



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 3904

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Revised

ORGANIC FIBER, YARN AND ROVING For Cables, Cordage, and Mechanical Goods

1. SCOPE:

- 1.1 Form: This specification and its supplementary detail specifications cover organic fibers in the form of continuous, multifilament yarn and roving.
- 1.2 Application: Primarily for use as primary elements in cables, cordage, and mechanical goods.
- 1.3 Classification: The fibers shall be as specified in the applicable detail specification, wherein each material is defined by form, denier, and finish. An example is shown in 8.1. The material covered by each detail specification appears as part of the title.

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 Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

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

ASTM D1505 - Density of Plastics by the Density-Gradient Technique

ASTM D2256 - Breaking Load (Strength) and Elongation of Yarn by the Single-Strand Method

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

2.3.1 Military Standards:

MIL-STD-105 - Sampling Procedures and Tables for Inspection by Attributes

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

3. TECHNICAL REQUIREMENTS:

- 3.1 Detail Specifications: The requirements for a specific material shall consist of all the requirements specified herein in addition to the requirements specified in the applicable detail specification. In the case of any conflict between the requirements of this basic specification and an applicable detail specification, the requirements of the detail specification shall govern.

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3.2 Material:

3.2.1 Construction: The product shall consist of parallel, unidirectional, continuous, organic filaments characterized by flexibility and fineness.

3.2.2 Finish: A finish or treatment shall be applied to the fibers to promote internal abrasion resistance. The amount of finish shall be as specified in the applicable detail specification.

3.2.3 Color: The material shall be essentially yellow in color.

3.3 Properties: The product, as-received, shall conform to the requirements of this specification and the applicable detail specification. Tests shall be performed on the product supplied and in accordance with applicable test procedures of this specification.

3.4 Quality: The product shall be uniform in quality and condition, clean, and free from foreign materials and from internal and external imperfections detrimental to fabrication, appearance, or performance of parts.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples 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 perform such confirmatory testing as he deems 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 construction (3.2.1), property testing in accordance with 3.3 or as specified in the applicable detail specification, quality (3.4), and splicing requirements of the detail specification are classified as acceptance tests.

4.2.2 Qualification Tests: Tests to determine conformance to all technical requirements of this specification and the applicable detail specification are classified as qualification tests and may be the basis for approval of the product (See 4.4.1).

4.2.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, qualification 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:

4.3.1 Sampling Schedule: Shall be in accordance with Single Sampling for Normal Inspection, General Inspection Level II, with an Acceptable Quality Level (AQL) of 1.5 specified in MIL-STD-105 as shown in Table I. Test specimens shall be taken from spools selected at random throughout the lot.

TABLE I
SAMPLING SCHEDULES

Number of Inspection Units in the Lot	Number of Inspection Units from Which Samples are to be Taken	Number of Nonconforming Specimens to	
		Accept	Reject
1 - 90	8 (4.3.1.1)	0	1
91 - 280	32	1	2
281 - 500	50	2	3

- 4.3.1.1 If number of inspection units to be sampled equals or exceeds lot size, inspect each unit.
- 4.3.2 Lot: Shall be all product produced in a single production run from the same batches of raw materials under the same fixed conditions and submitted for vendor's inspection at one time.
- 4.3.3 Inspection Unit: Shall be each 25 lb (11.4 kg) of yarn or an individual package, whichever is smaller. An inspection unit of roving shall be as agreed upon by purchaser and vendor.
- 4.3.4 Tensile Strength and Modulus of Elasticity: Four specimens from each inspection unit.
- 4.3.5 Denier: Two specimens from each inspection unit.

4.4 Approval:

- 4.4.1 Sample material shall be approved by purchaser before material for production use is supplied, unless such approval be waived. Results of tests on production material shall be essentially equivalent to those on the approved sample.
- 4.4.2 Vendor shall use ingredients, manufacturing procedures, processes, and methods of inspection on production material which are essentially the same as those used on the approved sample material. If any change is necessary 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 and processing and, when requested, sample material. Production material made by the revised procedure shall not be shipped prior to receipt of reapproval.

4.5 Test Methods:

- 4.5.1 Tensile Strength and Modulus of Elasticity: Shall be determined in accordance with ASTM D2256, Options 1 and A, using 1.1 twist multiplier in the equation specified below to determine the twist (turns) to be applied to the 10-in. (254-mm) gage length specimen, and tested at 50% per min. rate of elongation. The specific twist shall be as specified in the applicable detail specification. (See 8.2).

$$1.1 = \frac{\text{Turns/in.} \times \text{denier}}{73} \quad \text{or} \quad 1.1 = \frac{\text{Turns}/25.4 \text{ mm} \times \text{denier}}{73}$$

- 4.5.2 Fiber Density: Shall be determined in accordance with ASTM D1505.

- 4.5.3 Denier: Shall be determined as follows:

- 4.5.3.1 Measure a 900-mm length of yarn or roving to the nearest millimetre.
- 4.5.3.2 Weigh the yarn or roving sample in grams to the nearest 10 milligrams.
- 4.5.3.3 Calculate the denier (weight per length) as follows:

$$\text{Denier} = \text{wt in g of 9000 m} = \text{wt of 900-mm sample} \times 10,000$$

- 4.5.4 Fiber Finish Content: Shall be determined as follows:

- 4.5.4.1 Weigh, to the nearest mg, a 1.0 - 2.0 g sample of finished yarn or roving (W_1). Place sample in a Whatman paper thimble previously extracted with acetone.
- 4.5.4.2 Pour approximately 200 mL of freshly distilled acetone into a 300 mL boiling flask previously cleaned, dried, and weighed to the nearest mg (W_2).
- 4.5.4.3 Place the thimble containing the sample in a Soxhlet extraction apparatus with condenser and attach the boiling flask containing the acetone.

- 4.5.4.4 Adjust the rate of condensation dripping into the thimble to not less than 1 mL per minute.
- 4.5.4.5 Extract for not less than 4 hr at this rate.
- 4.5.4.6 Remove flask and distill off all but approximately 5 - 10 mL of acetone. Place flask in oven at $210^{\circ}\text{F} \pm 10$ ($99^{\circ}\text{C} \pm 5$) and allow to remain until completely dry.
- 4.5.4.7 Reweigh the flask to the nearest mg (W_3). Determine weight of resin extracted from the sample and calculate percent by weight of finish as follows:

$$\text{Fiber Finish Content, \% by weight} = \frac{(W_3 - W_2)}{W_1} \times 100$$

where, W_1 = Weight of original fiber sample

W_2 = Weight of clean, dry flask

W_3 = Weight of flask plus extracted resin

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 tests specified in the applicable detail specification and stating that the product conforms to the other technical requirements of this specification and the applicable detail specification. This report shall include the purchase order number, material specification number including applicable detail specification number, vendor's material designation, treatment finish, date of manufacture, lot number, spool number, and net weight.
- 4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number including applicable detail specification number, contractor or other direct supplier of material, supplier's material designation, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification and the applicable detail specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.
- 4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the product may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

- 5.1.1 Yarn and roving shall be supplied in continuous lengths wound on spools with cores having an OD of not less than 1 in. (25 mm). Winding shall be uniform and provide for proper unreeling. Ends shall be secured.