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AEROSPACE MATERIAL SPECIFICATION

AMS 3791

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Revised

CLOTH, MARQUISETTE, NYLON

1. SCOPE:

1.1 Form: This specification covers nylon in the form of marquisette cloth.

1.2 Application: Primarily for construction of parachutes.

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) 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

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 Textiles
ASTM D737 - Air Permeability of Textile Fabrics
ASTM D1388 - Stiffness of Fabrics
ASTM D1777 - Measuring Thickness of Textile Materials
ASTM D2261 - Tearing Strength of Woven Fabrics by the Tongue (Single Rip) Method (Constant-Rate-of-Extension Tensile Testing Machine)
ASTM D3776 - Weight (Mass) per Unit Area of Woven Fabrics

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Street, Philadelphia, PA 19120 except as shown in 2.3.4.

2.3.1 Federal Specifications:

PPP-P-1133 - Packaging and Packing of Synthetic Fiber Fabrics

2.3.2 Federal Standards:

FED-STD-4 - Glossary of Fabric Imperfections
FED-STD-191 - Textile Test Methods

2.3.3 Military Standards:

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

2.3.4 Other Publications: Available from the Federal Trade Commission, Washington, DC 20580.

Rules and Regulations Under the Textile Fiber Products Identification Act

3. TECHNICAL REQUIREMENTS:

3.1 Material: The cloth shall be woven from 70 denier, 34 filament, bright, multifilament nylon yarn.

3.1.1 Yarn: The nylon yarn used shall be a polyamide prepared from hexamethylene diamine and adipic acid or its derivatives. It shall have a melting point not lower than 250°C (482°F).

3.2 Properties: The finished cloth shall conform to the requirements specified in Table I and the following:

3.2.1 Weave: The weave pattern of the marquisette cloth shall be a 4-end leno as shown in Fig. 1. Selvages shall be closely woven and shall be not less than 1/4 in. (6.2 mm) nor more than 1/2 in. (12.5 mm) in width.

TABLE I

PHYSICAL PROPERTIES

Property	Value
Weight, oz per sq yd (g/m^2), max	1.0 (34)
Thickness, in. (mm)	0.010 (0.25)
Breaking Strength, lb per in. (N/m), min	
Warp	35 (6,125)
Filling	25 (4,380)
Tearing Strength, lb (N), min	
Warp	3.0 (13.5)
Filling	3.0 (13.5)
Yarns per in. (25.4 mm), min	
Warp	52
Filling	34
Air Permeability, cu ft/min. per ft^2 (m^3/min./m^2)	1,500 - 1,800 (450 - 540)

3.2.2 Finish: The cloth shall be finished with a resin treatment to impart a stiffness of 0.015 in.-lb ± 0.050 (0.0017 N·m + 0.0060) when tested as specified in Table II.

3.2.2.1 Permanence of Finish: The finish of the cloth shall be permanent. The permanence of the cloth finish shall conform to 3.2.2.1.1, 3.2.2.1.2, and 3.2.2.1.3 when the cloth is subjected to the test specified in 4.5.3:

3.2.2.1.1 The average of the air permeability readings taken after testing shall be within 10% of the average of the initial readings.

3.2.2.1.2 The cloth thickness after testing shall not increase more than 10% of the initial thickness readings.

3.2.2.1.3 The cloth shrinkage, measured after testing, shall not exceed 3% in either the warp or filling direction.

3.2.3 Acidity - Alkalinity (pH): The pH value of the finished cloth shall be 5.0 - 8.5 when tested as specified in Table II.

3.2.4 Color: The color of the cloth shall be natural.

3.2.5 Dimensions:

3.2.5.1 Width: The width, inclusive of selvage, shall be as specified by the procuring activity.

3.2.5.2 Length of Cut: The length of single continuous pieces shall be not less than 100 yd (90 m).

3.3 Quality: Cloth, as received by purchaser, shall be clean, evenly woven, and free from foreign materials and from imperfections detrimental to usage of the cloth.

3.3.1 Imperfections: Acceptability of each lot of cloth shall be based on defects defined in FED-STD-4.

3.3.2 Yard-by-Yard Examination: Each roll in the sample shall be examined on the face side only. When the total length in the roll does not exceed 100 yd (90 m), the entire length of the roll shall be examined. When the total length in the roll exceeds 100 yd (90 m), only 100 yd (90 m) shall be examined. All defects as defined in FED-STD-4, which are visible at normal inspection distance of 1 yd (1 m), shall be scored and assigned demerit points as listed in 4.3.1.2. No linear yard (metre) increments of 1 yd (1 m) on the measuring machine from any one roll within the sample shall be penalized more than 4 points. The lot shall be unacceptable if the points per 100 sq yd (95 m^2) of two or more individual rolls exceeds 17.0 points. If no individual roll exceeds the point level, the lot shall be acceptable with respect to this characteristic. If one roll exceeds the point level, a second sample equal in size to the first, shall be examined only for individual roll quality examination. The lot shall be

3.3.2 (Continued):

unacceptable if one or more rolls in the second sample exceeds the point level. Point computation for lot quality and individual roll quality shall be as follows:

3.3.2.1 Using Inch/Pound units:

$$\frac{\text{Total points scored in sample} \times 3{,}600}{\text{Width of cloth, in.} \times \text{total length, yd, inspected}} = \text{Points per 100 sq yd}$$

3.3.2.2 Using SI units:

$$\frac{\text{Total points scored in sample} \times 100{,}000}{\text{Width of cloth, in.} \times \text{total length, m, inspected}} = \text{Points per } 100\ m^2$$

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the cloth 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 cloth 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 and shall be performed prior to or on the initial shipment of cloth to a purchaser, on each lot, 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.

4.2.1 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: Each lot of cloth shall be visually examined as required below for quality (3.3) and sampled at random for all other 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 Yard-by-Yard Examination of Cloth: The unit of cloth for this examination shall be 1 sq yd (1 m^2). The sample size shall be 5 rolls.

4.3.1.2 Demerit Points: Demerit points shall be assigned to the yd-by-yd examination as follows:

For defects 3 in. (75 mm) and under in any dimension	1 point
For defects over 3 to 6 in. (25 to 150 mm), incl in any dimension	2 points
For defects over 6 to 9 in. (150 to 225 mm), incl in any direction	3 points
For defects over 9 in. (225 mm) in any dimension	4 points

4.3.1.2.1 The following defects, when present, shall be scored four points for each yard (metre) in which they occur:

Baggy, ridgy or wavy cloth
Objectionable odor
Width less than specified, selvage width less or more than specified
Uneven weaving

4.3.1.3 The unit of cloth for property determination shall be not less than 3-1/2 yd (3.2 m), continuous piece, full width. The sample size shall be as follows:

Lot Size		Sample Size
Yards	Metres	
Up to 800, incl	Up to 730, incl	2
800 to 22,000, incl	730 to 20,100, incl	3
Over 22,000	Over 20,100	5

4.3.1.4 A lot shall be all cloth produced in a single production run under the same fixed conditions and submitted for vendor's inspection at one time. A lot may be packaged in small quantities under the basic lot approval, provided lot identification is maintained.

4.3.1.5 When a statistical sampling plan and acceptance quality level (AQL) in accordance with MIL-STD-105 other than as specified herein have been agreed upon by purchaser and vendor for testing other than quality (3.3), sampling shall be in accordance with such plan in lieu of sampling as in 4.3.1.3 and the report of 4.6.1 shall state that such a plan was used.

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

4.4 Approval:

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

4.5 Test Methods: Shall be in accordance with Table II and the following:

TABLE II

Test Methods

Characteristic	Test Method	Number of Determinations per Sample Unit	Results Reported As
Yarn Denier, filament tenacity, luster	4.5.1	--	--
Melting point	FED-STD-191, Method 1534	2	Avg. of 2 det. to nearest 0.5°C (1°F)
Weave	Visual	1	Pass or fail
Weight	ASTM D3776	5	Avg. of 5 det. to nearest whole number
Thickness	ASTM D1777	5	Avg. of 5 det. to nearest 0.001 in. (0.02 mm)
Breaking strength (Warp and Filling)	FED-STD-191, Method 5104	5	Avg. of 5 det. to nearest 1.0 lb (0.45 kg)
Tearing strength (Warp and Filling)	ASTM D2261	5	Avg. of 5 det. to nearest 0.1 lb (45 g)
Yarns per in. (/mm) (Warp and Filling)	FED-STD-191, Method 5050	5	Avg. of 5 det. to nearest whole number
Air permeability, initial	ASTM D737	5	Avg. of 5 det. to nearest 1.0 cu ft/min. per sq ft (0.3 m^3/min. per m^2)

TABLE II (Continued)

Characteristic	Test Method	Number of Determinations per Sample Unit	Results Reported As
Finish (Stiffness)	ASTM D1388	3	Avg. of 3 det. to nearest 1.0 in.-lb (0.0001 N·m)
Permanence of Finish			
Air Permeability	4.5.3 and FED-STD-191, Methods 5450 & 5030	5 (See 4.5.2)	Avg. of 10 det. to nearest 0.1 cu ft per min. per sq ft (0.03 $m^3/min./m^2$); then nearest 1.0% of initial
Thickness	4.5.3 and ASTM D1777	5 (See 4.5.2)	Avg. of 10 det. to nearest 0.001 in. (0.025 mm); then nearest 1.0% of initial
Shrinkage (Warp and Filling)	4.5.3	6 (See 4.5.2)	Avg. of 6 det. to nearest 0.1% then nearest 1.0% of initial
Acidity - Alkalinity (pH)	FED-STD-191, Method 2811	2	Avg. of 2 det. to nearest 0.1 pH

4.5.1 A contractor's certificate submitted with each lot indicating conformance to this requirement will suffice.

4.5.2 The results of the warp skein and filling skein for the permanence of finish, thickness, air permeability, and shrinkage tests shall be averaged for each sample unit.

4.5.3 Permanence of Finish:

4.5.3.1 Two 20-in. (500 mm) square specimens of cloth shall be prepared. Using a template and indelible ink, an 18-in. (450-mm) square shall be marked on each specimen. The specimens shall be subjected to the air permeability and thickness tests specified in Table II. A container of adequate size to accommodate both specimens, prepared as described below, shall be filled to within 3 in. (75 mm) of the top with water which shall be heated to a rapid boil. Both specimens shall be placed

4.5.3.1 (Continued):

in the boiling water in a skein form prepared by stapling the two opposite ends of a specimen together to form a loop or skein. One specimen shall have the warp yarns vertical in the skein and the other specimen shall have the filling yarns vertical.

4.5.3.2 Each specimen shall be placed over a glass rod 1/4 in. (6.2 mm) in diameter and 21 in. (525 mm) in length. A glass tube, 1/4 in. (6.2 mm) in diameter and 21 in. (525 mm) in length, and approximately 100 g in weight, shall be placed inside each loop at the bottom. Both loops shall then be suspended freely in the boiling water bath by attaching each with twine or wire to glass rods which are 1/4 in. (6.2 mm) in diameter and of sufficient length to rest on the top of the container. The specimens shall be subjected to the action of the boiling water bath for 15 min. ± 1, after which they shall be removed from the bath and allowed to drain for a few minutes. The staples shall be removed from the specimens and the specimens shall be placed flat on a horizontal screen to dry.

4.5.3.3 After the specimens are thoroughly dry, they shall be exposed for at least 4 hr to a standard atmosphere of 65% relative humidity and a temperature of 21°C (70°F). The 18-in. (450 mm) shall be measured to the nearest 0.01 in. (0.25 mm) in 6 places, 3 in the warp direction and 3 in the filling direction. The percentage of shrinkage in either the warp or filling shall be computed as follows:

4.5.3.4 Using Inch/Pound units:

$$\frac{18 - \text{distance between marks after boiling}}{18} \times 100 = \% \text{ shrinkage}$$

4.5.3.5 Using SI units:

$$\frac{450 - \text{distance between marks after boiling}}{450} \times 100 = \% \text{ shrinkage}$$

4.5.3.6 The specimens shall again be subjected to the air permeability and thickness tests to determine conformance to 3.2.2.1.

4.6 Reports:

4.6.1 The vendor of cloth shall furnish with each shipment 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, AMS 3791, vendor's material designation, lot number and quantity.