

AEROSPACE MATERIAL SPECIFICATION

SAE

AMS-3791

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Superseding AMS-3791

Submitted for recognition as an American National Standard

CLOTH, MARQUISSETTE, NYLON

1. SCOPE:

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

1.2 Application: Primarily for fabrication of parachutes.

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 applicable issue of referenced publications shall be the issue in effect on the date of the purchase order.

2.1 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM D 123 - Terminology Relating to Textile Materials

ASTM D 737 - Air Permeability of Textile Fabrics

ASTM D 1388 - Stiffness of Fabrics

ASTM D 1777 - Measuring Thickness of Textile Materials

ASTM D 2261 - Tearing Strength of Woven Fabrics by the Tongue
(Single Rip) Method (Constant-Rate-of-Extension Tensile
Testing Machine)

ASTM D 3776 - Mass per Unit Area (Weight) of Woven Fabric

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2.2 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094 and as noted in 2.2.3.

2.2.1 Federal Specifications:

PPP-P-1133 - Packaging of Synthetic Fiber Fabrics

2.2.2 Federal Standards:

FED-STD-4 - Glossary of Fabric Imperfections

FED-STD-191 - Textile Test Methods

2.2.3 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).

3.1.2 Weave: The weave pattern of the marquisette cloth shall be a 4-end leno as shown in Figure 1.

less than 1/4 inch (6.4 mm) nor more than 1/2 inch (12.7 mm) in width.

3.1.3 Finish: The cloth shall be finished with a resin treatment to impart a stiffness of 0.015 inch-pound \pm 0.005 (0.0017 N·m \pm 0.006), determined in accordance with 4.5.

3.2 Properties: The finished cloth shall conform to the following requirements:

3.2.1 Weight, maximum 1.0 ounce per square yard(34 g/m²)

3.2.2 Thickness 0.010 inch (0.25 mm)

3.2.3 Breaking Strength, minimum
Warp 35 pounds force/inch (6129 N/m)
Filling 25 pounds force/inch (4378 N/m)

3.2.4 Tearing Strength, minimum
Warp 3.0 pounds force (13.3 N)
Filling 3.0 pounds force (13.3 N)

3.2.5 Yarns per inch (25.4 mm), minimum
Warp 52
Filling 34

- 3.2.6 Air Permeability 1,500 - 1,800 cubic feet/minute/square foot
(450 - 540 m³/minute/m²)
- 3.2.7 Permanence of Finish: The finish of the cloth shall be permanent. The permanence of the cloth finish shall conform to 3.2.7.1, 3.2.7.2, and 3.2.7.3 when the cloth is subjected to the test specified in 4.5.3:
- 3.2.7.1 The average of the air permeability readings taken after testing shall be within 10% of the average of the initial readings.
- 3.2.7.2 The cloth thickness after testing shall not increase more than 10% of the initial thickness readings.
- 3.2.7.3 The cloth shrinkage, measured after testing, shall not exceed 3% in either the warp or filling direction.
- 3.2.8 Acidity - Alkalinity (pH): The pH value of the finished cloth shall be 5.0 - 8.5, tested as specified in 4.5.
- 3.2.9 Color: Shall be natural.
- 3.2.10 Dimensions:
- 3.2.10.1 Width: The width, inclusive of selvage, shall be as specified by the procuring activity.
- 3.2.10.2 Length of Cut: The length of single continuous pieces shall be not less than 100 yards (91 m).
- 3.3 Quality: Cloth, as received by purchaser, shall be evenly woven and free from foreign materials and from imperfections detrimental to usage of the cloth. Definitions of terms used herein are covered in ASTM D 123.
- 3.3.1 Imperfections: Acceptability of each lot of cloth shall be based on imperfections 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 yards (91 m), the entire length of the roll shall be examined. When the total length in the roll exceeds 100 yards (91 m), only 100 yards (91 m) shall be examined. All imperfections as defined in FED-STD-4, which are visible at normal inspection distance of 1 yard (1 m), shall be scored and assigned demerit points as listed in 4.3.1.2. No linear yard (metre) increments of 1 yard (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 square yards (84 m²) of two or more individual rolls exceeds 17 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 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:

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

3.3.2.2 Using SI units:

$$\frac{\text{Total points scored in sample} \times 100.000}{\text{Width of cloth, m} \times \text{total length, m, inspected}} = \text{Points per 100 m}^2$$

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the cloth shall supply all 0 samples for vendor's 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 cloth conforms to the requirements of this specification.

4.2 Classification of Tests: Tests for all technical requirements are acceptance tests and 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 ingredients and/or processing 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, contracting officer, or request for procurement.

4.3 Sampling and Testing: Shall be as follows:
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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 specified in 4.3.1.3 and 4.5.

4.3.1.1 Yard-by-Yard Examination of Cloth: The unit of cloth for this examination shall be 1 square yard (1 m²). The sample size shall be 5 rolls.

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

For imperfections 3 inches (76 mm) and under in any dimension	1 point
For imperfections over 3 to 6 inches (76 to 152 mm), inclusive, in any dimension	2 points
For imperfections over 6 to 9 inches (152 to 229 mm), inclusive, in any direction	3 points
For imperfections over 9 inches (229 mm) in any dimension	4 points

SAE AMS-3791 Revision A

4.3.1.2.1 The following imperfections, 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 yards (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 732, incl	2
800 to 22,000, incl	732 to 20,117, incl	3
Over 22,000	Over 20,117	5

4.3.1.4 A lot shall be all cloth produced in a single production run under the same fixed conditions and presented for vendor's inspection at one time.

4.3.1.5 When a statistical sampling plan has been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as 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 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 change in ingredients, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in ingredients and/or processing 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 the following:

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	Average of 2 determinations to nearest 0.5°C (1°F)
Weave	Visual	1	Pass or fail
Weight	ASTM D 3776	5	Average of 5 determinations to nearest whole number
Thickness	ASTM D 1777	5	Average of 5 determinations to nearest 0.001 inch (0.02 mm)
Breaking Strength (Warp and Filling)	FED-STD-191, Method 5104	5	Average of 5 determinations to nearest 1.0 pound force/inch (4.4 N/m)
Tearing Strength (Warp and Filling)	ASTM D 2261	5	Average of 5 determinations to nearest 0.1 pound force (0.4 N)
Yarns per inch (25.4 mm) (Warp and Filling)	FED-STD-191, Method 5050	5	Average of 5 determinations to nearest whole number
Air permeability, (Warp and Filling)	ASTM D 737	5	Average of 5 determinations to nearest 1.0 cubic foot/minute per square foot (0.3 m ³ /minute per m ²)
Finish (Stiffness)	ASTM D 1388	3	Average of 3 determinations to nearest 1.0 inch/pound (0.0001 N·m)

Characteristic	Test Method	Number of Determinations per Sample Unit	Results Reported As
Permanence of Finish			
Air Permeability	4.5.3 and FED-STD-191, Methods 5450 and 5030	5 (See 4.5.2)	Average of 10 determinations to nearest 0.1 cubic foot per minute per square foot (0.03 m ³ /minute/m ²); then nearest 1.0% of initial value
Thickness	4.5.3 and ASTM D 1777	5 (See 4.5.2)	Average of 10 determinations to nearest 0.001 inch (0.025 mm); then nearest 1.0% of initial value
Permanence of (Warp and Filling)	4.5.3.	6 (See 4.5.2)	Average of 6 determinations to nearest 0.1% then nearest 1.0% of initial value
Acidity - Alkalinity (pH)	FED-STD-191, Method 2811	2	Average of 2 determinations 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-inch (508 mm) square specimens of cloth shall be prepared. Using a template and indelible ink, an 18-inch (457-mm) square shall be marked on each specimen. The specimens shall be subjected to the air permeability and thickness tests. A container of adequate size to accommodate both specimens, prepared as described below, shall be filled to within 3 inches (76 mm) of the top with water which shall be heated to a rapid boil. Both specimens shall be placed 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 inch (6.4 mm) in diameter and 21 inches (533 mm) in length. A glass tube, 1/4 inch (6.4 mm) in diameter and 21 inches (533 mm) in length, and approximately 100 grams 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 inch (6.4 mm) in diameter and of sufficient length to rest on the top of the container. The specimens shall be subject to the action of the boiling water bath for 15 minutes \pm 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 hours to a standard atmosphere of 65% relative humidity and a temperature of 21°C (70°F). The 18-inch (457 mm) square shall be measured to the nearest 0.01 inch (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:

$$\frac{457 - \text{distance between marks after boiling}}{457} \times 100 = \% \text{ shrinkage}$$

4.5.3.6 The specimens shall again be subjected to the air permeability and thickness tests to determine conformance to 3.2.7.

4.6 Reports: 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, lot number, AMS-3791A, vendor's material designation, and quantity.

4.7 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the cloth 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 cloth represented and no additional testing shall be permitted. Results of all tests shall be reported.