SAE LAND SEA AIR SPACE

# AEROSPACE MATERIAL SPECIFICATION

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

AMS 3902A
Superseding AMS 3902
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## CLOTH, ORGANIC FIBER, HIGH MODULUS
For Structural Composites



1. SCOPE:

1.1 Form: This specification covers fabrics woven from high-modulus, continuous, multifilament yarn.

1.2 Application: Primarily for use as reinforcements in composites for structural applications.

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
AMS 3901 - Organic Fiber, Yarn and Roving, High Modulus, For Structural Composites

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

ASTM D123 - Definition of Terms Relating to Textile Materials
ASTM D1682 - Breaking Load and Elongation of Textile Fabrics
ASTM D1777 - Measuring Thickness of Textile Materials
ASTM D1910 - Construction Characteristics of Woven Fabrics

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

3. TECHNICAL REQUIREMENTS:

3.1 Material:

Ø 3.1.1 Yarn: The material shall be woven from AMS 3901 organic fiber yarns as specified in Table I.

3.1.2 Weave: Shall be as specified in Table I.

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

3.1.4 Finish: A finish or treatment may be applied if required to promote compatibility with the resin system with which it is used in making laminates. The cloth shall be supplied without finish or treatment, unless otherwise specified.

3.2 Properties: Shall be as specified in Table I except that finish content shall be as agreed upon by purchaser and vendor; tests shall be made on the product supplied and in accordance with test methods specified in 4.5.

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

3.3.1 Imperfections: In any 100 yd (91.4 m) of fabric supplied, there shall be no more than the equivalent of 10 major imperfections (2 minors = 1 major), based on the following imperfection classification; definitions of terms shall be in accordance with ASTM D123:

| Imperfection | Description and Limitation | Classification |
|---|---|---|
| Bias or bowed filling | Distorted from horizontal by more than 3 in. (76 mm) for 38-in. (965-mm) widths and proportionately for all other widths. | Major |
| Baggy, ridgy, or wavy cloth | Clearly noticeable. | Major |
| Crease | Hard, embedded, and folded over on self. | Major |
| Brittle or fused area | Any. | Major |
| Uneven finish | Thin areas where finishing compound is missing or insufficient. | Major |
| Cut or tear | 2 in. (51 mm) or more in combined directions.<br>Less than 2 in. (51 mm) but greater than 1/4 in. (6.4 mm) in combined directions. | Major<br>Minor |
| Hole | 1/2 in. (12.7 mm) or more in diameter.<br>Less than 1/2 in. (12.7 mm) in diameter. | Major<br>Minor |
| Spots, streaks, or stains | Clearly noticeable 2 in. (51 mm) or more in combined directions.<br>Clearly noticeable less than 2 in. (51 mm) in combined directions. | Major<br>Minor |
| Tender or weak spot | Clearly noticeable 2 in. (51 mm) or more in combined directions.<br>Clearly noticeable less than 2 in. (51 mm) but greater than 1/4 in. (6.4 mm) in combined directions. | Major<br>Minor |
| Smash | 3 in. (76 mm) or more in combined directions.<br>Less than 3 in. (76 mm) in combined directions. | Major<br>Minor |
| Broken or missing ends or picks | 3 or more contiguous regardless of length or 2 contiguous more than 36 in. (914 mm) in length.<br>2 contiguous less than 36 in. (914 mm) in length. | Major<br>Minor |
| Floats | 2 in. (51 mm) or more in combined directions.<br>Less than 2 in. (51 mm) in combined directions. | Major<br>Minor |
| Coarse or light place | Over 1/2 in. (12.7 mm) in width causing thickness outside of limits specified in Table I. | Minor |
| Selvage defects | Cut or torn.<br>Curled or folded under. | Major<br>Minor |

3.4 Tolerances: Unless otherwise specified, the following tolerances shall apply:

3.4.1 Width: Shall be within ±1/2 in. (±12.7 mm) from the standard or specified width.

3.4.2 Weight: Shall conform to Table I within the following limits:

| Nominal Weight | | Permissible Variation |
|---|---|---|
| oz per sq yd | ($g/m^2$) | %, Plus and Minus |
| Up to 4.00, incl | (Up to 135.6, incl) | 10 |
| Over 4.00 | (Over 135.6) | 6 |

3.4.3 Fabric Count:

3.4.3.1 Warp: The average count of warp ends shall be within the limits of ±2 ends from the nominal count listed in Table I.

3.4.3.2 Fill: The average count of filling picks shall be within the limits of ±2 picks from the nominal count listed in Table I.

3.4.4 Thickness: Permissible variation in thickness shall be as specified in Table II.

TABLE II

| Nominal Thickness Inch | Tolerance, Inch plus and minus |
|---|---|
| Up to 0.0030, incl | 0.0005 |
| Over 0.0030 to 0.0100, incl | 0.0010 |
| Over 0.0100 to 0.0150, incl | 0.0020 |
| Over 0.0150 | 0.0030 |

TABLE II (SI)

| Nominal Thickness Millimetre | Tolerance, Millimetre plus and minus |
|---|---|
| Up to 0.076, incl | 0.013 |
| Over 0.076 to 0.254, incl | 0.025 |
| Over 0.254 to 0.381, incl | 0.051 |
| Over 0.381 | 0.076 |



4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of fabric 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 fabric conforms to the requirements of this specification.

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests.

4.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction Ø 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; a lot shall be all fabric produced in a single production run under the same fixed conditions and submitted for vendor's inspection at one time.

4.3.1 Examination of Rolls: 100% visual examination shall be performed on all lots.

4.3.2 Fabric Tests: Shall be in accordance with Table III.

TABLE III

SAMPLE SIZE FOR TESTS OF ORGANIC CLOTH

| Lot Size, Yards | Sample Size, Yards |
|---|---|
| Up to 3,200, incl | 2 |
| Over 3,200 to 22,000, incl | 3 |
| Over 22,000 | 5 |

TABLE III (SI)

| Lot Size, Metres | Sample Size, Metres |
|---|---|
| Up to 2,925, incl | 1.8 |
| Over 2,925 to 20,100, incl | 2.7 |
| Over 20,100 | 4.6 |

4.4 Approval:

4.4.1 Sample fabric shall be approved by purchaser before fabric for production use is supplied, unless such approval be waived. Results of tests on production fabric 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 fabric which are essentially the same as those used on the approved sample fabric. 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 fabric. Production material made by the revised procedure shall not be shipped prior to receipt of approval of such procedure.

4.5 Test Methods: Tests to determine conformance to this specification shall be as follows:

| | |
|---|---|
| Weight | ASTM D1910, Small Sample Method |
| Nominal Thickness | ASTM D1777 |
| Fabric Count | ASTM D1910 |
| Finish, % | 4.5.1 |
| Breaking Strength | ASTM D1682 |

4.5.1 Fiber Finish Content: Shall be determined as follows:

4.5.1.1 Weigh, to the nearest mg, a 1.0 - 2.0 g sample of finished fabric ($W_1$). Place sample in a Whatman paper thimble previously extracted with acetone.

4.5.1.2 Pour approximately 200 $cm^3$ of freshly distilled acetone into a 300 $cm^3$ boiling flask previously cleaned, dried, and weighed to the nearest mg ($W_2$).

4.5.1.3 Place the thimble containing the sample in a Soxhlet extraction apparatus with condenser and attach the boiling flask containing the acetone.

4.5.1.4 Adjust the rate of condensation dripping into the thimble to not less than 1 $cm^3$ per minute.

4.5.1.5 Extract for not less than 4 hr at this rate.

4.5.1.6 Remove flask and distill off all but approximately 5 - 10 $cm^3$ of acetone. Place flask in oven which is at 210°F ± 10 (99°C ± 6) and allow to remain until completely dry.

4.5.1.7 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 fabric shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the technical requirements of this specification. This report shall include the purchase order number, material specification number and its revision letter, fabric style number, vendor's material and finish designation, date of finishing, and quantity.

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 and its revision letter, fabric style number, contractor or other direct supplier of fabric, supplier's material and finish designation, and quantity. When fabric for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of fabric to determine conformance to the requirements of this specification, and shall include in the report a statement that the fabric 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 fabric 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 fabric 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 Each roll of fabric shall have attached a tag showing the manufacturer's name or trademark and the phrase "CLOTH, ORGANIC FIBER, HIGH MODULUS, STYLE _____".

5.1.2 Packaging shall be accomplished in such a manner as to ensure that the fabric, during shipment and storage, will be protected against damage from exposure to moisture, weather, or any normal hazard.

5.1.3 Packages: 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:

CLOTH, ORGANIC FIBER, HIGH MODULUS_____STYLE FABRIC
AMS 3902A
YARDAGE_____
WIDTH_____
PURCHASE ORDER NUMBER_____
MANUFACTURER'S IDENTIFICATION_____
LOT_____
WEIGHT OF PACKAGE_____