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

AEROSPACE MATERIAL SPECIFICATION

AMS 3867

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Revised

BORON FILAMENT TAPE
Epoxy Resin Impregnated

1. SCOPE:

1.1 Form: This specification and its supplementary detail specifications cover boron filaments in the form of tape impregnated with epoxy resin, the resin to be supplied in a "B" stage condition.

1.2 Application: Primarily for fabricating high-strength and high-modulus composite parts, using either hand-layup or automated-tape-layup.

1.3 Classification: The tapes shall be as specified in the applicable detail specifications, wherein each product is defined by filament nominal diameter, resin system, and continuous service temperature. 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
AMS 3824 - Cloth, Type "E" Glass, Finished for Resin Laminates
AMS 3865 - Filaments, Boron, Tungsten Substrate, Continuous
AMS 3898 - Interleaf Carrier Material, Composite Tape

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

ASTM D790 - Flexural Properties of Plastic
ASTM D792 - Specific Gravity and Density of Plastics by Displacement
ASTM D1505 - Density of Plastics by the Density-Gradient Technique
ASTM D2344 - Apparent Horizontal Shear Strength of Reinforced Plastics by Short Beam Method
ASTM D3039 - Tensile Properties of Oriented Fiber Composites

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

2.4 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 Detail Specifications: The requirements for a specific tape 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.

3.2 Material:

3.2.1 Construction: The tape shall consist of parallel, unidirectional, boron filaments conforming to AMS 3865 impregnated with an epoxy resin which will yield a product meeting the requirements of the applicable detail specification. The resin shall be moldable using low-pressure laminating methods. The boron filaments shall be arranged in a single in-plane layer and supported by a glass scrim cloth. The scrim cloth shall be an integral part of the tape and shall hold the collimated boron filaments in their fixed positions while in storage, during shipment, and when being handled during layup operations. The warp of the scrim cloth shall be parallel to the length of the boron filaments in the impregnated material. The glass fabric shall conform to the requirements of AMS 3824 for the type of cloth specified in the applicable detail specification and shall have an A-1100 soft finish.

3.2.2 Splices: Not more than four filament splices shall occur in any 12-in. (305-mm) length of 3-in. (76-mm) wide tape. No more than three such groups of splices per 100 ft (30.5 m) of tape shall be permitted.

3.2.3 Storage Life: Tape, packaged in waterproof, heat-sealed bags, shall meet the requirements of the applicable detail specification after storage as specified therein.

3.2.4 Working Life: Tape shall meet the requirements of the applicable detail specification after exposure for a continuous period at the relative humidity and temperature specified therein.

3.2.5 Interleaf Carrier: When specified, the interleaf carrier shall conform to the applicable detail specification of AMS 3898, as specified in the applicable detail specification of AMS 3867.

3.3 Properties of Uncured Impregnated Product: The as-received tape shall conform to the requirements of this specification and the applicable detail specification. Tests shall be performed on the tape supplied and in accordance with the test procedures specified herein or in the applicable detail specification.

3.4 Properties of Cured Laminate: Test laminates shall conform to the requirements of this specification and the applicable detail specification. Tests shall be performed on specimens cut from laminates prepared and tested in accordance with 4.5.

3.5 Quality: Tape 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.

3.5.1 Visual Imperfection Acceptance Criteria: In any roll of tape supplied, there shall be no more than the equivalent of 2% of the total tape length of the roll marked for major imperfections based on the following imperfection classification. More than three minor imperfections in a 12 ft (3.7 m) length of tape shall be classified as a major imperfection.

3.5.1 (Continued)

Imperfection	Description and Limitation	Classification
Filaments not wetted	Visible area not wetted	Major
Filaments not collimated parallel to centerline	Filaments more than ± 0.25 deg from parallel to centerline	Major
Crimps	Visible crimps present	Minor
Cured resin particles	None permitted	Major
Foreign Material	None permitted	Minor
Glass fabric carrier distortion	None permitted	Major
Rippled interleaving	(to be determined)	
Resin starved area and voids	None allowed	Minor
Fiber crossovers	None allowed	Minor
Horizontal waviness (snaking)	Maximum of 0.030 in. (0.76 mm) from the edge for any 24 in. (610 mm) length	Minor
Flatness (marcelling)	Maximum of 0.125 in. (3.18 mm) across the width	Minor
Broken fiber	None allowed	Minor

3.5.1.1 Visible major imperfections shall be marked by inserts and shall be cause for rejection only if the total length of such areas exceeds 2% of the total tape length of the roll.

3.6 Sizes and Tolerances: Shall be as follows, unless otherwise specified, determined as in 4.5.7:

3.6.1 Width: Shall be 3 in. (76 mm), +0, -0.015 in. (-0.38 mm), determined by measuring the distance between the outsides of the extreme boron filaments.

3.6.2 Length per Roll: Shall be 125 - 800 ft (38 -243 m) except that the last roll of a lot may have less than 125 ft (38 m). Any length of defective tape shall not be counted in the specified length.

3.6.3 Filament Count and Spacing: Shall be as specified in the applicable detail specification and shall be such that the filaments do not touch each other. The filament gap shall not exceed three filament diameters.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of tape 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 tape 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), properties of uncured impregnated product (3.3), longitudinal flexural strength, modulus of elasticity in flexure, and short-beam shear strength, all at room temperature, and fiber volume of cured laminate (3.4), quality (3.5), and tolerance (3.6) requirements are classified as acceptance tests.

4.2.2 Qualification Tests: Tests to determine conformance to all technical requirements of this specification are classified as qualification tests.

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 qualification 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 at random throughout the lot.

TABLE I

Sampling Schedules

Test	Frequency
All tests on uncured tape	Every 2500 ft (762 m)
Mechanical property tests	Every 5000 ft (1525 m)

4.3.2 Lot: A lot shall be all tape 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.

4.3.2.1 Vendor of tape shall, for purposes of traceability, maintain records of the ingredients of each lot for a period of not less than 3 years.

4.4 Approval:

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

4.5 Test Methods: Tests to determine conformance to this specification shall be conducted as follows; requirements for the number of specimens apply to each temperature of interest:

Property	Minimum Number of Specimens per Test		Test Procedure
	Qualification Tests	Acceptance Tests	
Volatile Content	4	4	4.5.3.1
Resin Solids	4	4	4.5.3.2
Resin Flow	2	2	4.5.4
Gel Time	2	2	4.5.5
Tack			4.5.6
As-received	2	2	
Tack retention	2	2	
Filament Count and Spacing	2	2	4.5.7.2
Flexural Strength and Modulus of Elasticity	5	3	4.5.9
Compressive Strength and Modulus of Elasticity (0 deg and 90 deg Orientation)	5	0	4.5.10
Short-Beam Shear Strength	5	3	4.5.11
Tensile Strength and Modulus of Elasticity (0 deg and 90 deg Orientation)	5	0	4.5.12
Fiber Volume	5	3	4.5.13

4.5.1 Preparation of Test Laminates: Test laminates of suitable thickness and area shall be prepared from sufficient plies of impregnated tape oriented unidirectionally and cured in an autoclave or equivalent at a temperature and pressure to provide optimum properties. Details of time, temperature, rate of heating, and pressures used in the cure cycle shall be noted in the report. The resultant laminate shall be uniform in thickness within ±0.003 in. (±0.08 mm) and shall have a fiber volume of 51% ± 3. The thickness per ply shall be within +10%, -5% of the nominal cured thickness, unless otherwise specified, determined from the equation:

$$T = \frac{A}{B}$$

where, T = Thickness per ply in in. (mm)
A = Thickness of test panel in in. (mm)
B = Number of plies in panel

4.5.2 Splices: Conformance to the requirements for splices shall be verified by examination of the tags on the spools as described herein.

4.5.3 Volatile and Resin Solids Content:

4.5.3.1 Volatile Content: Shall be determined by accurately weighing (W_1), to the nearest 0.01 g, each of four samples weighing not less than 1.0 g each, cut on the bias of the tape. Using porcelain crucibles (preferably covered) previously brought to constant weight by igniting at 845° C ± 25, (1553° F ± 45), dry samples in an circulating-air oven at 165° C ± 5, (329° F ± 9) for 15 min. ± 1. Cool in a desiccator and reweigh (W_2).

$$\text{Volatile content, \%} = \frac{(W_1 - W_2)}{W_1} \times 100$$

4.5.3.2 Resin Solids Content: Shall be determined on the four samples of 4.5.3.1 from which volatiles have been removed.

4.5.3.2.1 Record weight of volatile free samples, each about 1 g, to the nearest 0.001 g (W_2).

4.5.3.2.2 Place the samples in separate containers and extract the resin by heating in a suitable solvent for not less than 2 minutes. Time starts when the solvent starts to boil. After 2 min. of boiling, decant the solvent. Repeat the extraction for three complete wash cycles. Report the temperature used.

4.5.3.2.3 Dry the specimens by placing them in a circulating-air oven maintained at 165° C ± 5 (329° F ± 9) for not less than 1 hr or until the weight is constant. Remove and place in a desiccator.

4.5.3.2.4 After 10 min., remove specimens from the desiccator and weigh to the nearest 0.001 g (W_3).

4.5.3.2.5 Calculate resin solids content as follows:

$$\text{Resin Solids (Volatile free), \% by weight} = \frac{(W_2 - W_3)}{W_2} \times 100$$

where, W_2 = Original volatile free weight of the specimen, g

W_3 = Final weight of specimen, g

4.5.3.3 Calculate the arithmetic mean of the four determinations of volatile content of the samples, and the arithmetic mean of the four determinations of resin solids content of the samples. Report both the individual results and the arithmentic means (average results).

4.5.4 Resin Flow:

4.5.4.1 Cut four 3-in. (75-mm) square pieces along the roll and weigh to the nearest 0.01 g (W_4). Stack samples alternately in the 0 deg and 90 deg direction, to minimize fiber movement, between two separator sheets, approximately 5-in. (125-mm) square, of aluminum foil. If the sample tends to stick to the separator sheets after curing, it is permissible to use a nonvolatile mold release agent. Such agents may be used only under conditions such that they do not undergo a weight loss greater than 0.005 g during curing. Place samples and separator sheets between press platens preheated to the temperature specified in the applicable detail specification, taking care that the edges of all pieces remain properly aligned. Apply pressure to the sample as specified in the applicable detail specification and hold at heat for 11 min. ± 1. Remove sample and cool in desiccator. Remove separators and resin flash, trimming sample to original 3-in. (75-mm) square, taking care not to remove any of the reinforcing fiber. Reweigh samples to nearest 0.01 g (W_5).

$$\text{Resin Flow, \%} = \frac{(W_4 - W_5)}{W_4} \times 100$$

4.5.4.2 Report the average of the determinations and the individual minimum.

4.5.5 Gel Time:

4.5.5.1 Cut a piece of impregnated tape approximately 0.25 in. (6.5 mm) square from the roll. Preheat a hot plate to the same temperature ±5°C (±9°F) used for resin flow. Place a microscope slide cover glass on the hot plate, allowing 20 sec for it to reach temperature equilibrium. Position the specimen at the center of the cover glass and simultaneously commence timing. Within 5 sec, place a second cover glass over the specimen. After the resin softens and during the first 30 sec, probe the cover glass and isolate a drop of resin. Observe the fluidity and color of the isolated resin drop periodically (continuously as the end point approaches). The lateral (spreading) movement of the resin upon probing will decrease or regress and the color shade will change as the gel point approaches. Stop the timer at the first indication of resin immobility and record the elapsed time to the nearest second.

4.5.5.2 Report the average of the determinations and the individual minimum.

4.5.6 Tack: Shall be determined with the tape in the as-received condition and for tack retention after exposure for 7 days at 20° - 25°C (68° - 77°F) and not higher than 65% relative humidity. For the latter requirement, the tape may be covered with a layer of polyethylene film for protection but it shall not be sealed off in any manner. The method of test shall be as agreed upon by purchaser and vendor.

4.5.7 Visual Defect Acceptance Criteria:

4.5.7.1 Allow a sample approximately 12 ft (3.7 m) in length to be exposed, while lying flat on the table, to standard environmental conditions for not less than 8 hr prior to inspection at 20° - 25°C (68° - 77°F) and not higher than 65% relative humidity.

4.5.7.2 Inspection aids and measuring devices of applicable accuracy shall be used as required. Perform the actual filament count and spacing measurements at 50 - 100X magnification using an optical comparator equipped with a micrometer attachment.

4.5.7.3 Report the results of the inspection for each sample of material.

4.5.8 Normalized Property Values: Normalized strength and modulus values, based on 51% boron filament by volume in cured laminate, for all types are listed below. Normalization of longitudinal (0 deg) compressive, flexural, and tension strengths and moduli shall be accomplished as follows:

$$\text{Normalized Strength, psi} = \frac{\text{Actual Strength (psi) x Measured Laminate Thickness (in.)}}{\text{N.T. (in.) x number of boron plies}}$$

$$\text{(MPa)} = \frac{\text{Actual Strength (MPa) x Measured Laminate Thickness (mm)}}{\text{N.T. (mm) x number of boron plies}}$$

$$\text{Modulus } (10^6 \text{ psi}) = \frac{\text{Actual Modulus } (10^6 \text{ psi}) \text{ x Measured Laminate Thickness (in.)}}{\text{N.T. (in.) x number of boron plies}}$$

$$\text{(MPa)} = \frac{\text{Actual Modulus (MPa) x Measured Laminate Thickness (mm)}}{\text{N.T. (mm) x number of boron plies}}$$

where, N.T. = Nominal ply thickness as specified in the applicable detail specification.

4.5.9 Flexural Strength and Modulus: Shall be determined in accordance with ASTM D790, using the specimen shown in Fig. 1 loaded as shown in Fig. 2. For the test to be valid, the failure shall originate in the tensile face beneath the loading point.

4.5.9.1 Calculations: The normalized mechanical properties shall be calculated and reported to three significant figures, using the following formulas:

4.5.9.1.1 Ultimate Flexural Strength (Modulus of Rupture):

4.5.9.1.1.1 For simply-supported unidirectional (0 deg) specimens under center loading:

$$F_b\,(ult) = \frac{3\,PL}{2bt^2}\,\frac{(t)}{t'}\ \text{psi (Pa)}$$

4.5.9.1.1.2 For simply-supported 90 deg specimens under two point loading:

$$F_b\,(ult) = \frac{3\,Pa}{bt^2}\,\frac{(t)}{t'}\ \text{psi (Pa)}$$

or when $a = \frac{L}{4}$

$$F_b\,(ult) = \frac{3\,PL}{4\,bt^2}\,\frac{(t)}{t'}\ \text{psi (Pa)}$$

4.5.9.1.2 Flexural Modulus of Elasticity:

4.5.9.1.2.1 For simply-supported unidirectional (0 deg) specimens under center loading:

$$E_b = \frac{L^3}{4\,bt^3}\,\frac{(\Delta P)}{(\Delta y)}\,\frac{(t)}{t'}\ \text{psi (Pa)}$$

4.5.9.1.2.2 For simply-supported 90 deg specimens under two point loading:

$$E_b,\ \text{psi (Pa)} = \frac{a}{4bt^3}\,\frac{(\Delta P)}{(\Delta y)}\,(3L^2 - 4a^2)\,\frac{(t)}{t'}$$

or when $a = \frac{L}{4}$

$$E_b,\ \text{psi (Pa)} = \frac{11\,L^3}{64\,bt^3}\,\frac{(\Delta P)}{(\Delta y)}\,\frac{(t)}{t'}$$

where, F_b = Flexural strength, psi (Pa)
E_b = Modulus of elasticity in bending, psi (Pa)
P_b = Total applied load, lb (N)
L = Test span, in. (m)
a = maximum moment arm, in. (m)
b = measured width of specimen, in. (m)
t = measured thickness of specimen, in. (m)
t' = theoretical or normalized thickness, (nominal ply thickness as specified in the applicable detail specification times the no. of plies), in. (m)
y = measured center of deflection of specimen, in. (m)
Δ = increment of value for calculation purposes

4.5.9.2 Report the average of the determinations and the individual minimum.

4.5.10 Compressive Strength: Shall be determined by the sandwich beam test method. The specimen description and dimensions shall be as agreed upon by purchaser and vendor. Report the test specimen description, the average of the determinations, and the individual minimum.

4.5.11 Short-Beam Shear Strength: Shall be determined as in ASTM D2344 and the following, using the specimens and loading schedule shown in Fig. 3.

4.5.11.1 Shear Strength Calculations: The gross mechanical properties shall be calculated and reported to three significant figures using the following equations:

$$F_s, \text{ psi (Pa)} = \frac{3\ P}{4\ bt} = \frac{0.75\ P}{A}$$

where, F_s = Shear Strength, psi (Pa)
P = Load, lb (N)
b = Measured width of specimen, in. (m)
t = Measured thickness of specimen, in. (m)
A = Measured area (b x t), sq in. (m^2)

4.5.11.2 Report the average of the determinations and the individual minimum.

4.5.12 Tensile Strength and Modulus of Elasticity: Shall be determined in accordance with ASTM D3039 on a cured laminate as close as possible to 0.030 in. (0.76 mm) in thickness.

4.5.13 Fiber Volume:

4.5.13.1 Preparation of Specimens: Cut three pieces, each not less than 1.0 in. (25 mm) square, from one of the test laminates prepared as in 4.5.1. Measure the laminate thickness (t). Clean and weigh (W_6) thimbles. Put each cut piece into a separate thimble and weigh (W_7) to the nearest 0.001 g.

4.5.13.2 Nitric Acid Digestion: Place each thimble in a separate 150 cm^3 beaker and add 100 cm^3 of concentrated nitric acid (Reagent grade, 69 - 71%) to the beaker. The beaker with the contents shall be heated at 65° C ± 6 (149° F ± 9) until the resin has been dissolved and digestion is complete, then the beaker and contents shall be cooled to room temperature.

4.5.13.3 Filtration: The nitric acid used in the digestion shall be discarded without loss of residue and the thimble attached on a vacuum filter flask. Rinse the fibers with additional clean nitric acid, followed by distilled water, and finally with acetone. The acetone shall remain clear, indicating complete removal of resin from the fibers.

4.5.13.4 Drying and Weighing: Each thimble, with its content, shall be heated in a circulating air oven at 120° C ± 5 (248° F ± 9) for 60 min. ± 5, cooled in a desiccator to room temperature, and weighed to the nearest 0.001 g (W_g).

4.5.13.5 Calculation: The laminate fiber volume shall be calculated as follows:

$$\text{Fiber Volume, \%} = \left[\frac{(W_8 - W_6)}{(W_7 - W_6)} - \frac{NW_9}{10^6 D_2 t}\right] \frac{D_2}{D_1} \times 100$$

4.5.13.5 (Continued)

where, W_6 = Weight of extraction thimble, 0.001 g

W_7 = Weight of extraction thimble plus specimen, 0.001 g

W_8 = Weight of extraction thimble plus specimen after desiccation, 0.001 g

D_1 = Density of boron filaments as follows: g/cm^3 4.0 mil, D_1 = 2.602; 5.6 mil, D_1 = 2.491; 8.0 mil, D_1 = 2.380

D_2 = Density of laminate, determined in accordance with ASTM D792 or ASTM D1505, g/cm^3

W_9 = Weight per square metre of scrim material, mg

N = Number of plies of material in laminate

t = Laminate thickness, mm

4.5.13.6 Report all individual values and the average.

4.5.13.7 An optical method may be used as an alternate. A photomicrograph at 100X magnification of a cross section of a specimen perpendicular to the filament direction shall be examined and the percent fiber content calculated as follows:

$$\text{Fiber Volume, \%} = \frac{A_2 \times N}{A_1} \times 100$$

where, A_1 is sample cross sectional area

A_2 is area of a single filament

N is the number of filaments in the sample area

4.6 Reports:

4.6.1 The vendor of tape shall furnish with each shipment three copies of a report showing the results of tests to determine conformance to the acceptance test requirements of this specification and the applicable detail specification, including the identification of the resin system used, the cure cycle, and fiber volume of the test laminate, and stating that the tape 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 and its applicable detail specification number, vendor's material designation, lot number, spool numbers, date of manufacture, quantity (length and width), total length of defective tape, and location of test samples within the lot and spool.

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 applicable detail specification number, contractor or other direct supplier of tape, supplier's material designation, part number, and quantity. When tape for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of tape to determine conformance to the requirements of this specification, and shall include in the report a statement that the tape 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 test fails to meet the specified requirements, disposition of the tape may be based on the results of testing three additional specimens for each original nonconforming specimen, prepared from the original panel or a newly-prepared panel. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the tape 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 Tape for Hand Layup: Shall be interleaved with a nonadherent film and wound on spools having a hub diameter not less than 8 in. (203 mm). Winding shall be uniform and shall provide for proper unreeling. Each spool shall contain 125 - 800 ft (38 - 143 m) except that one spool may contain less than 125 ft (38 m). Tape ends shall be secured.

5.1.1.1 Location of visually imperfect areas and of splices shall be plainly identified on the tape 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 requirements 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 (See 8.4). Quantity on each reel and marking of visually imperfect areas and of splices shall be as specified in 5.1.1.

5.1.2.1 Tape Placement: The tape shall be placed on the interleaf (carrier) material within ±0.015 in. (±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 in. (0.38 mm) of the center line of the interleaf or no greater than 0.030 in. (0.76 mm) from an edge and shall not extend beyond the edge of the interleaf.

5.1.3 Sheet: Shall be supplied flat with a suitable nonadherent protective covering or separator film on each face.

5.1.4 Identification: Each reel or spool of tape and each sheet shall be identified by attached removable tags using characters of such size as to be clearly legible and which will not be obliterated by normal handling. Each tag shall show not less than the following information:

BORON FILAMENT TAPE, EPOXY-RESIN-IMPREGNATED
AMS 3867/_____
INTERLEAF MATERIAL, AMS 3898/_____ (when applicable)
NAS 992 REEL, TYPE _____ SIZE _____, CLASS _____
(when applicable)
MANUFACTURER'S MATERIAL DESIGNATION _____
PURCHASE ORDER NUMBER _____
DATE OF MANUFACTURE _____
LOT AND SPOOL NUMBERS _____
TAPE WIDTH _____
QUANTITY _____

5.1.5 Package Sealing: Each reel or spool and each sheet shall be sealed in a bag of suitable nonadherent material to prevent penetration of moisture or loss of impregnating resin solvent.

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

5.1.7 Each package shall be permanently and legibly marked to show not less than the following information:

BORON FILAMENT TAPE, EPOXY RESIN IMPREGNATED
AMS 3867/ _____
PURCHASE ORDER NUMBER _____
MANUFACTURER'S MATERIAL DESIGNATION _____
LOT AND PACKAGE NUMBERS _____
TAPE WIDTH _____
QUANTITY _____
PERISHABLE - STORE BELOW 0° F (-18° C)

5.1.8 Packages shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to handling of this product to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

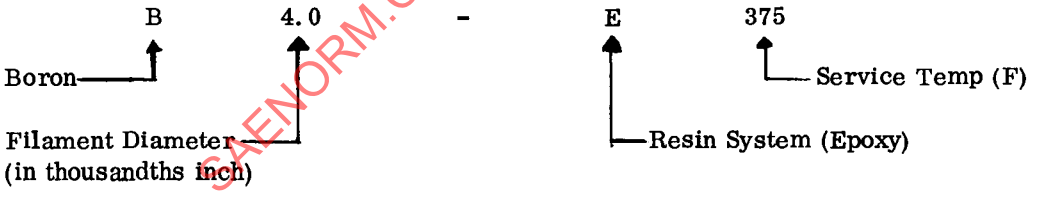
5.1.9 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1.1 or 5.1.2, 5.1.6, and 5.1.8 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and the applicable detail specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Tape not conforming to this specification and the applicable detail specification or to authorized modifications will be subject to rejection.

8. NOTES:

8.1 Classification: The classification system used to identify each detail specification tape is shown by the following example



8.2 Interleaf Perforations: The parallel perforations (sprocket hole guides) located on the carrier between the tape and each edge are critical in positioning the tape during machine layup. The hole dimensions, the distance between the two parallel rows of perforations, and the location of the tape relative to the theoretical centerline between these two rows of perforations are critical dimensions.

8.3 Test Specimen Stabilization: The results of previous tension tests on boron/epoxy, employing repeated static loading of unidirectional and cross-plied test specimens, have shown that when the proportional limit stress is exceeded on the first cycle, it is increased for the following cycle and is accompanied by a slight reduction in the modulus of elasticity. Subsequent loading cycles to the same stress level cause an insignificant change in the stress-strain relationship. The test specimens, therefore, are stabilized by applying a pre-stress of about 75% of ultimate strength.