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INTERNATIONAL
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 3895B

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Superseding AMS 3895A

Submitted for recognition as an American National Standard

BROADGOODS AND TAPE, CARBON FIBER-EPOXY RESIN IMPREGNATED
Multi-Ply, Uniform Fiber

1. SCOPE:

1.1 Form:

This specification covers epoxy-resin-impregnated carbon-fiber broadgoods and tape in the form of multi-plied unidirectional layers constructed from the same or uniform fibers and supplied as broadgood rolls, tape, or cut sheet. The individual ply orientation shall be as ordered.

1.2 Application:

These products have been used typically for fabricating high-strength and high-modulus composite parts, using either hand-layup or a machine for automated-tape-layup, but usage is not limited to such applications.

1.3 Safety - Hazardous Materials:

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards which may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2825 Material Safety Data Sheets
AMS 3894 Carbon Fiber Tape and Sheet, Epoxy Resin Impregnated
AMS 3898 Interleaf Carrier Material, Composite Tape

2.2 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-2073-1 DOD Materiel, Procedures for Development and Application of Packaging Requirements

2.3 AIA Publications:

Available from National Standards Association, Inc., 1321 14th Street, N.W., Washington, DC 20005.

NAS 992 Reel, Composite Filament Tape, Automated Machine Layup

3. TECHNICAL REQUIREMENTS:

3.1 Material:

3.1.1 The product shall consist of superimposed, unidirectional plies of epoxy-resin impregnated carbon-fiber broadgoods or tape. Each ply shall conform to the requirements of AMS 3894 and its applicable detail specification, and shall be of the orientation specified.

3.1.1.1 When specified, the broadgoods product shall be supplied in sheet form of specified length and width.

3.1.2 Designation: Each product construction shall be identified by the fiber/impregnating resin specification number, followed by the individual ply direction in brackets, each ply indicated by the direction code, as follows: (See 8.2 for examples)

a. Fiber/impregnation resin detail specification: 3894/*
* = Detail Specification number, as applicable.

b. Ply direction: Ø = longitudinal fiber direction
45 = 45 degrees from longitudinal, (right bias, often designated +45)
90 = 90 degrees or perpendicular
135 = 135 degrees from longitudinal, (left bias, often designated -45)

c. Number of plies: (Ø) = One ply, longitudinal
(Ø/Ø) = Two plies, longitudinal

3.1.2.1 Example:

3894/2 (O/45/9Ø) = Three ply, AMS 3894/2 in each ply, longitudinal (Ø degree) fiber direction in first (bottom) ply, right bias (45 degree) fiber direction in second (center) ply, and perpendicular (90 degree) fiber direction in third (top) ply.

3.2 Storage Life:

The product shall meet the requirements of 3.4 when tested at any time up to three months from date of receipt by purchaser provided it has been stored in the original sealed bags at a temperature not higher than -18 °C (Ø °F).

3.3 Working Life:

The product shall meet the requirements of 3.4 when tested after continuous exposure for 14 days within the relative humidity and temperature limits shown in Figure 1.

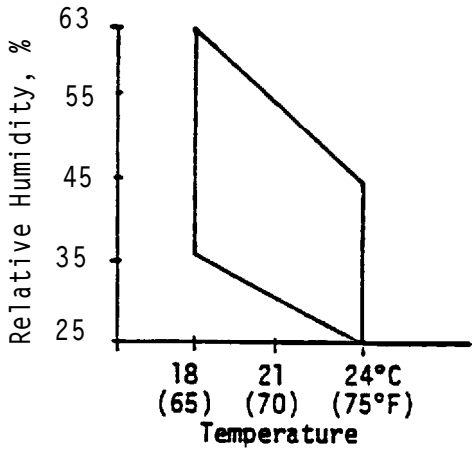

FIGURE 1

3.4 Properties:

The product shall conform to the requirements of AMS 3894 and its applicable detail specification and the following:

3.4.1 Uncured Product: Tests shall be performed on the product supplied, after warming to above the dew point prior to opening the heat sealed bag for sampling, and in accordance with the test procedures specified herein and in AMS 3894, as applicable.

3.4.1.1 Bending: The product shall withstand, without visible material damage, bending through an angle of 180 degrees around a 1.0-inch (25-mm) diameter mandrel with the 0 degree ply direction perpendicular to the axis of bend; 10X magnification shall be used in examination for damage.

3.4.1.2 Tack, Time Adherence: Specimens shall adhere for not less than 30 minutes, determined in accordance with 4.5.2.

3.4.1.3 Tack, Peel Strength: Shall be the preproduction value established as in 4.4.1 ± 10% determined in accordance with 4.5.3.

3.4.2 Cured Laminate: When required by purchaser, tests shall be performed on specimens cut from laminates prepared in accordance with 4.5.1.

3.5 Quality:

The product, as received by purchaser, shall be uniform in quality and condition, free from foreign materials, and, in addition to the requirements of 3.5.1, free from imperfections detrimental to usage of the product.

3.5.1 Visual Inspection Criteria: Shall be as shown in Table 1. In addition to the requirements specified in AMS 3894 and its applicable detail specification for each ply, visible indications of voids between plies, incorrectly positioned impregnated material (excessive gap or overlap), or irregular interleaf carrier shall be unacceptable if the total length of each area exceeds limits indicated in Table 1, determined in accordance with 4.5.4. Examination of interior plies may be made by any suitable nondestructive method, such as radiographic inspection, agreed upon by purchaser and supplier.

TABLE 1 - Visual Inspection Criteria

Imperfections	Acceptance Criteria
Ply Count and Fiber Orientation	Shall be as designed
Flatness	Shall not exceed 0.075 inch (1.90 mm) for each inch
	Shall not curl after separator has been removed
Voids between plies (R)	Shall not exceed 2%
Between adjacent AMS 3894 material in the same ply	
Gap	Shall not exceed 0.040 inch (1.02 mm)
Overlap	Shall not exceed 0.030 inch (0.76 mm)
Butt Splices	None
Rippled interleaf carrier	None, or as agreed upon by purchaser and vendor

3.6 Tolerances:

Shall be as follows:

3.6.1 Broadgoods Roll-Width: Shall be as specified in Table 2.

TABLE 2A - Width Tolerances, Inch/Pound Units

Nominal Width Inches	Tolerance Inch Plus	Tolerance Inch Minus
Up to 12.000, excl	0.125	0
12.000 to 30.000, excl	0.188	0
30.000 to 48.000, excl	0.250	0
48.000 and over	As agreed upon	

TABLE 2B - Width Tolerances, SI Units

Nominal Width Millimeters	Tolerance Millimeters Plus	Tolerance Millimeter Minus
Up to 304.80, excl	3.18	0
304.80 to 762.00, excl	4.78	0
762.00 to 1219.20, excl	6.35	0
1219.20 and over	As agreed upon	

3.6.2 Broadgoods Sheet - Length and Width: Shall be as specified for product width in Table 2.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

(R) The manufacturer of the product shall supply all samples for required tests and shall be responsible for performing all required tests. 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 for construction (3.1.1), bending (3.4.1.1), tack (3.4.1.2 and 3.4.1.3), quality (3.5), and tolerances (3.6) are acceptance tests and shall be performed on each lot.

4.2.2 Preproduction Tests: Tests for all technical requirements are preproduction tests and shall be performed prior to or on the initial shipment of the product by the manufacturer, when a change in ingredients and/or processing 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, contracting officer, or request for procurement.

4.3 Sampling and Testing:

(R) Shall be as follows:

4.3.1 For Acceptance Tests: Each lot of broadgoods, sheet, and tape shall be sampled at random to provide sufficient product to perform all required tests. Except as specified in 4.5, 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 produced in a continuous production run from
(R) the same lot(s) of AMS 3894 under the same fixed conditions and presented for manufacturer's inspection at one time.

4.3.1.2 When a statistical sampling plan has been agreed upon by purchaser and
(R) manufacturer, sampling shall be in accordance with such plan in lieu of sampling in 4.3.1 and the report of 4.6 shall state that such plan was used.

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

4.4 Approval:

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

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

4.5 Test Methods:

Tests to determine conformance to requirements of this specification shall be conducted as specified herein or in the applicable test procedures specified in AMS 3894.

4.5.1 Preparation of Test Laminates: When required by purchaser, one end of each roll shall be so arranged that not less than one yard (1 m) of product shall be interleaved with a suitable nonadhering separator between each ply, in such a manner that the separate layers may be individually used for test and to make a test laminate for evaluation of cured laminate properties. Test laminates shall be prepared from the required number of plies in accordance with AMS 3894 and its applicable detail specification.

4.5.2 Tack, Time Adherence:

4.5.2.1 Cut two pieces of product, approximately 1 x 3 inches (25 x 76 mm), retaining the protective film until immediately before using the specimens. The 0-degree oriented unidirectional ply (plies) shall be parallel to the l-inch (25-mm) dimension.

4.5.2.2 Remove the protective film from one face of one specimen and apply the product to the center of a clean piece of austenitic, corrosion-resistant steel sheet with a commercial 2D finish, any thickness, by approximately 4 x 8 inches (102 x 203 mm). Apply light pressure with a squeegee or roller over the backing film. Remove the backing film and apply the second specimen to the first, in exactly the same manner, making sure the opposing faces of the pieces are not covered with protective backing film. The second layer of narrow product shall be so positioned that the butt joints do not coincide with those of the first layer. Remove the protective film from the exposed surface of the product and maintain the test plate and the long dimension of the test specimen in a vertical position for not less than 30 minutes at 20 to 30 °C (68 to 86 °F) and 50 to 70% relative humidity.

4.5.2.3 Report results as pass or fail. If the specimen fails to adhere for the test period, record the elapsed time at which the specimen separates fully from the steel sheet.

4.5.3 Tack, Peel Strength: Shall be determined as agreed upon by purchaser and supplier.

4.5.4 Visual Imperfections: Shall be determined as follows:

4.5.4.1 Allow a sample of the product, approximately 15 feet (4.6 m) in length lying flat on the table, to be exposed to standard environmental conditions for 10 to 30 minutes prior to inspection.

4.5.4.2 Inspection aids and measuring devices of applicable accuracy may be used as required.

4.5.4.3 Report the results of the inspection of each sample.

4.6 Reports:

The supplier of the product shall furnish with each shipment a report showing the results of tests to determine conformance to the acceptance test requirements, including the identification of the resin system used, the cure cycle, and fiber volume of the test laminate when required, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS 3895B, product designation (3.1.2), manufacturer's material designation, spool, roll, or sheet numbers, date of manufacture, quantity (broadgoods width and length, or sheet width and length and number of sheets), and location of test samples within the lot and spool, roll, or sheet.

4.6.1 The supplier of the product shall also furnish with each shipment a report stating that each ply of the product conforms to the acceptance test requirements of AMS 3894 and its applicable detail specification.

4.6.2 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 product for production use. Each request for modification of product formulation shall be accompanied by a revised data sheet for the proposed formulation.

4.7 Resampling and Retesting:

(R) 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. When applicable, these specimens shall be cut from additional or newly prepared panels using the same procedures and curing cycles as used on the original panels. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

A lot of broadgoods or tape may be packaged in small quantities and delivered under the basic lot approval provided lot identification is maintained,

5.1.1 Broadgoods for Hand Layup:

5.1.1.1 Broadgoods in each roll shall be interleaved with a suitable non-adherent film and wound on spools having a hub diameter not less than 24 inches (610 mm). Winding shall be uniform and shall provide for proper unreeling. Each spool shall contain the lengths of product shown in Table 3 except that, in any one shipment, up to 20% of the spools may contain lengths as short as 60% of the shorter length for each plied construction. Broadgoods ends shall be secured. Spooled broadgoods shall be packaged in sealed bags of nonadherent material to prevent penetration of moisture or loss of impregnating resin solvent.

TABLE 3 - Product Length in Each Spool

Construction Plies	Feet	Meters
2	330 to 660	101 to 201
3	200 to 440	61 to 134
4	150 to 330	46 to 101
5	120 to 260	37 to 79
6	100 to 220	30 to 67
7	85 to 190	26 to 58

5.1.1.2 Broadgoods sheet shall be supplied flat and shall be protected on both sides by nonadhering separator film conforming to the specified detail specification of AMS 3898. Sheets shall be packaged separately, or as specified in 5.1.1.1 and 5.1.1.3, in sealed bags of suitable nonadherent material to prevent penetration of moisture or loss of impregnating resin solvent.

5.1.1.3 Location of visually imperfect areas and of splices shall be plainly identified on the product by suitable markers visible on the spool or reel and on the package. The total length of such areas in each roll shall be itemized in the applicable inspection report. Visually imperfect areas shall not be counted in conforming to any requirement for length.

5.1.2 Tape for Machine Layup: Shall be interleaved with a nonadherent film conforming to the specified detail specification of AMS 3898 and wound on NAS 992 reels of the type, size, and class specified. Quantity on each reel and marking of visually imperfect areas and of splices shall be as specified in 5.1.1.3.

5.1.2.1 The tape shall be placed on the interleaf (carrier) material within ±0.015 inch (±0.38 mm) of the center line of the interleaf or centered between the perforations (sprocket hole guides) by the same tolerance if perforated carrier is specified. If tape and interleaf are specified to have the same width, the tape shall be placed within 0.015 inch (0.38 mm) of the center line of the interleaf or not greater than 0.030 inch (0.76 mm) from the edge and shall not extend beyond the edge of the interleaf.

5.1.3 Broadgoods: Rolls or sheet, and tape, shall be maintained at not higher than -18 °C (0 °F) during shipment and storage.

5.1.4 Each roll or sheet of broadgoods and each reel of tape shall be legibly identified, with not less than the following information, by attached removable tags using characters which will not be obliterated by normal handling:

BROADGOODS (TAPE), MULTI-PLY GRAPHITE FIBER/EPOXY RESIN IMPREGNATED
AMS 3895B
CONSTRUCTION DESIGNATION: 3894/___*___/(___**___/___**___/___**___)
INTERLEAF MATERIAL, AMS 3898/___*___(when applicable)
NAS 992 REEL, TYPE _____, SIZE _____, CLASS _____
(when applicable)
MANUFACTURER'S IDENTIFICATION _____
PURCHASE ORDER NUMBER _____
DATE OF MANUFACTURE _____
LOT AND REEL, SPOOL, OR SHEET NUMBER _____
WIDTH OR SHEET SIZE _____
QUANTITY _____
WEIGHT, GROSS _____, NET _____
PERISHABLE, STORE BELOW -18 °C (0 °F)

* Code from applicable detail specification
** Ply orientation (See 3.1.2)

5.1.5 Each reel, spool, roll, or sheet of product shall be sealed in a bag of nonadherent material to prevent penetration of moisture and loss of impregnating resin solvent.

5.1.6 Packaging of protected reels, spools, rolls, and sheets shall be accomplished to ensure that the product, during shipment and storage, will be protected against damage from exposure to moisture, weather, or any other normal hazard. The exterior shipping container shall be capable of maintaining the required temperature during transit and storage.