

GLASS ROVING, EPOXY RESIN PREIMPREGNATED  
Type E Glass

1. SCOPE:

1.1 Form: This specification covers glass roving impregnated with epoxy resin, the resin being partially processed to a "B" stage condition.

1.2 Application: Primarily for use in high strength filament-wound structures for aircraft, missiles, and related structures.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods  
AMS 2825 - Material Safety Data Sheets

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM D2290 - Apparent Tensile Strength of Ring or Tubular Plastics and Reinforced Plastics by Split Disk Method

ASTM D2343 - Tensile Properties of Glass Fiber Strands, Yarns, and Rovings Used in Reinforced Plastics

ASTM D2344 - Apparent Interlaminar Shear Strength of Parallel Fiber Composites by Short Beam Method

ASTM D2584 - Ignition Loss of Cured Reinforced Resins

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

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## 2.3.1 Military Specifications:

MIL-C-9084 - Cloth, Glass, Finished, for Resin Laminates  
MIL-R-9300 - Resin, Epoxy, Low Pressure Laminating  
MIL-R-60346 - Roving, Glass, Fibrous (For Filament Winding Applications)

## 2.3.2 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

## 3. TECHNICAL REQUIREMENTS:

3.1 Material: Shall be glass roving conforming to MIL-R-60346, Type II, Class Ø ECG 135-140, impregnated with epoxy resin formulated to meet MIL-R-9300, Type I, Class 1, the resin being processed to "B" stage condition.

3.1.1 Splices: No splices or knots shall be introduced during the impregnation process except as shall have been previously agreed upon by purchaser and vendor.

3.1.2 Shelf Life: When packaged in vaporproof, heat sealed bags, the preimpregnated roving shall have a shelf life of not less than 3 weeks when stored at not higher than 4°C (40°F), and not less than 3 months when stored at not higher than -18°C (0°F).

3.1.3 Cure: Material shall be fully cured by filament winding under 12 - 15 psi (0.08 - 0.10 MPa) tension and curing for 1 hr at 95°C ± 15 (200°F ± 25) plus 2 hr at 175°C ± 15 (350°F ± 25), or as recommended by the manufacturer.

3.2 Properties: The product shall conform to the following requirements; tests shall be performed on the product supplied and in accordance with specified test methods, insofar as practicable:

### 3.2.1 As Received (Uncured):

3.2.1.1 Volatile Matter, by weight	0.5 - 2.5%	4.5.1
3.2.1.2 Ignition Loss, by weight	17 - 23%	ASTM D2584
3.2.1.3 Gel Time	1.0 - 3.5 min.	4.5.2
3.2.1.4 Resin Flow, by weight	8 - 17%	4.5.3
3.2.1.5 Tensile Strength, Impregnated Strand, min	300,000 psi (2070 MPa)	ASTM D2343

3.2.2 As Cured: Specimens, cured as in 3.1.3, shall have the following properties, determined at 23°C ± 1 (73°F ± 2):

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3.2.2.1	Hoop Tensile Strength (NOL Ring), min	190,000 psi (1310 MPa)	ASTM D2290
3.2.2.2	Interlaminar Shear Strength, min	6000 psi (40 MPa)	ASTM D2344

3.3 Quality: The product, as received by purchaser, shall be uniform in quality and condition and free from foreign materials and from internal and external imperfections detrimental to usage of the product.

#### 4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.6. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

#### 4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for volatile matter (3.2.1.1), resin flow (3.2.1.4), and cured hoop tensile strength (3.2.2.1) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed on or prior to the first shipment of the product to a purchaser, when a change in material or processing, or both, requires reapproval as in 4.4.2; and when purchaser deems confirmatory testing to be required.

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.

#### 4.3 Sampling: Shall be as follows:

4.3.1 For Acceptance Tests: Sufficient product shall be taken at random from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.

4.3.1.1 A lot shall be all product from the same batches or lots of roving and resin produced in one continuous run and presented for vendor's inspection at one time. An inspection lot shall not exceed 500 lb (225 kg) and may be packaged and delivered in smaller quantities under the basic lot approval provided the lot identification is maintained.

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4.3.1.1.1 A batch of resin shall be that quantity formulated and mixed at the same  
Ø time.

4.3.1.2 When a statistical sampling plan and acceptance quality level (AQL) have  
Ø been agreed upon by purchaser and vendor, sampling shall be in accordance  
with such plan in lieu of sampling as in 4.3.1 and the report of 4.6.1  
shall state that such plan was used.

4.3.2 For Preproduction Tests: As agreed upon by purchaser and vendor.

## 4.4 Approval:

4.4.1 Sample impregnated roving shall be approved by purchaser before roving for  
production use is supplied, unless such approval be waived by purchaser.  
Results of tests on production roving shall be essentially equivalent to  
those on the approved sample.

4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and  
Ø methods of inspection on production roving which are essentially the same  
as those used on the approved sample roving. If necessary to make any  
change in ingredients, in type of equipment for processing, or in  
manufacturing procedures, vendor shall submit for reapproval a statement of  
the proposed changes in material or processing, or both, and, when  
requested, sample roving. Production roving made by the revised procedure  
shall not be shipped prior to receipt of reapproval.

## 4.5 Test Methods:

4.5.1 Volatile Matter: Cut three specimens each 72 in.  $\pm$  0.1 (1800 mm  $\pm$  2.5)  
long. Fold each specimen three times to a length of approximately 9 in.  
(225 mm) and tie loosely into an overhand bow knot. Weigh each specimen to  
the nearest 0.001 gram. Hang each specimen separately on a rack and place  
in an oven at 135°C  $\pm$  3 (275°F  $\pm$  5) for 15 min.  $\pm$  1. Cool to room  
temperature in a desiccator and weigh each specimen. Calculate volatile as  
follows:

$$\text{Volatile matter, \%} = \frac{W_0 - W_1}{W_0} \times 100$$

where,  $W_0$  = original weight  
 $W_1$  = final weight

Average the results from the three specimens.

- 4.5.2 Gel Time: Precondition a Fisher-Johns Melting Point Apparatus to  $165^{\circ}\text{C} \pm 1$  ( $325^{\circ}\text{F} \pm 2$ ). Place a microscope slide on the heated block, allowing 20 - 30 sec for it to reach temperature equilibrium. Cut a piece of roving  $1/4$  in.  $\pm 1/16$  ( $6.25$  mm  $\pm 1.5$ ) long. Place sample on heated microscope slide and commence timing. Within 5 sec, place a second microscope slide over the sample. As the resin softens and during the first 30 sec, isolate a drop of resin by gently pressing on the upper slide. Observe lateral movement of the resin drop while periodically pressing on the upper slide. As the resin thickens, the lateral movement will be retarded. A sharp color change and the formation of small droplets when the cover slide is pressed indicate the gel point. Stop the timer and record the elapsed time in minutes as gel time. Report the average of three results.
- 4.5.3 Resin Flow: Cut six lengths of roving, each 3 in. (75 mm) long. Weigh each specimen, consisting of two 3-in. (75-mm) lengths, to the nearest 0.001 gram. With the lengths spaced  $1/2$  in. (12.5 mm) apart, sandwich the specimen between four layers (two on each side of specimen) of MIL-C-9084, Type I, Volan A finish glass cloth. Preheat a 1500 g metal weight to  $150^{\circ}\text{C} \pm 5$  ( $300^{\circ}\text{F} \pm 10$ ). Press the sandwiched material on a preheated hot plate and maintain at  $150^{\circ}\text{C} \pm 5$  ( $300^{\circ}\text{F} \pm 10$ ) for 2 min., using a surface pyrometer to ensure maintenance of the required temperature. While still hot, remove the glass cloth and reweigh each roving specimen to the nearest 0.001 gram. Calculate resin flow as follows:

$$\text{Resin flow, wt \%} = \frac{W_0 - W_1}{W_0} \times 100$$

where,  $W_0$  = Weight of roving before cure

$W_1$  = Weight of roving with excess resin removed (after cure)

Report the average value of the tests on the three specimens.

#### 4.6 Reports:

- 4.6.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the acceptance test requirements and stating that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, AMS 3828A, lot number, vendor's material designation, size, and quantity.
- 4.6.1.1 A material safety data sheet conforming to AMS 2825 or equivalent shall be supplied to each purchaser prior to, or concurrent with, the report of preproduction test results or, if preproduction testing be waived by purchaser, concurrent with the first shipment of the impregnated roving for production use. Each request for modification of the product formulation shall be accompanied by a revised data sheet for the proposed formulation.