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SUPERSEDING
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MILITARY SPECIFICATION

# YARN, CORD, SLEEVING, CLOTH, AND TAPE-GLASS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification primarily covers the basic forms of untreated glass fiber used by themselves or as components of other materials.

1.2 Classification. Glass fiber shall be of the following classes and forms, as specified (see 6.2):

Class C - Continuous filament
Class S - Staple fiber

Form 1 - Yarn
Form 2 - Cordage
Form 3 - Sleeving
Form 4 - Cloth
Form 5 - Tape

1.3 Designations.

1.3.1 General. The basic designation common to all glass fiber is formed as follows:

1.3.1.1 Glass composition. The first letter designates glass composition. For all electrical applications, this is the letter "E".

1.3.1.2 Fiber class. The second letter designates fiber class "C" for continuous filament; "S" for staple fiber.

1.3.2 Form 1, yarn. For form 1, the basic designation is followed by the following designations:

1.3.2.1 Fiber diameter. The third letter designates the nominal average filament or staple fiber diameter, as shown in table I.

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* TABLE I. Letter designations for fiber diameters of yarn

| Filament or staple fiber size letter symbol | Nominal average fiber diameter (inches) | Made in fiber classes |
|---|---|---|
| B | 0.00014 | C |
| C | 0.00018 | C |
| D | 0.00023 | C |
| D-E | 0.00025 | C |
| E | 0.00028 | C and S |
| G | 0.00038 | C and S |
| H | 0.00042 | C |
| K | 0.00053 | C |

1.3.2.2 Count. Following the first three letters is a number which represents one-hundredth of the yardage per pound per strand of bare glass.

1.3.2.3 Plies. The next number indicates the plies, and is shown in one of the following ways:

1.3.2.3.1 Continuous filament yarn. The first digit indicates the number of original strands twisted; and the second, the number of yarns plied.

1.3.2.3.2 Staple fiber yarn. A single digit indicates the number of plies.

1.3.2.4 Examples. ECD 450-3/3 indicates electrical-grade, continuous filament yarn made from 0.00023 inch average diameter fiber, having a nominal yardage of 45,000 yards per pound per strand of bare glass and made up of nine strands (three plies, each consisting of three strands twisted together before plying). ECD-E 150-1/0 indicates electrical-grade continuous filament yarn made from 0.00025 inch average diameter fiber, having a nominal yardage of 15,000 yards per pound per strand and made up of a single strand. ESE 12.5/2 indicates electrical-grade, staple-fiber yarn made from 0.00028 inch average diameter, having a nominal yardage of 1,250 yards per pound per strand and made up of two plies.

1.3.3 Form 2, cordage. For form 2, the basic designation is followed by the following designations:

1.3.3.1 Construction. The first number indicates the construction.

1.3.3.2 Diameter. The second number indicates relatively increasing sizes of cordage.

1.3.4 Form 3, sleeving. For form 3, the basic designation is followed by the following designations:

1.3.4.1 Interlacing yarn. The third letter "C" indicates continuous filament used for the interlacing yarn.

1.3.4.2 Construction. The last letter indicates the construction "A" for 0.008 inch wall; "B" for 0.006 inch wall.

1.3.4.3 Example. ECC-B indicates electrical-grade sleeving, with continuous filament in both major and minor yarns, having a 0.006 inch nominal wall thickness.

1.3.5 Form 4, cloth. For form 4, the fiber class in the basic designation represents the fiber class in the warp. The basic designation is followed by the following designations:

1.3.5.1 Filling. The third letter represents the fiber class in the filling.

1.3.5.2 Cloth number. Following the letter designation is a cloth number identifying the general construction of the cloth (see tables VII and VIII).

1.3.5.3 Example. ESS-248 indicates a cloth construction of electrical-grade staple fiber in both the warp and filling.

1.3.6 Form 5, tape. For form 5, the first three letters of the designations are compounded as they are for form 4, and are followed by the following designations:

1.3.6.1 Texture. A final letter follows the three letters and indicates the texture: "A" for medium texture; "B" for close texture.

1.3.6.2 Example. ECC-B indicates an electrical-grade, continuous filament, close textured tape.

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein:

SPECIFICATIONS

FEDERAL

UU-P-268 - Paper, Kraft, Untreated, Wrapping.
PPP-B-576 - Boxes, Wood, Cleated, Veneer, Paper Overlaid.

PPP-B-591 - Boxes, Fiberboard, Wood-Cleated.
PPP-B-601 - Boxes, Wood, Cleated-Plywood.
PPP-B-621 - Boxes, Wood, Nailed and Lock-Corner.
PPP-B-636 - Boxes, Shipping, Fiberboard.
PPP-F-320 - Fiberboard: Corrugated and Solid, Sheet Stock (Container Grade), and Cut Shapes.
PPP-T-45 - Tape, Gummed, Paper, Reinforced and Plain, For Sealing and Securing.

MILITARY

MIL-L-10547 - Liners, Case, and Sheet, Overwrap; Water - Vapor-proof or Waterproof, Flexible.

STANDARDS

FEDERAL

FED-STD-191 - Textile Test Methods.

MILITARY

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes.
MIL-STD-129 - Marking for Shipment and Storage.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless a specific issue is identified, the issue in effect on date of invitation for bids or request for proposal shall apply:

National Motor Freight Traffic Association, Inc., Agent

National Motor Freight Classification

(Application for copies should be addressed to the American Trucking Associations, Inc., Tariff Order Section, 1616 P Street, N.W., Washington, D.C. 20036.)

Uniform Classification Committee, Agent

Uniform Freight Classification

(Application for copies should be addressed to the Uniform Classification Committee, Room 1106, 222 South Riverside Plaza, Chicago, Illinois 60606.)

3. REQUIREMENTS

3.1 Material.

3.1.1 Fibers. The fibers shall be free from any free alkali metal oxides, such as soda or potash, and from foreign particles, dirt and other impurities.

3.1.1.1 Staple fiber. Staple glass fiber is produced by blowing molten glass into fibers of varying lengths to provide characteristics resembling those of cotton or worsted fibers in their subsequent textile processing. The individual fibers are smooth and substantially cylindrical, and the lengths may vary up to approximately 15 inches.

3.1.1.2 Continuous filament. Continuous filament glass fiber is produced by mechanical drawing of the molten glass into fibers of indefinite length that have a general resemblance to natural silk and rayon in a manner in which they are later processed.

3.2 Design and construction.

3.2.1 Form 1, yarn.

3.2.1.1 Class C, continuous filament yarn. Continuous filament bare glass untreated yarn shall be furnished in conformance with table II, as specified (see 6.2).

TABLE II. Form 1, class C, continuous filament yarn

| Yarn No. 1/ | Twist, turns per inch | Ply, turns per inch | Diameter of yarn 1/ | Yards per pound 2/ | Minimum breaking strength 2/ |
|---|---|---|---|---|---|
| | (Z-twist) | (S-twist) | (inches) | | (pounds) |
| ECB150-1/0 | 1.0 | - | 0.0080 | 15,000 | 4.0 |
| ECB150-1/0 | 3.0 | - | 0.0080 | 15,000 | 4.0 |
| ECB150-2/0 | 3.0 | - | 0.0097 | 7,500 | 8.0 |
| ECB150-4/0 | 3.0 | - | 0.0137 | 3,750 | 16.0 |
| ECC150-1/0 | 1.0 | - | 0.0080 | 15,000 | 3.8 |
| ECC150-1/0 | 4.0 | - | 0.0080 | 15,000 | 3.5 |
| ECC150-2/0 | 4.0 | - | 0.0097 | 7,500 | 7.5 |
| ECC150-3/0 | 4.0 | - | 0.0119 | 5,000 | 11.0 |
| ECC150-4/0 | 4.0 | - | 0.0137 | 3,750 | 14.5 |
| ECD1800-1/0 | 1.0 | - | 0.0026 | 180,000 | 0.25 |
| ECD900-1/0 | 1.0 | - | 0.0028 | 90,000 | 0.5 |

TABLE II. Form 1, class C, continuous filament yarn (cont'd)

| Yarn No. 1/ | Twist, turns per inch | Ply, turns per inch | Diameter of yarn 1/ | Yards per pound 2/ | Minimum breaking strength 2/ |
|---|---|---|---|---|---|
| | (Z-twist) | (S-twist) | (inches) | | (pounds) |
| ECD900-1/0 | 5.0 | - | 0.0026 | 90,000 | 0.5 |
| ECD900-1/2 | 5.0 | 4.4 | 0.0040 | 45,000 | 1.1 |
| ECD450-1/0 | 1.0 | - | 0.0040 | 45,000 | 1.1 |
| ECD450-1/0 | 2.5 | - | 0.0040 | 45,000 | 1.1 |
| ECD450-1/0 | 5.0 | - | 0.0040 | 45,000 | 1.1 |
| ECD450-1/2 | 5.0 | 4.4 | 0.0074 | 22,500 | 2.2 |
| ECD450-1/3 | 5.0 | 4.4 | 0.0077 | 15,000 | 3.3 |
| ECD450-2/0 | 5.0 | - | 0.0056 | 22,500 | 2.2 |
| ECD450-2/2 | 5.0 | 4.4 | 0.0094 | 11,250 | 4.4 |
| ECD450-3/0 | 5.0 | - | 0.0074 | 15,000 | 3.3 |
| ECD450-3/2 | 5.0 | 4.4 | 0.0116 | 7,500 | 6.6 |
| ECD450-3/3 | 5.0 | 4.4 | 0.0119 | 5,000 | 9.9 |
| ECD450-3/5 | 5.0 | 4.4 | 0.0154 | 3,000 | 15.8 |
| ECD450-4/0 | 5.0 | - | 0.0084 | 11,250 | 4.4 |
| ECD450-4/3 | 5.0 | 4.4 | 0.0163 | 3,750 | 13.2 |
| ECD450-4/4 | 5.0 | 4.4 | 0.0195 | 2,805 | 17.6 |
| ECD450-4/5 | 5.0 | 4.4 | 0.0223 | 2,250 | 22.6 |
| ECD225-1/0 | 1.0 | - | 0.0065 | 22,500 | 2.4 |
| ECD225-1/0 | 2.0 | - | 0.0065 | 22,500 | 2.4 |
| ECD225-1/0 | 5.0 | - | 0.0065 | 22,500 | 2.4 |
| ECD225-1/2 | 5.0 | 4.4 | 0.0094 | 11,250 | 4.8 |
| ECD225-1/3 | 5.0 | 4.4 | 0.0102 | 7,500 | 7.2 |
| ECD225-2/0 | 5.0 | - | 0.0079 | 11,250 | 4.8 |
| ECD225-2/2 | 5.0 | 4.4 | 0.0133 | 5,625 | 9.6 |
| ECD225-3/0 | 5.0 | - | 0.0097 | 7,500 | 7.2 |
| ECD225-3/2 | 5.0 | 4.4 | 0.0167 | 3,750 | 14.4 |
| ECD225-4/3 | 5.0 | 4.4 | 0.0216 | 1,875 | 28.8 |
| ECD-E300-1/0 | 1.0 | - | 0.0057 | 30,000 | 1.9 |
| ECD-E150-1/0 | 1.0 | - | 0.0080 | 15,000 | 3.5 |
| ECD-E150-1/0 | 4.0 | - | 0.0080 | 15,000 | 3.5 |
| ECD-E150-2/0 | 4.0 | - | 0.0097 | 7,500 | 7.0 |
| ECD-E75-1/0 | 1.0 | - | 0.0106 | 7,500 | 5.7 |
| ECD-E75-1/0 | 4.0 | - | 0.0106 | 7,500 | 5.7 |
| ECD-E37-1/0 | 1.0 | - | 0.0156 | 3,700 | 11.2 |
| ECD-E37-1/0 | 4.0 | - | 0.0156 | 3,700 | 11.2 |
| ECE225-1/0 | 1.0 | - | 0.0065 | 22,500 | 2.2 |
| ECE225-1/0 | 5.0 | - | 0.0065 | 22,500 | 2.2 |
| ECE225-1/2 | 5.0 | 4.4 | 0.0094 | 11,250 | 4.4 |
| ECE225-1/3 | 5.0 | 4.4 | 0.0102 | 7,500 | 6.6 |

TABLE II. Form 1, class C, continuous filament yarn (cont'd)

| Yarn No. 1/ | Twist, turns per inch (Z-twist) | Ply, turns per inch (S-twist) | Diameter of yarn 1/ (inches) | Yards per pound 2/ | Minimum breaking strength 2/ (pounds) |
|---|---|---|---|---|---|
| ECE225 2/0 | 5.0 | - | 0.0079 | 11,250 | 4.4 |
| ECE225-2/2 | 5.0 | 4.4 | 0.0133 | 5,625 | 8.8 |
| ECE225-3/0 | 5.0 | - | 0.0097 | 7,500 | 6.6 |
| ECE225-3/2 | 5.0 | 4.4 | 0.0167 | 3,750 | 13.2 |
| ECE225-4/3 | 5.0 | 4.4 | 0.0216 | 1,875 | 26.4 |
| ECE225-2/5 | 5.0 | 4.4 | 0.0189 | 2,250 | 24.0 |
| ECG150-1/0 | 1.0 | - | 0.0080 | 15,000 | 3.0 |
| ECG150-1/2 | 4.0 | 3.8 | 0.0117 | 7,500 | 6.0 |
| ECG150-1/3 | 4.0 | 3.8 | 0.0127 | 5,000 | 9.0 |
| ECG150-2/0 | 4.0 | - | 0.0097 | 7,500 | 6.4 |
| ECG150-2/2 | 4.0 | 3.8 | 0.0169 | 3,750 | 12.0 |
| ECG150-2/3 | 4.0 | 3.8 | 0.0218 | 2,500 | 18.0 |
| ECG150-3/0 | 4.0 | - | 0.0119 | 5,000 | 9.6 |
| ECG150-3/2 | 4.0 | 3.8 | 0.0218 | 2,500 | 18.0 |
| ECG150-3/3 | 4.0 | 3.8 | 0.0236 | 1,665 | 27.0 |
| ECG150-3/4 | 4.0 | 3.8 | 0.0271 | 1,250 | 36.0 |
| ECG150-4/0 | 4.0 | - | 0.0137 | 3,750 | 12.8 |
| ECG150-4/2 | 4.0 | 3.8 | 0.0236 | 1,875 | 24.0 |
| ECG150-4/3 | 4.0 | 3.8 | 0.0240 | 1,250 | 36.0 |
| ECG150-4/4 | 4.0 | 3.5 | 0.0276 | 938 | 48.0 |
| ECG75-1/0 | 0.5 to 1.0 | - | 0.0106 | 7,500 | 5.7 |
| ECG75-1/0 | 4.0 | - | 0.0106 | 7,500 | 5.7 |
| ECG75-2/0 | 4.0 | - | 0.0149 | 3,750 | 11.4 |
| ECG75-1/2 | 4.0 | 3.8 | 0.0160 | 3,750 | 15.8 |
| ECG75-1/3 | 4.0 | 3.8 | 0.0175 | 2,500 | 17.1 |
| ECG75-2/2 | 4.0 | 3.8 | 0.0236 | 1,875 | 22.8 |
| ECG75-2/3 | 4.0 | 3.8 | 0.0271 | 1,250 | 34.2 |
| ECG37-1/0 | 0.5 to 1.0 | - | 0.0156 | 3,700 | 11.2 |
| ECG37-1/0 | 4.0 | - | 0.0156 | 3,700 | 11.2 |
| ECG37-1/2 | - | 3.8 | 0.0160 | 1,850 | 22.8 |
| ECG37-1/3 | - | 3.8 | 0.0175 | 1,230 | 34.2 |
| ECH25-1/0 | 0.5 to 1.0 | - | 0.0186 | 2,500 | 17.0 |
| ECH55-1/0 | 0.5 to 1.0 | - | 0.0125 | 5,500 | 9.5 |

TABLE II. Form 1, class C, continuous filament yarn (cont'd)

| Yarn No. 1/ | Twist, turns per inch (Z-twist) | Ply, turns per inch (S-twist) | Diameter of yarn 1/ (inches) | Yards per pound 2/ | Minimum breaking strength 2/ (pound) |
|---|---|---|---|---|---|
| ECK75-1/0 | 0.5 to 1.0 | - | 0.0106 | 7,500 | 5.7 |
| ECK75-2/0 | 4.0 | - | 0.0149 | 3,750 | 11.4 |
| ECK75-2/2 | 4.0 | 3.85 | 0.0236 | 1,875 | 22.8 |
| ECK37-1/0 | 0.5 to 1.0 | - | 0.0156 | 3,700 | 11.2 |
| ECK18-1/0 | 0.5 to 1.0 | - | 0.0206 | 1,800 | 23.0 |

1/ For engineering information only.

2/ See 3.2.1.3 for tolerances.

3.2.1.2 Class S, staple fiber yarn. Staple fiber bare glass untreated yarn shall be furnished in conformance with table III, as specified (see 6.2).

TABLE III. Form 1, class S, staple fiber yarn
Single yarn

| Yarn No. 1/ | Twist turns per inch (Z-twist) | Diameter of yarn 1/ (inches) | Yards per pound 2/ | Minimum breaking strength 2/ (pounds) |
|---|---|---|---|---|
| ESE70/1R 3/ | 8.5 | 0.010 | 7,000 | 1.7 |
| ESE50/1R 3/ | 8.5 | 0.012 | 5,000 | 2.8 |
| ESE25/1 | 8.5 | 0.016 | 2,570 | 4.7 |
| ESE12.5/1 | 4.0 | 0.023 | 1,250 | 9.0 |

TABLE III. Form 1, class S, staple fiber yarn
Two-ply yarn (cont'd)

| Yarn No. 1/ | Twist turns per inch | Ply turns per inch | Diameter of yarn 1/ | Yards per pound 2/ | Minimum breaking strength 2/ |
|---|---|---|---|---|---|
| | (Z-twist) | (S-twist) | (inches) | | (pounds) |
| ESE70/2R 3/ | 8.5 | 6.5 | 0.014 | 3,500 | 4.3 |
| ESE50/2R 3/ | 8.5 | 6.5 | 0.017 | 2,500 | 5.6 |
| ESE40/2R 3/ | 8.5 | 6.5 | 0.018 | 2,000 | 7.2 |
| ESE31/2 | 8.5 | 6.5 | 0.021 | 1,586 | 8.6 |
| ESE25/2 | 8.5 | 6.5 | 0.023 | 1,285 | 9.2 |
| ESE12.5/2 | 4.0 | 3.5 | 0.033 | 625 | 18.0 |
| ESE10.5/2 | 4.0 | 3.5 | 0.038 | 488 | 21.0 |
| ESE8.4/2 | 4.0 | 3.5 | - | 420 | 24.6 |
| ESE6.2/2 | 4.0 | 3.5 | 0.047 | 313 | 37.0 |

1/ For engineering information only.

2/ See 3.2.1.3 for tolerances.

3/ R- Indicates reinforcement with a continuous filament strand or yarn.

* 3.2.1.3 Tolerances. The following tolerances will be permitted for glass fiber yarn:

(a) Yards per pound - Plus or minus 10 percent for continuous filament yarns
Plus or minus 15 percent for staple fiber yarns

(b) No individual break shall be less than 80 percent of the minimum requirement.

3.2.1.4 Twist and ply. Plies yarn shall be furnished twist-against-twist, with Z-twist in the singles and S-twist in the ply.

* 3.2.1.5 Put-up. Unless otherwise specified (see 6.2), the yarn shall be put-up on tubes or cones, and the suppliers usual quantity of yarn will be acceptable. The tubes shall have an approximate inside diameter of 1-5/8 inches and the cones shall have an approximate inside diameter of 7/8 inch by 1-13/16 inches.

3.2.1.6 Yards per pound. The yards per pound specified in tables II and III are the bare glass nominal and that a commercial yarn normally has a size treatment which will decrease yardage in proportion to the amount of size.

3.2.2 Form 2, cordage.

3.2.2.1 Treatment. Unless untreated cordage is specified (see 6.2), in the contract or order, cordage shall be so treated or coated as to increase its resistance to internal abrasion and raise its knot strength. The material for such treatment shall be noncorrosive to metals and easy to remove when necessary.

3.2.2.2 Construction. Cordage shall be furnished in the following constructions:

3.2.2.2.1 Class C, continuous filament cordage. Continuous filament cordage shall be furnished in conformance with table IV, as specified (see 6.2).

* TABLE IV. Form 2, class C, continuous filament cordage

| Cordage No. 1/ | Diameter (inches) 1/ | Yards per pound 2/ | Minimum breaking strength 2/ (pounds) | |
|---|---|---|---|---|
| | | | Untreated | Treated |
| EC9-1-U 3/ | 0.009 | 3,620 | 13 | - |
| EC9-2-U | 0.026 | 700 | 61 | - |
| EC9-3-U | 0.034 | 425 | 95 | - |
| EC9-4-U | 0.052 | 221 | 179 | - |
| EC9-5-U | 0.076 | 114 | 307 | - |
| EC9-6-U | 0.083 | 90 | 357 | - |
| EC9-7-U | 0.095 | 67 | 430 | - |
| EC9-8-U | 0.119 | 46 | 576 | - |
| EC9-10-U | 0.149 | 29 | 780 | - |
| EC9-1-N 4/ | 0.0105 | 3,240 | - | 11 |
| EC9-2-N | 0.032 | 668 | - | 51 |
| EC9-3-N | 0.039 | 414 | - | 77 |
| EC9-4-N | 0.062 | 206 | - | 146 |
| EC9-5-N | 0.084 | 105 | - | 250 |
| EC9-6-N | 0.094 | 86 | - | 288 |
| EC9-7-N | 0.110 | 65 | - | 355 |
| EC9-8-N | 0.128 | 42 | - | 461 |
| EC9-10-N | 0.165 | 27 | - | 605 |

1/ For engineering information only.

2/ See 3.2.2.3 for tolerance.

3/ "U" is the symbol for untreated cordage.

4/ "N" is the symbol for neoprene-treated cordage.

3.2.2.2.2 Form 2, class S, staple fiber cordage. Staple fiber cordage shall be furnished in conformance with table V, as specified (see 6.2).

TABLE V. Form 2, class S, staple fiber cordage

| Cordage No. 1/ | Diameter (inches) 1/ | Yards per pound 2/ | Minimum breaking strength pounds 2/ |
|---|---|---|---|
| ES6-2 | 0.030 | 1,040 | 19 |
| ES6-3 | 0.045 | 500 | 30 |
| ES6-4 | 0.060 | 415 | 33 |
| ES6-5 | 0.075 | 200 | 50 |
| ES6-6 | 0.096 | 150 | 65 |
| ES6-8 | 0.120 | 100 | 75 |

1/ For engineering information only.

2/ See 3.2.2.3 for tolerance.

* 3.2.2.3 Tolerance. The following tolerances will be permitted for cordage:

(a) Yards per pound - Plus or minus 15 percent for staple fiber yarns
- Plus or minus 10 percent for continuous filament yarns

(b) No individual break shall be less than 80 percent of the minimum requirement

* 3.2.2.4 Put-up. Unless otherwise specified (see 6.2) cordage shall be wound on spools or suitable tubes in such a manner as to form cylindrical, self-supporting coils.

3.2.3 Form 3, sleeving.

3.2.3.1 Treatment. Sleeving shall be furnished as follows (see 6.2):

(a) Untreated.
(b) Treated (to reduce fraying at ends).
(c) Treated and surface-dyed (for identification purposes only) in red, green, blue, black or yellow.

3.2.3.2 Construction. Glass sleeving shall be continuous filament bare glass untreated sleeving and shall be constructed in conformance with table VI, as specified (see 6.2).

TABLE VI. Form 3, class C, continuous filament braided sleeving

| Sleeving No. 1/ | Inside diameter 2/ (inches) | Wall thickness 2/ (inches) | Yards per pound 2/ |
|---|---|---|---|
| ECC-A (heavy wall) | 1/16 | 0.008 | 221 |
| | 1/8 | 0.008 | 100 |
| | 3/16 | 0.008 | 83 |
| | 1/4 | 0.008 | 65 |
| | 5/16 | 0.008 | 52 |
| | 3/8 | 0.008 | 44 |
| | 1/2 | 0.008 | 32 |
| ECC-B (light wall) | 1/16 | 0.006 | 372 |
| | 1/8 | 0.006 | 204 |
| | 3/16 | 0.006 | 149 |
| | 1/4 | 0.006 | 109 |
| | 5/16 | 0.006 | 88 |
| | 3/8 | 0.006 | 67 |
| | 1/2 | 0.006 | 52 |

1/ For engineering information only.

2/ See 3.2.3.3 for tolerances.

3.2.3.3 Tolerances. The following tolerances will be permitted for sleeving:

(a) Inside diameter:
3/16 inch and under - Plus 1/64 inch.
Over 3/16 to 3/8 inch - Plus 1/32 inch.
Over 3/8 inch - Plus 1/16 inch.

(b) Wall thickness - Plus or minus 0.001 inch.

(c) Yards per pound - Plus or minus 10 percent.

3.2.3.4 Put-up. Sleeving shall be wound on suitable spools or tubes in such a manner as to form cylindrical, self-supporting coils. Spools or tubes for treated and untreated sleeving shall be 6-3/8 or 8-3/8 inches in length (tolerance plus or minus 1/8 inch) having 5/8-inch inside diameter, and shall contain

100 yards ± 20 yards. No spool or tube shall contain more than three pieces of sleeving and no piece shall be less than 15 yards in length. The sleeving shall be wound on these tubes with a 6- or 8-inch traverse.

3.2.4 Form 4, cloth.

3.2.4.1 Class C, cloth, continuous filament. Cloth fabricated from continuous filament bare glass untreated yarn shall be furnished in conformance with table VII, as specified (see 6.2).

TABLE VII. Form 4, class C, continuous filament cloth

| Fabric No. 1/ | Count Yarns/in or 2.5 cm 2/ | Yarn No. 1/ | Breaking strength (lb/in) 2/ | Breaking strength (kilo/cm) 2/ | Warp or Filling 3/ | Thickness (in) 2/ | Thickness (mm) 2/ | Weight ($oz/yd^2$) 2/ | Weight ($gm/m^2$) 2/ | Weave |
|---|---|---|---|---|---|---|---|---|---|---|
| 104 | 60 | D900-1/0 | 40 | 7.1 | W | .0012 | .030 | 0.58 | 19.7 | Plain |
| | 52 | D1800-1/0 | 15 | 2.7 | F | | | | | |
| 325 | 90 | D900-1/0 | 60 | 10.7 | W | .0012 | .030 | 0.70 | 23.8 | Plain |
| | 44 | D1800-1/0 | 10 | 2.8 | F | | | | | |
| 106 | 56 | D900-1/0 | 45 | 7.9 | W | .0015 | .038 | 0.73 | 24.7 | Plain |
| | 56 | D900-1/0 | 40 | 7.1 | F | | | | | |
| 107 | 60 | D900-1/2 | 70 | 12.5 | W | .0017 | .043 | 1.06 | 35.9 | Plain |
| | 35 | D900-1/0 | 20 | 3.6 | F | | | | | |
| 1070 | 60 | D450-1/0 | 70 | 12.5 | W | .0019 | .048 | 1.06 | 35.9 | Plain |
| | 35 | D900-1/0 | 20 | 3.6 | F | | | | | |
| 108 | 60 | D900-1/2 | 70 | 12.5 | W | .0020 | .051 | 1.43 | 48.5 | Plain |
| | 47 | D900-1/2 | 40 | 7.1 | F | | | | | |
| 1080 | 60 | D450-1/0 | 70 | 12.5 | W | .0020 | .051 | 1.43 | 48.5 | Plain |
| | 47 | D450-1/0 | 40 | 7.1 | F | | | | | |
| 112 | 40 | D450-1/2 | 90 | 16.1 | W | .0032 | .081 | 2.10 | 71.2 | Plain |
| | 39 | D450-1/2 | 80 | 14.3 | F | | | | | |
| 2112 | 40 | D225-1/0 | 90 | 16.1 | W | .0034 | .086 | 2.10 | 71.2 | Plain |
| | 39 | D225-1/0 | 80 | 14.3 | F | | | | | |
| 1125 | 40 | D450-1/2 | 90 | 16.0 | W | .0035 | .089 | 2.62 | 88.8 | Plain |
| | 39 | G150-1/0 | 130 | 23.3 | F | | | | | |

TABLE VII. Form 4, class C, continuous filament cloth (cont'd)

| Fabric No. 1/ | Count Yarns/in or 2.5 cm 2/ | Yarn No. 1/ | Breaking strength (lb/in) 2/ | Breaking strength (kilo/cm) 2/ | Warp or Filling 3/ | Thickness (in) 2/ | Thickness (mm) 2/ | Weight ($oz/yd^2$) 2/ | Weight ($gm/m^2$) 2/ | Weave |
|---|---|---|---|---|---|---|---|---|---|---|
| 2125 | 40 | D225-1/0 | 90 | 16.1 | W | .0037 | .094 | 2.62 | 88.8 | Plain |
| | 39 | G150-1/0 | 130 | 23.3 | F | | | | | |
| 1610 | 32 | G150-1/0 | 115 | 20.6 | W | .0040 | .102 | 2.41 | 81.7 | Plain |
| | 28 | G150-1/0 | 100 | 17.9 | F | | | | | |
| 113 | 60 | D450-1/2 | 123 | 22.0 | W | .0030 | .076 | 2.46 | 83.4 | Plain |
| | 64 | D900-1/2 | 60 | 10.7 | F | | | | | |
| 2113 | 60 | D225-1/0 | 140 | 25.0 | W | .0032 | .081 | 2.38 | 80.7 | Plain |
| | 56 | D450-1/0 | 60 | 10.7 | F | | | | | |
| 1674 | 40 | G150-1/0 | 140 | 25.0 | W | .0043 | .109 | 2.85 | 96.5 | Plain |
| | 32 | G150-1/0 | 95 | 17.0 | F | | | | | |
| 1675 | 40 | DE150-1/0 | 140 | 25.0 | W | .0043 | .109 | 2.85 | 96.5 | Plain |
| | 32 | DE150-1/0 | 95 | 17.0 | F | | | | | |
| 116 | 60 | D450-1/2 | 125 | 22.3 | W | .0040 | .102 | 3.16 | 107 | Plain |
| | 58 | D450-1/2 | 120 | 21.5 | F | | | | | |
| 2116 | 60 | D225-1/0 | 125 | 22.3 | W | .0040 | .102 | 3.20 | 109 | Plain |
| | 58 | D225-1/0 | 120 | 21.5 | F | | | | | |
| 1165 | 60 | D450-1/2 | 125 | 22.3 | W | .0047 | .119 | 3.70 | 125 | Plain |
| | 52 | G150-1/0 | 140 | 25.0 | F | | | | | |
| 2165 | 60 | D225-1/0 | 125 | 22.3 | W | .0045 | .114 | 3.70 | 125 | Plain |
| | 52 | G150-1/0 | 140 | 25.0 | F | | | | | |

TABLE VII. Form 4, class C, continuous filament cloth (cont'd)

| Fabric No. 1/ | Count Yarns/in or 2.5 cm 2/ | Yarn No. 1/ | Breaking strength (lb/in) 2/ | Breaking strength (kilo/cm) 2/ | Warp or Filling 3/ | Thickness (in) 2/ | Thickness (mm) 2/ | Weight ($oz/yd^2$) 2/ | Weight ($gm/m^2$) 2/ | Weave |
|---|---|---|---|---|---|---|---|---|---|---|
| 120 | 60 | D450-1/2 | 125 | 22.3 | W | .0040 | .102 | 3.16 | 107 | Crowfoot |
| | 58 | D450-1/2 | 120 | 21.5 | F | | | | | |
| 2120 | 60 | E225-1/0 | 125 | 22.3 | W | .0040 | .102 | 3.16 | 107 | Crowfoot |
| | 58 | E225-1/0 | 120 | 21.5 | F | | | | | |
| 1677 | 40 | DE150-1/0 | 140 | 25.0 | W | .0045 | .114 | 3.21 | 109 | Plain |
| | 40 | DE150-1/0 | 130 | 23.3 | F | | | | | |
| 1681 | 56 | DE150-1/0 | 195 | 34.9 | W | .0047 | .119 | 3.60 | 122 | Plain |
| | 36 | DE150-1/0 | 110 | 19.7 | F | | | | | |
| 125 | 36 | D450-2/2 | 150 | 26.8 | W | .0050 | .127 | 3.75 | 127 | Plain |
| | 34 | D450-2/2 | 140 | 25.0 | F | | | | | |
| 118 | 90 | D450-1/2 | 190 | 34.0 | W | .0050 | .127 | 4.04 | 137 | Crowfoot |
| | 60 | D450-1/2 | 140 | 25.0 | F | | | | | |
| 1676 | 56 | DE150-1/0 | 195 | 34.9 | W | .0048 | .122 | 4.10 | 139 | Plain |
| | 48 | DE150-1/0 | 150 | 26.8 | F | | | | | |
| 126 | 34 | D450-3/2 | 225 | 40.3 | W | .0070 | .178 | 5.45 | 185 | Plain |
| | 32 | D450-3/2 | 200 | 35.8 | F | | | | | |
| 1526 | 34 | G150-1/2 | 225 | 40.3 | W | .0070 | .178 | 5.45 | 185 | Plain |
| | 32 | G150-1/2 | 200 | 35.8 | F | | | | | |
| 7626 | 34 | G75-1/0 | 225 | 40.3 | W | .0066 | .168 | 5.40 | 183 | Plain |
| | 32 | G75-1/0 | 200 | 35.8 | F | | | | | |

TABLE VII. Form 4, class C, continuous filament cloth (cont'd)

| Fabric No. 1/ | Count Yarns/in or 2.5 cm 2/ | Yarn No. 1/ | Breaking strength (lb/in) 2/ | Breaking strength (kilo/cm) 2/ | Warp or Filling 3/ | Thickness (in) 2/ | Thickness (mm) 2/ | Weight ($oz/yd^2$) 2/ | Weight ($gm/m^2$) 2/ | Weave |
|---|---|---|---|---|---|---|---|---|---|---|
| 1557 | 57 | G150-1/2 | 350 | 62.6 | W | .0055 | .140 | 5.42 | 184 | Crowfoot |
| | 30 | D450-1/2 | 60 | 10.7 | F | | | | | |
| 7533 | 18 | G75-1/2 | 250 | 44.8 | W | .0080 | .203 | 5.80 | 197 | Plain |
| | 18 | G75-1/2 | 220 | 39.4 | F | | | | | |
| 3733 | 18 | G37-1/0 | 250 | 44.8 | W | .0080 | .203 | 5.8 | 197 | Plain |
| | 18 | G37-1/0 | 200 | 35.8 | F | | | | | |
| 127 | 42 | D450-3/2 | 250 | 44.7 | W | .0075 | .190 | 5.95 | 202 | Plain |
| | 32 | D450-3/2 | 200 | 35.8 | F | | | | | |
| 128 | 42 | E225-1/3 | 250 | 44.7 | W | .0070 | .178 | 5.95 | 202 | Plain |
| | 32 | E225-1/3 | 200 | 35.8 | F | | | | | |
| 1528 | 44 | G150-1/2 | 250 | 44.7 | W | .0070 | .178 | 6.00 | 203 | Plain |
| | 32 | G150-1/2 | 200 | 35.8 | F | | | | | |
| 7628 | 44 | G75-1/0 | 250 | 44.7 | W | .0068 | .173 | 6.00 | 203 | Plain |
| | 32 | G75-1/0 | 200 | 35.8 | F | | | | | |
| 76281 | 44 | G75-1/0 | 250 | 44.7 | W | .0068 | .173 | 6.00 | 203 | Crowfoot |
| | 32 | G75-1/0 | 200 | 35.8 | F | | | | | |
| 7532 | 16 | G75-1/3 | 300 | 53.7 | W | .0100 | .254 | 7.25 | 246 | Plain |
| | 14 | G75-1/3 | 280 | 50.1 | F | | | | | |
| 2532 | 16 | H25-1/0 | 300 | 53.7 | W | .0100 | .254 | 7.25 | 246 | Plain |
| | 14 | H25-1/0 | 280 | 50.1 | F | | | | | |

TABLE VII. Form 4, class C, continuous filament cloth (cont'd)

| Fabric No. 1/ | Count Yarns/in or 2.5 cm 2/ | Yarn No. 1/ | Breaking strength (lb/in) 2/ | Breaking strength (kilo/cm) 2/ | Warp or Filling 3/ | Thickness (in) 2/ | Thickness (mm) 2/ | Weight ($oz/yd^2$) 2/ | Weight ($gm/m^2$) 2/ | Weave |
|---|---|---|---|---|---|---|---|---|---|---|
| 141 | 32 | E225-3/2 | 400 | 71.6 | W | .0110 | .280 | 8.75 | 297 | Plain |
| | 21 | E225-3/2 | 290 | 51.9 | F | | | | | |
| 7641 | 32 | G75-1/2 | 400 | 71.6 | W | .0100 | .254 | 8.70 | 297 | Plain |
| | 21 | G75-1/2 | 290 | 51.9 | F | | | | | |
| 143 | 49 | E225-3/2 | 600 | 107 | W | .0090 | .228 | 8.78 | 298 | Crowfoot |
| | 30 | D450-1/2 | 60 | 10.7 | F | | | | | |
| 1543 | 49 | G150-2/2 | 600 | 107 | W | .0090 | .228 | 8.75 | 297 | Crowfoot |
| | 30 | E225-1/0 | 60 | 10.7 | F | | | | | |
| 3743 | 49 | G37-1/0 | 600 | 107 | W | .0080 | .208 | 8.45 | 286 | Crowfoot |
| | 30 | E225-1/0 | 60 | 10.7 | F | | | | | |
| 341 | 30 | D450-1/2 | 60 | 107 | W | .0090 | .228 | 8.78 | 298 | Crowfoot |
| | 49 | E225-3/2 | 600 | 10.7 | F | | | | | |
| 1581 | 57 | G150-1/2 | 350 | 62.6 | W | .0090 | .228 | 8.90 | 302 | 8-H Satin |
| | 54 | G150-1/2 | 340 | 60.9 | F | | | | | |
| 7781 | 57 | DE75-1/0 | 350 | 62.6 | W | .0090 | .228 | 8.95 | 304 | 8-H Satin |
| | 54 | DE75-1/0 | 340 | 60.9 | F | | | | | |
| 7500 | 16 | G75-2/2 | 450 | 80.6 | W | .0140 | .355 | 9.60 | 326 | Plain |
| | 14 | G75-2/2 | 350 | 62.6 | F | | | | | |
| 1800 | 16 | K18-1/0 | 450 | 80.6 | W | .0130 | .330 | 9.60 | 326 | Plain |
| | 14 | K18-1/0 | 350 | 62.6 | F | | | | | |
| 7743 | 120 | DE75-1/0 | 800 | 14.3 | W | .0110 | .280 | 10.22 | 346 | 8-H Satin |
| | 20 | G150-1/0 | 60 | 10.7 | F | | | | | |

TABLE VII. Form 4, class C, continuous filament cloth (cont'd)

| Fabric No. 1/ | Count Yarns/in or 2.5 cm 2/ | Yarn No. 1/ | Breaking strength (lb/in) 2/ | Breaking strength (kilo/cm) 2/ | Warp or Filling 3/ | Thickness (in) 2/ | Thickness (mm) 2/ | Weight ($oz/yd^2$) 2/ | Weight ($gm/m^2$) 2/ | Weave |
|---|---|---|---|---|---|---|---|---|---|---|
| 1523 | 28 | G150-3/2 | 525 | 94.0 | W | .0140 | .355 | 11.85 | 402 | Plain |
| | 20 | G150-3/2 | 375 | 67.1 | F | | | | | |
| 162 | 28 | E225-2/5 | 450 | 80.6 | W | .0150 | .381 | 12.20 | 413 | Plain |
| | 16 | E225-2/5 | 350 | 62.6 | F | | | | | |
| 164 | 20 | E225-4/3 | 500 | 89.5 | W | .0160 | .406 | 12.60 | 427 | Plain |
| | 18 | E225-4/3 | 450 | 80.6 | F | | | | | |
| 1564 | 20 | G150-4/2 | 500 | 89.5 | W | .0150 | .381 | 12.60 | 427 | Plain |
| | 18 | G150-4/2 | 450 | 80.6 | F | | | | | |
| 7664 | 20 | G75-2/2 | 500 | 89.5 | W | .0150 | .381 | 12.60 | 427 | Plain |
| | 18 | G75-2/2 | 450 | 80.6 | F | | | | | |
| 3732 | 48 | G37-1/0 | 550 | 98.4 | W | .0135 | .345 | 12.60 | 427 | Crowfoot |
| | 32 | G37-1/0 | 400 | 71.6 | F | | | | | |
| 182 | 60 | E225-2/2 | 440 | 78.8 | W | .0130 | .330 | 12.50 | 423 | 8-H Satin |
| | 56 | E225-2/2 | 400 | 71.6 | F | | | | | |
| 1582 | 60 | G150-1/3 | 490 | 87.7 | W | .0140 | .335 | 13.90 | 471 | 8-H Satin |
| | 56 | G150-1/3 | 450 | 80.6 | F | | | | | |
| 1527 | 17 | G150-3/3 | 500 | 89.5 | W | .0160 | .406 | 12.85 | 435 | Plain |
| | 17 | G150-3/3 | 485 | 86.8 | F | | | | | |

TABLE VII. Form 4, class C, continuous filament cloth (cont'd)

| Fabric No. 1/ | Count Yarns/in or 2.5 cm 2/ | Yarn No. 1/ | Breaking strength (lb/in) 2/ | Breaking strength (kilo/cm) 2/ | Warp or Filling 3/ | Thickness (in) 2/ | Thickness (mm) 2/ | Weight ($oz/yd^2$) 2/ | Weight ($gm/m^2$) 2/ | Weave |
|---|---|---|---|---|---|---|---|---|---|---|
| 183 | 54 | E225-3/2 | 650 | 116 | W | .0170 | .432 | 16.50 | 559 | 8-H Satin |
| | 48 | E225-3/2 | 590 | 106 | F | | | | | |
| 1583 | 54 | G150-2/2 | 650 | 116 | W | .0160 | .406 | 16.10 | 545 | 8-H Satin |
| | 48 | G150-2/2 | 590 | 106 | F | | | | | |
| 1544 | 28 | G150-4/2 | 750 | 134 | W | .0220 | .559 | 18.00 | 610 | 2/1 Basket |
| | 14 | G150-4/4 | 750 | 134 | F | | | | | |
| 7544 | 28 | G75-2/2 | 750 | 134 | W | .0220 | .559 | 18.00 | 610 | 2/1 Basket |
| | 14 | G75-2/2 | 750 | 134 | F | | | | | |
| 7587 | 40 | G75-2/2 | 750 | 134 | W | .0300 | .761 | 20.50 | 695 | Mock Leno |
| | 21 | G75-2/2 | 450 | 80.6 | F | | | | | |
| 184 | 42 | E225-4/3 | 950 | 170 | W | .0260 | .670 | 26.00 | 880 | 8-H Satin |
| | 36 | E225-4/3 | 800 | 143 | F | | | | | |
| 1584 | 44 | G150-4/2 | 950 | 170 | W | .0260 | .670 | 26.00 | 880 | 8-H Satin |
| | 35 | G150-4/2 | 800 | 143 | F | | | | | |
| 1884 | 44 | K18-1/0 | 950 | 170 | W | .0260 | .670 | 25.40 | 860 | 8-H Satin |
| | 35 | K18-1/0 | 800 | 143 | F | | | | | |
| 1588 | 42 | G150-4/4 | 1900 | 340 | W | .0500 | 1.270 | 51.80 | 1760 | 12-H Satin |
| | 36 | G150-4/4 | 1350 | 242 | F | | | | | |

1/ For engineering information only.

2/ See 3.2.4.3 for tolerances.

3/ Code letters designating warp or filling:

W - Warp
F - Filling

3.2.4.2 Form 4, class S, cloth staple fiber. Cloth fabricated from staple fiber bare glass untreated yarn shall be furnished in conformance with table VIII, as specified (see 6.2).

TABLE VIII. Form 4, class S, staple fiber cloth

| Cloth No. 1/ | Thickness 2/ (inches) | Weight per sq. yd. 2/ (ounces) | Yarn, warp and filling 1/ | Count warp fill 2/ | Minimum breaking strength per inch of width 2/ Warp (pounds) | Filling (pounds) | Type of weave |
|---|---|---|---|---|---|---|---|
| 248 | 0.012 | 7.81 | E70/2R | 26x20 | 114 | 112 | Plain |
| 261 | 0.015 | 10.32 | E40/2R | 20x14 | 169 | 120 | Plain |
| 294 | 0.023 | 14.70 | E25/2 | 16x16 | 176 | 202 | Plain |

1/ For engineering information only.

2/ See 3.2.4.3 for tolerance.

3.2.4.3 Tolerances. The following tolerances will be permitted for glass fiber cloth:

(a) Width - Plus or minus 1/4 inch per yard of specified width (inclusive of selvage).
(b) Thickness -

TABLE IX. English units, permissible variations in thickness (U. S. customary units)

| Material thickness (inches) | Tolerance (inches) Staple fiber | Continuous filament |
|---|---|---|
| 0.003 inch and under | - | ±0.0005 |
| Over 0.003 to 0.011 inch | - | ±0.001 |
| Over 0.011 to 0.015 | ±0.003 | ±0.002 |
| Over 0.015 inch | ±0.003 | ±0.003 |

TABLE X. Metric units, permissible variations in thickness (metric units)

| Nominal thickness, mm | Permissible variations, mm | |
|---|---|---|
| | Continuous filament | Staple fiber |
| 0.100 and under | ±0.010 | |
| Over 0.100 to 0.200 | ±0.020 | ±0.020 |
| Over 0.200 to 0.400 | ±0.040 | ±0.040 |
| Over 0.400 | ±0.050 | ±0.050 |

(c) Ounces per square yard - Plus or minus 10 percent.
(d) Construction (ends and picks) - Plus or minus 2.
(e) No individual break shall be less than 80 percent of the minimum requirement.

3.2.4.4 Put-up. Cloth shall be furnished in rolls, in widths and lengths as specified (see 6.2) and shall be wound on spiral or convolute tubes measuring 2 inches minimum inside diameter and 1 inch longer than the overall width of the cloth. No roll shall contain more than three pieces and no piece shall be less than 15 yards in length.

3.2.5 Form 5, tape.

3.2.5.1 Class C, tape, continuous filament. Tape fabricated from continuous filament bare glass untreated yarn shall be furnished in conformance with table XI, as specified (see 6.2).

TABLE XI. Form 5, class C, continuous filament tape, plain weave

| Tape No. 1/ | Thickness 2/ (inches) | Width 2/ (inches) | Total ends 2/ | Picks per inch 2/ | Yards per pound 2/ | Minimum breaking strength 2/ (pounds) |
|---|---|---|---|---|---|---|
| ECC-A (medium texture) | 0.005 | 1/2 | 24 | 35 | 258 | 100 |
| | | 3/4 | 32 | 35 | 185 | 135 |
| | | 1 | 42 | 35 | 140 | 160 |
| | | 1 | 36 | 34 | 146 | 160 |
| | | 1-1/2 | 62 | 35 | 95 | 250 |
| | | 2 | 72 | 34 | 73 | 300 |
| | | 2-1/2 | 104 | 35 | 54.5 | 350 |
| | | 3 | 108 | 34 | 49 | 500 |
| | | 4 | 144 | 34 | 37 | 565 |

TABLE XI. Form 5, class C, continuous filament tape, plain weave

| Tape No. 1/ | Thickness 2/ (inches) | Width 2/ (inches) | Total ends 2/ | Picks per inch 2/ | Yards per pound 2/ | Minimum breaking strength 2/ (pounds) |
|---|---|---|---|---|---|---|
| ECC-A (medium texture) (cont'd) | 0.007 | 1/2 | 24 | 32 | 179 | 130 |
| | | 3/4 | 32 | 32 | 128 | 175 |
| | | 1 | 42 | 32 | 97 | 240 |
| | | 1-1/2 | 62 | 32 | 67 | 370 |
| | | 2 | 88 | 32 | 48 | 520 |
| | 0.010 | 1/2 | 16 | 21 | 133 | 160 |
| | | 3/4 | 24 | 21 | 89 | 250 |
| | | 1 | 32 | 21 | 68 | 350 |
| | | 1-1/2 | 48 | 21 | 45 | 550 |
| | 0.015 | 1/2 | 14 | 16 | 95 | 210 |
| | | 3/4 | 20 | 16 | 66 | 320 |
| | | 1 | 26 | 16 | 50 | 440 |
| | | 1-1/2 | 40 | 16 | 33 | 660 |
| ECC-B (close texture) | 0.003 | 3/8 | 21 | 42 | 620 | 45 |
| | | 1/2 | 30 | 42 | 419 | 60 |
| | | 3/4 | 45 | 42 | 282 | 95 |
| | | 1 | 63 | 42 | 206 | 135 |
| | | 1-1/2 | 108 | 42 | 122 | 190 |
| | 0.005 | 3/8 | 21 | 39 | 279 | 115 |
| | | 1/2 | 27 | 39 | 216 | 135 |
| | | 3/4 | 39 | 39 | 149 | 225 |
| | | 1 | 51 | 39 | 113 | 310 |
| | | 1-1/2 | 75 | 39 | 77 | 440 |
| | 0.007 | 3/8 | 21 | 39 | 231 | 115 |
| | | 1/2 | 27 | 39 | 179 | 135 |
| | | 3/4 | 39 | 39 | 123 | 225 |
| | | 1 | 51 | 39 | 94 | 310 |
| | | 1-1/2 | 75 | 39 | 63 | 440 |

1/ For engineering information only.

2/ See 3.2.5.3 for tolerances.

3.2.5.2 Class S tape, staple fiber. Tape fabricated from staple fiber bare glass untreated yarn shall be furnished in conformance with table XII, as specified (see 6.2).

TABLE XII. Form 5, class S, staple fiber tape, plain weave

| Tape No. 1/ | Thickness 2/ (inches) | Width 2/ (inches) | Total ends 2/ | Picks per inch 2/ | Yards per pound 2/ | Minimum breaking strength 2/ (pounds) |
|---|---|---|---|---|---|---|
| ESS-A (medium texture) | 0.010 | 1/2 | 18 | 21 | 127 | 100 |
| | | 3/4 | 26 | 21 | 83 | 150 |
| | | 1 | 34 | 21 | 65 | 200 |
| | | 1-1/2 | 52 | 21 | 42 | 300 |
| | 0.015 | 3/4 | 20 | 16-1/2 | 60 | 200 |
| | | 1 | 28 | 16-1/2 | 45 | 250 |
| | | 1-1/2 | 52 | 16-1/2 | 29 | 350 |
| | 0.020 | 3/4 | 20 | 14 | 49 | 250 |
| | | 1 | 28 | 14 | 36 | 300 |
| | | 1-1/2 | 44 | 14 | 25 | 450 |
| | 0.025 | 3/4 | 20 | 10 | 44 | 210 |
| | | 1 | 28 | 10 | 32 | 300 |
| | | 1-1/2 | 44 | 10 | 18 | 550 |

1/ For engineering information only.

2/ See 3.2.5.3 for tolerances.

3.2.5.3 Tolerances. The following tolerances will be permitted for fiber glass tape:

(a) Thickness -

| Thickness (inches) | Tolerance Type ECC (inches) | Tolerance Type ESS (inches) |
|---|---|---|
| 0.003 | ±0.0005 | - |
| 0.005 | ±0.0010 | - |
| 0.007 | ±0.0010 | - |
| 0.010 | ±0.0010 | ±0.0020 |
| 0.015 | ±0.0020 | ±0.0030 |
| 0.020 | - | ±0.0030 |
| 0.025 | - | ±0.0030 |

(b) Width of tape:
Under 1 inch - Plus or minus 1/32 inch.
1 inch and over - Plus or minus 1/16 inch.
(c) Ends - Plus or minus 1 end.
(d) Picks - Plus or minus 2 picks.
(e) Yards per pounds - Plus or minus 10 percent.
(f) No individual break shall be less than 80 percent of the minimum requirement.

3.2.5.4 Put-up. Unless otherwise specified (see 6.2), glass fiber tape shall be furnished in 36 yard minimum to 40 yard maximum lengths, except for 0.003 inch tape which shall be furnished in 72 yard minimum to 76 yard maximum lengths. No roll shall contain more than two pieces and no piece shall be less than 15 yards in length. The tape shall be wound on suitable cores, of the same width as the tape, having 3/8 inch inside diameter. The ends of rolls shall be securely fastened with gummed tape to prevent slippage and unrolling of the tape.

3.3 Identification label. Each tube, cone, roll, or package of tape of glass fiber material shall have an identification gummed label attached. The color of the label shall be light in intensity to permit easy reading of printed, stamped, or typed markings. The use of handwritten entries is prohibited. The label shall be legibly printed with water insoluble ink with the following information:

Stock number
Item description
Specification number
Yardage
Contract number and date
Suppliers name

3.4 Workmanship. The finished material shall conform to the quality and grade of product established by this specification. The occurrence of defects shall not exceed the applicable quality levels.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Certificate of compliance. Where certificates of compliance are submitted, the Government reserves the right to check test such items to determine the validity of the certification.

4.2 Inspection. Sampling for inspection shall be performed in accordance with MIL-STD-105, except where otherwise indicated hereinafter.

4.2.1 Examination of cloth, sleeving and tape. The defects found during the examination of the cloth, sleeving, and tape shall be scored in accordance with 4.2.1.1 through 4.2.1.3.

4.2.1.1 End item examination of cloth, sleeving and tape. The entire yardage of each roll of cloth shall be examined on the face side and the entire yardage of each tube or roll of sleeving and tape shall be examined on both sides for defects listed in table XIII. All defects found shall be counted regardless of their proximity one to another except where two or more defects represent a single local condition of the end item, in which case only the more serious defect shall be counted. A continuous defect shall be counted as one defect. The sample unit shall be one roll or tube. The sample size shall be in accordance with inspection level I of MIL-STD-105. The acceptable quality levels (AQL's) shall be 0.65 major and 2.5 total (major and minor combined) defects per hundred units (yards) for the sleeving and tape, and 2.5 major and 6.5 total (major and minor combined) defects per hundred units for the cloth.

TABLE XIII. Visual examination of cloth, sleeving and tape

| Defect | Classification Major | Minor |
|---|---|---|
| Any hole, cut, tear, or smash | X | |
| Baggy, ridgy or wavy cloth or tape | X | |
| Spot or stain, uncleaned: 1/ | | |
| 1/2 inch or more in combined length and width directions | X | |
| Less than 1/2 inch in combined length and width directions | | X |
| Tender, weak or thin place 1/ | X | |
| Broken or missing yarn: | | |
| Two or more contiguous, regardless of length | X | |
| Single, 2 inches or more in length | X | |
| Single, less than 2 inches in length | | X |
| Untreated area: | | |
| 1/2 inch or more in combined length and width directions | X | |
| Less than 1/2 inch in combined length and width directions | | X |
| Floats and skips: | | |
| Two or more, regardless of length | X | |
| Single, 2 inches or more in length | X | |
| Single, more than 1/4 inch but less than 2 inches in length | | X |
| Any hard embedded crease | X | |
| Any brittle or fused area | X | |
| Width beyond specified tolerances | | X |
| Uneven weaving | | X |

1/ Clearly visible at normal inspection distance (3 feet).

4.2.1.2 Examination for length of cloth, sleeving and tape.

4.2.1.2.1 Examination for length of individual tube or roll. Each tube or roll, as applicable, shall be examined for defects listed below. The sample unit for this examination shall be one tube or roll, as applicable. The lot size shall be expressed in units of one tube or roll. The inspection level shall be S-3 and the acceptable quality level (AQL) shall be 2.5 defects per 100 units.

Defects

Gross length less than specified minimum length or more than specified maximum length.
Gross length more than 2 yards less than the gross length marked on label.
Any piece less than the allowable minimum length of piece.
Any tube or roll containing more than the allowable number of pieces.

4.2.1.2.2 Examination for total yardage in sample. The lot shall be unacceptable if the total of the actual gross lengths of tubes or rolls, as applicable, in the sample is less than the total of the gross lengths marked.

4.2.2 Examination of yarn and cord. The defects listed in table XIV shall be counted regardless of their proximity one to another except where two or more defects represent a single local condition, in which case only the more serious defect shall be counted. The sample unit shall be the outersurface of the spool or tube selected for examination. The lot size for this examination shall be expressed in units of one cone or tube of yarn or cord, as applicable. The AQL shall be 1.5 defects per hundred units. The inspection level shall be level I.

TABLE XIV. Visual examination of yarn and cord

| Examine | Defect |
|---|---|
| Appearance and workmanship | Any cut<br>Chafed or damaged, affecting serviceability<br>Finish other than specified<br>Spot or stain 1/<br>Embedded foreign matter 1/ |
| Put-up | Any defect affecting the free unhampered unwinding of yarn or cord or affecting the secure holding of yarn or cord winds on the package<br>Not put-up on spool or tube as specified |

1/ Clearly visible at normal inspection distance (approximately 3 feet).

4.2.2.1 Examination of cord for total weight per tube. The sample unit for this examination shall be one tube. The inspection level shall be level S-3 and the AQL shall be 4.0 defects per hundred units, except for lots consisting of 500 or fewer units, the sample size shall be 13 tubes and the lot shall be unacceptable if two or more tubes in the sample are defective in regard to weight. Any tube found not within the range of weight specified in 3.2.2 shall be considered a defect with respect to weight.

4.2.3 Examination of preparation for delivery requirements. An examination shall be made to determine that the packaging, packing and marking complies with the section 5 requirements. Defects shall be scored in accordance with the list below. The sample unit shall

be one shipping container fully prepared for delivery with the exception that it need not be closed. Defects of closure listed below shall be examined on shipping containers fully prepared for delivery. The lot size shall be the number of shipping containers in the end item inspection lot. The inspection level shall be S-2 and the AQL shall be 2.5 defects per 100 units.

| Examine | Defect |
|---|---|
| Marking (exterior and interior) | Omitted; incorrect; illegible; of improper size, location, sequence or method of application. |
| Materials | Any component missing.<br>Any component damaged, affecting serviceability. |
| Workmanship | Inadequate application of components, such as: incomplete closure of container flaps and case liner, loose strapping, inadequate stapling, improper taping.<br>Bulged or distorted container. |
| Weight | Weight of contents exceeds requirements. |

4.3 Testing of the end item. The methods of testing specified in FED-STD-191 wherever applicable and as listed in table XV shall be followed. Except where otherwise indicated, the physical values specified in section 3 apply to the results of the determinations made on a sample unit for test purposes as specified in the applicable test methods. All test reports shall contain the individual values utilized in expressing the final result. The lot shall be unacceptable if one or more units fail to meet any requirement specified. The lot size shall be expressed in units of 1 linear yard for cloth, tape and sleeving and in units of spools or tubes for yarn and cord. The sample unit for testing shall be as follows:

| | | |
|---|---|---|
| Yarn | - | Up to 10,000 yards per pound - 120 yards<br>10,001 yards per pound and over - 240 yards |
| Cord | - | 30 yards |
| Sleeving | - | 12 yards full width |
| Tape | - | 5 yards full width |
| Cloth | - | 2 yards full width |

The sample size for testing for sleeving, tape and cloth shall be as follows:

| Lot size (yards) | Sample size |
|---|---|
| 800 or less | 2 |
| 801 up to and including 22,000 | 3 |
| 22,001 and over | 5 |

The sample size for testing for yarn and cord shall be as follows:

| Lot size (spools or tubes) | Sample size |
|---|---|
| 15 or less | 2 |
| 16 up to and including 40 | 3 |
| 41 up to and including 110 | 5 |
| 111 up to and including 300 | 7 |
| 301 up to and including 500 | 10 |
| 501 and over | 15 |

TABLE XV. Test methods

| Characteristic | Requirement paragraph | Test method |
|---|---|---|
| Yarn and cordage: | | |
| Material | 3.1.1, 3.2.1 and 3.2.2 | 1/ |
| Turns twist | 3.2.1 | 4054 |
| Ply | 3.2.1 | Visual 2/ |
| Yards per pound | 3.2.1 and 3.2.2 | 4010 |
| Breaking strength | 3.2.1 and 3.2.2 | 4100 |
| Sleeving: | | |
| Inside diameter | 3.2.3.2 | 4.3.1 |
| Wall thickness | 3.2.3.2 | 4.3.2 |
| Yards per pound | 3.2.3.2 | 4.3.3 |
| Cloth: | | |
| Weave | 3.2.4.1 and 3.2.4.2 | Visual 2/ |
| Count: | | |
| Warp | 3.2.4.1 and 3.2.4.2 | 5050 |
| Filling | 3.2.4.1 and 3.2.4.2 | 5050 |
| Thickness | 3.2.4.1 and 3.2.4.2 | 5030 |
| Weight (ounce per square yard) | 3.2.4.1 and 3.2.4.2 | 5041 |
| Breaking strength: | | |
| Warp | 3.2.4.1 and 3.2.4.2 | 5104 4/ |
| Filling | 3.2.4.1 and 3.2.4.2 | 5104 4/ |

TABLE XV. Test methods (cont'd)

| Characteristic | Requirement paragraph | Test method |
|---|---|---|
| Tape: | | |
| Weave | 3.2.5.1 and 3.2.5.2 | Visual 2/ |
| Count: | | |
| Warp (total ends) | 3.2.5.1 and 3.2.5.2 | 5050 |
| Filling (picks per inch) | 3.2.5.1 and 3.2.5.2 | 5050 |
| Thickness | 3.2.5.1 and 3.2.5.2 | 5030 |
| Weight (yards per pound) | 3.2.5.1 and 3.2.5.2 | 4.3.4 2/ |
| Breaking strength, | | |
| Warp | 3.2.5.1 and 3.2.5.2 | 5100 3/ 4/ |

1/ Unless otherwise specified, a certificate of compliance shall be submitted and will be acceptable for the stated requirement.

2/ One determination per sample unit and the results reported as "pass" or "fail".

3/ Breaking strength shall be determined on the full width of the specimen and the jaw dimensions shall be greater than the width of the specimen.

4/ No individual break shall be less than 80 percent of the minimum requirement.

4.3.1 Inside diameter, form 3 (sleeving). To determine the inside diameter, two mandrels approximately 1 yard long with hemispherical ends shall be used. One mandrel shall have the diameter of the nominal inside diameter of the sleeving minus the tolerance, and the other shall have the diameter of the nominal inside diameter of the sleeving plus the tolerance. Five specimens of sleeving, each approximately 1-1/4 yards long, shall be used for each size tested. Each specimen shall be of such size that it will fit without undue disturbance of the construction caused by forcing the sample on the large size mandrel, yet will not be loose when placed over the small size mandrel.

4.3.2 Wall thickness, form 3 (sleeving). The thickness of the wall shall be determined by inserting in the specimen a mandrel having the same nominal inside diameter as the sleeving, and measuring the outside diameter. Ten different measurements shall be made in this way, and the average shall be used in determining the wall thickness of the sleeving.

4.3.3 Yards per pound, form 3 (sleeving). To determine the weight of sleeving, the sleeving shall be slipped over a mandrel approximately 1 yard long having the same diameter as the inside diameter of the sleeving as a hemispherical end. The material shall lie smoothly on the mandrel. A specimen 2 feet long shall be cut with a sharp instrument from the center of the piece on the mandrel. The specimen shall then be weighed on an analytical balance or other scale of equal accuracy, and the number of yards per pound calculated. The average value obtained from tests conducted on five specimens shall be taken as the average number of yards per pound of the sleeving.

4.3.4 Yards per pound, form 5 (tape). A length of tape 2-1/2 yards long shall be smoothly laid on a flat surface using sufficient tension to keep the tape flat. A specimen two yards long shall be accurately measured from the center of this piece and cut off with a sharp instrument. The two yard specimen shall then be weighed and the yards per pound calculated to the nearest 0.1 yard.

## 5. PREPARATION FOR DELIVERY

5.1 Packaging. Packaging shall be level A or C as specified (see 6.2).

5.1.1 Level A. Glass fiber material, put-up as specified, shall be completely wrapped in a 30 pound minimum basis weight kraft paper conforming to grade B of UU-P-268, except that the cloth material shall be wrapped in a 60 pound minimum basis weight kraft paper. For tape, a number of rolls may be wrapped in one package not exceeding an overall length of 12 inches. Each wrapped item shall be secured with 1 inch minimum width gummed paper tape conforming to type III, grade B of PPP-T-45, except that paper wrapping on cloth material rolls shall be secured with 2 inch minimum width gummed paper tape.

5.1.2 Level C. Glass fiber material shall be packaged to afford adequate protection against physical damage during shipment from the supply source to the first receiving activity. The supplier may use his standard practice when it meets this requirement.

5.2 Packing. Packing shall be level A, B or C as specified (see 6.2).

5.2.1 Level A. Glass fiber material of one class and form only, packaged as specified in 5.1, shall be packed in a snug-fitting shipping container conforming to style RSC-L or FOL-L, grade V2s of PPP-B-636. Alternatively, shipping containers may be used that conform to style A or B, class 2 of PPP-B-576; class II of PPP-B-591; or overseas type of PPP-B-601; or class 2, style 2 or 4 of PPP-B-621 except that the requirements for

additional battens shall not apply. Each alternative shipping container shall be provided with a type I or II, grade C, sealed case liner conforming to MIL-L-10547. The inside of each fiberboard shipping container containing cloth material shall be fitted with a full-height taped box liner conforming to type CF, class weather-resistant, variety DW, grade V15c of PPP-B-636. Alternative to the box liner, for cloth material only fiberboard pads shall be placed at each end of the roll to support and immobilize the contents. Each fiberboard shipping container shall be waterproofed with tape in accordance with the appendix of the container specification. Each shipping container shall be closed and reinforced in accordance with the appendix of the applicable container specification. The net weight of contents in each fiberboard shipping container shall not exceed the weight limitation in the container specification. The net weight of contents in each alternative container shall not exceed 250 pounds.

5.2.2 Level B. Glass fiber material of one class and form only, packaged as specified in 5.1, shall be packed in a snug-fitting shipping container conforming to style RSC-L, or FOL-L, type CF (variety SW or DW) or SF, class domestic, grade as applicable of PPP-B-636. Alternatively, shipping containers may be used that conform to style A or B, class 1 of PPP-B-576; class I, style A or B of PPP-B-591; domestic type, style A or B of PPP-B-601; or class 1, style 2 or 4 of PPP-B-621, except that the requirements for additional battens shall not apply. The inside of each fiberboard shipping container shall be fitted with a full-height taped box liner conforming to type CF, class domestic, variety DW, grade 275 of PPP-B-636. Alternative to the box liner, for cloth material only, fiberboard pads shall be placed at each end of the roll to support and immobilize the contents. The fiberboard panels for the wood-cleated fiberboard shipping container shall conform to type SF, class domestic, grade as applicable of PPP-F-320. Each shipping container shall be closed in accordance with the appendix of the applicable container specification, with the method II closure required for fiberboard containers. The net weight of the contents in each fiberboard shipping container shall not exceed the weight limitation specified in the container specification. The net weight of contents in each alternative container shall not exceed 400 pounds.

5.2.2.1 When specified (see 6.2), the fiberboard shipping container shall be a grade V3c, V3s or V4s fiberboard box fabricated in accordance with PPP-B-636 and grade V3s for fiberboard panels of PPP-B-591, and closed in accordance with the appendix of the applicable container specification.

5.2.3 Level C. Glass fiber material, packaged as specified in 5.1, shall be packed in a manner to insure carrier acceptance and safe delivery at destination at the lowest transportation rate for such supplies. Containers shall be in accordance with Uniform Freight Classification Rules or National Motor Freight Classification Rules, as applicable.

5.3 Marking. In addition to any special marking required by the contract or order, interior packages and shipping containers shall be marked in accordance with MIL-STD-129.

6. NOTES

6.1 Intended use. The materials of this specification are, in general, used as electrical insulation. However, in many cases, they may be used for mechanical support or as structural members. Certain treated materials are also covered. Class C, forms 1, 3 and 5 are intended for use in the manufacture of ammunition.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification.
(b) Class required (see 1.2).
(c) Form required (see 1.2):

Form 1: Construction and size required (see 3.2.1.1 and 3.2.1.2).
Form 2: Treatment, construction and size required (see 3.2.2.1, 3.2.2.2.1 and 3.2.2.2.2).
Form 3: Treatment, construction, and size required (see 3.2.3.1 and 3.2.3.2).
Form 4: Construction, size and weave required (see 3.2.4.1 and 3.2.4.2).
Form 5: Construction and size required (see 3.2.5.1 and 3.2.5.2).

(d) Width of cloth required (see 3.2.4.4).
(e) Selection of applicable levels of packaging and packing (see 5.1 and 5.2).
(f) When weather-resistant grade fiberboard shipping containers and panels are required for level B packing (see 5.2.2.1).

6.3 Untreated glass cloth, form 4, class C is not intended for use in airborne radomes.

6.4 International interest. Certain provisions of this specification are subject of international standardization agreement as cited in ABC-Navy-Std-17. When amendment, revision or cancellation of this specification is proposed which will effect or violate the international agreement

concerned, the preparing activity will take appropriate reconciliation action through international standardization channels including departmental standardization offices, if required.

6.5 Cloth width. The following is for information only, and is not a mandatory requirement: Form 4, cloth specified in 3.2.4 is available in 38, 44, 50, 60 and 72-inches widths inclusive of selvage.

6.6 The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and suppliers are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

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