braided tubular sleeving.

28. Number of Carriers

28.1 Verify the number of carriers in the braided tubular sleeving for one test specimen from each of the selected tubes or serving spools in the laboratory sample. This is determined while making ends per carrier determinations and counting the total number of cut yarn ends observed and dividing by the ends per carrier.

29. Picks Per Unit Length

29.1 Determine the picks per centimetre (picks per inch) of the braided tubular sleeving as directed in Test Method D 3775

using three test specimens from each of the selected tubes or serving spools in the laboratory sample except:

29.1.1 Measure the number of picks per centimetre (picks per inch) over a 75-mm (3-in.) length after the braided tubular sleeving has been placed snugly upon a mandrel having the same diameter as the specified inside diameter of the sleeving. Use a standard pick counter in counting the number of picks per centimetre (picks per inch). Take the average of the three measurements as the number of picks per centimetre (picks per inch) 25 mm (1 in.).

NOTE 2—"Picks" is a common term used by industry when referring to the yarn crossover points laying crosswise in braided tubular sleeving created by the braiding action.

30. Inside Diameter

30.1 Determine the inside diameter of the braided tubular sleeving as directed in Test Methods D 350, using one test specimen from each of the selected tubes or serving spools in the laboratory sample.

31. Wall Thickness

31.1 Determine the wall thickness of the braided tubular sleeving as directed in Test Methods D 350, using one test specimen from each of the selected tubes or serving spools.

32. Length Per Unit Mass

32.1 Determine the length per unit mass in tex (or yards per pound) of the braided tubular sleeving as directed in Test Method D 1059, using a skein length of 60 cm (2 ft) for each specimen and one specimen from each of the selected tubes or serving spools in the laboratory sample except:

32.1.1 Slip the braided tubular sleeving over a mandrel approximately 0.9 m (1 yd) in length, the diameter of which corresponds to the specified inside diameter of the sleeving. Pull the material so it is snug against the mandrel. Measure a specimen 60 cm (2 ft) in length accurately from the center of this piece and cut it off with a sharp instrument. Remove the 60-cm specimen from the mandrel. Weigh this specimen on an analytical balance or other scale of equal accuracy and calculate the tex (or yards per pound).

32.1.2 Determine the average length per unit mass of the specimens [without exposure in a muffle furnace to $625 \pm 25^\circ\text{C}$ ($1157 \pm 45^\circ\text{F}$)].

32.2 The precision and bias of this procedure are as specified in Test Method D 1059.

33. Length Per Package

33.1 Measure the braided tubular sleeving length on each selected tube or serving spools in the lot sample as directed in Method D 3773, using any one of the four optional procedures. Verify that none of the sample tubes or serving spools contains more than the allowable number of pieces. Total the lengths for each of the tubes or serving spools measured and compare to the total of the yardages specified on the identification labels for those tubes or serving spools. In case of dispute, use Option A of Test Method D 3773 to resolve the dispute.

34. Ignition Loss

34.1 Determine the ignition loss of the braided tubular

sleeving as directed in Test Method D 4963, using a skein length of 60 cm (2 ft) for each specimen and one specimen from each of the selected tubes or serving spools in the laboratory sample.

35. Visual Appearance

35.1 Examine the braided tubular sleeving for visual appearance as directed in Specification D 579, using each selected tube or serving spool in the laboratory sample except both sides of the braided tubular sleeving are examined and the inspection machine is modified to accept the tube or serving spool.

PUT-UP, PACKAGING, AND MARKING

36. Put-Up

36.1 The braided tubular sleeving shall be wound on suitable tubes or serving spools having a $162 \pm 3\text{-mm}$ ($6\frac{3}{8} \pm \frac{1}{8}\text{-in.}$) or $213 \pm 3\text{-mm}$ ($8\frac{3}{8} \pm \frac{1}{8}\text{-in.}$) length and a 16-mm ($\frac{5}{8}\text{-in.}$) inside diameter in such a manner as to form cylindrical, self-supporting coils using a 152-mm (6-in.) or 203-mm (8-in.) traverse unless otherwise agreed upon between the purchaser and the supplier.

36.1.1 The supplier may use his standard winding practice when agreed upon between the purchaser and the supplier.

36.2 Unless otherwise agreed upon between the purchaser and the supplier, braided tubular sleeving pieces on a tube or serving spool shall be suitably overlapped and firmly joined (leading piece outside) and the joints shall be suitably marked for ready detection.

37. Packaging

37.1 Each tube or serving spool of braided tubular sleeving, put-up as specified, shall be packaged to afford adequate protection against physical damage during shipment from the supply source to the receiving activity. The supplier may use his standard practice when it meets this requirement.

38. Marking

38.1 Each package shall be marked to show the following information; characters shall be of such size as to be clearly

legible and shall not be obliterated by normal handling:

Braided Tubular Sleeving“ E” Glass Style _____ Greige
Type G

ASTM D581

Length

Inside Diameter

Wall Thickness

Purchase Order Number

Manufacturer’s Identification

CONFORMANCE AND INDEXING

39. Conformance

39.1 The purchaser and the supplier may agree on a procedure to establish conformance, including control charts furnished by the supplier, a sequential sampling plan, or double-sampling plan outlined in 39.2.

39.2 In the absence of a control chart or sequential sampling plan, proceed as directed in 39.2.1 through 39.2.3.

39.2.1 If the test results for a lot conform to the requirements for all characteristics listed in Sections 5-18, and Tables 2 and 1, the lot shall be considered acceptable.

39.2.2 If the test results for one or more characteristics do not conform to the requirements, 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 requirements in the first test and average the results of the first and second samples as if they were one test of double the original number of specimens. If the new average(s) conform(s) to the specified requirements, the lot shall be considered acceptable.

39.2.3 If the test results obtained as directed in 39.2.2 do not conform to the specified requirements, the lot shall be considered unacceptable.

40. Keywords

40.1 appearance; carriers; construction designation; diameter; glass sleeving; ignition loss (organic content); length; length per unit mass; thickness

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