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400 Commonwealth Dr., Warrendale, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 3841

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CLOTH, COTTON TWILL
Fire Retardant Treated

1. SCOPE:

1.1 Form: This specification covers a fire-retardant-treated cotton twill in the form of cloth.

1.2 Application: Primarily for use in flight clothing.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications shall 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 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120 except as specified in 2.2.3.

2.2.1 Federal Specifications:

V-T-276 - Thread, Cotton
PPP-P-1134 - Packaging and Packing of Cotton and Cotton-Synthetic Fiber Blend Fabrics (Excluding Duck Fabrics)

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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 Federal Trade Commission, Washington, DC 20580.

Textile Fiber Products Identification Act, Rules and Regulations

3. TECHNICAL REQUIREMENTS:

3.1 Material: The cloth shall be made from cotton which has been cleaned, carded, drawn, and spun into two ply yarns for both warp and filling.

3.2 Properties: The cloth shall conform to the requirements of Table I and the following, determined in accordance with test methods specified in Table II:

TABLE I

Property	Requirement
Weight of desized, mercerized, dyed cloth prior to treatment	4.4 oz per sq yd ± 0.2 (150 g/m^2 ± 7)
Increase in weight after treatment and finishing operation	18 to 28%
Yarns per in. (25.4 mm), min	
Warp	105
Filling	100
Yarn Ply	2
Breaking Strength, grab, min	
Warp	95 lb (420 N)
Filling	60 lb (265 N)
Tearing Strength, min	
Initial	
Warp	4.0 lb (18 N)
Filling	4.0 lb (18 N)
After 15 launderings	
Warp	3.0 lb (13 N)
Filling	3.0 lb (13 N)
Air Permeability at 0.5 in. (12.7 mm) Water Pressure	18 to 60 cu ft/min. per sq ft (5.4 to 18.0 m^3/min. per m^2)
Shrinkage in Laundering, max	
Warp	2.0%
Filling	2.0%

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TABLE I
(Continued)

Property	Requirement
Acidity, pH	5.5 to 9.0
Sewability, Seam Efficiency, min	80%
Stiffness of Cloth, cantilevered bending load, max	0.005 lb (0.002 N)

3.2.1 Weave: Shall be 3 up and 3 down, right-hand steep twill, determined visually.

3.2.2 Finish:

3.2.2.1 Cloth Preparation: Prior to treatment, the cloth shall be desized and mercerized. The starch and protein content, including the chloroform-soluble and water-soluble material of the finished cloth, shall not exceed 2.0%.

3.2.2.2 Fire Retardancy: Before and after 15 launderings, the treated cloth shall show no more than 2.0 sec average flame time, not more than 2.0 sec average glow time, and not more than 5.5 in. (140 mm) average and 6.5 in. (165 mm) single determination char length.

3.2.3 Color: Cloth color shall match one of the following listed colors:

Shade No. 1, Khaki
Shade No. 107, Olive Green
Shade No. 338, Orange
Shade No. 1524, Sage Green

3.2.3.1 The use of dyes, or substances containing elementary sulfur compounds, capable of oxidation to sulfuric acid, is prohibited. The dyed and finished cloth shall contain no more labile sulfur than that shown by the standard sample.

3.2.3.2 Matching: The color of the finished cloth shall match the standard sample under natural (north sky) daylight or artificial daylight having a color temperature of 7500° K and should be a good approximation to the standard sample under incandescent lamplight at 2800° Kelvin.

3.2.3.3 Colorfastness: The dyed and finished cloth shall show fastness to light, salt water and soap, perspiration, laundering, and crocking equal to, or better than, the standard sample.

3.2.3.3.1 When a standard sample is not referenced for colorfastness, the dyed and finished cloth shall show "good" fastness to light (40 standard fading hr), salt water and soap, perspiration, laundering, and crocking.

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3.2.4 Width: Shall be as ordered.

3.2.5 Fiber Identification: Each roll shall be labeled, ticketed, or invoiced for fiber content in accordance with Rules and Regulations under the Textile Fiber Products Identification Act.

3.3 Finishing Procedure: Shall be approved by purchaser prior to the finishing of any cloth.

3.4 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.

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

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of 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:

4.2.1 Acceptance Tests: Tests to determine conformance to the following requirements are classified as acceptance tests and shall be performed on each lot:

Requirement	Paragraph
Weight	Table I
Breaking Strength	Table I
Quality	3.4

4.2.2 Preproduction Tests: Tests to determine conformance to all technical requirements of this specification are classified as preproduction tests and shall be performed prior to or on the initial shipment of cloth to a purchaser, when a change in material, processing, or both 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, the contracting officer, or the request for procurement.

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4.3 Sampling: Shall be as follows:

4.3.1 For Acceptance Tests: Each lot of cloth shall be visually examined for quality (3.4). Sufficient cloth shall be taken at random from each lot to perform all required 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 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. A lot may be packaged and delivered in small quantities under the basic lot approval provided lot identification is maintained.

4.3.1.2 Yard-by-Yard (Metre-by-Metre) Examination: The sample size shall be 20 rolls selected from 20 containers.

4.3.1.2.1 Demerit Points: Shall be assigned to the yard-by-yard (metre-by-metre) examination as follows:

	Points
For defects up to 3 in. (75 mm) in any dimension	1
For defects over 3 to 6 in. (75 to 150 mm), incl, in any dimension	2
For defects over 6 to 9 in. (150 to 225 mm), incl, in any dimension	3
For defects over 9 in. (225 mm) in any dimension	4
The following defects, when present, shall be scored for each yard (metre) in which they occur:	
Finish too stiff or boardy	4
Overall uncleanness	4
Objectionable odor	4
Uneven weaving 1/	4
Selvage curled, folded, rolled, slack, or loopy 1/	4
Offshade, shaded side to side, side to center, or end to end	4
Mottled, poor penetration	4
Baggy, ridgy, or wavy cloth	4
Width less than specified	4

1/ Intermittently or continuously.

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4.3.1.3 Properties specified in Table I apply to the results of the determinations made on a sample unit for test purposes as specified in the applicable test method, except that the lot average shall apply for the weight of the finished cloth.

4.3.1.3.1 The sample unit shall be 5 continuous yd (4.5 continuous m), full width of the finished cloth and 9 in. (225 mm) of cloth prior to the flame resistant treatment. The sample size (number of sample units) shall be as shown below. The lot size shall be expressed in units of 1 yd (1 m). For all requirements except the lot average, the lot shall be unacceptable if one or more of the sample units fail to meet any test requirement specified. For the lot average requirements, the lot shall be unacceptable if the average of all determinations made on the sample units fails to meet any test requirement specified.

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

4.3.1.4 When a statistical sampling plan and acceptance quality level (AQL), have 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 4.6.1 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 cloth.

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 material or processing, in type of equipment for processing, or in manufacturing procedures, vendor shall submit for reapproval a statement of the proposed changes in material, processing, or both and, when requested, sample cloth. Production cloth made by the revised procedure shall not be shipped prior to receipt of reapproval.

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4.5 Test Methods: Shall be as specified in Table II and in 4.5.1 through 4.5.4.

TABLE II

TEST METHODS

Requirement	Test Method FED-STD-191, and Visual Method	No. of Determinations per Unit of Product	Results Reported As
Weight, untreated	5041	5	Avg. of 5 det. to nearest 0.1 oz (3 g)
Increase in weight, untreated to treated	5041	5	Avg. of all det. to nearest 0.1 oz (3 g)
Yarns per in. (25.4 mm),			
Warp	5050	5	Avg. of 5 det. to nearest whole number
Filling	5050	5	
Yarn Ply			
Warp and Filling	Visual	1	Pass or Fail
Breaking strength			
Warp	5100	5	Avg. of 5 det. to nearest 1.0 lb (4.4 N)
Filling	5100	5	
Tearing Strength, Initial			
Warp	5134	5	Avg. of 5 det. to nearest 0.1 lb (0.44 N)
Filling	5134	5	
After 15 Launderings	5556 1/		
Warp	5132	5	Avg. of 5 det. to nearest 0.1 lb (0.44 N)
Filling	5132	5	
Air permeability at 0.5 in. (12.7 mm) water pressure	5450	5	Avg. of 5 det. to nearest 0.1 cu ft ($0.0028\ m^3$)

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TABLE II

TEST METHODS (Continued)

Requirement	Test Method FED-STD-191, and Visual Method	No. of Determinations per Unit of Product	Results Reported As
Shrinkage in laundering			
Warp	5556	3	Avg. of 5 det. to nearest 0.1%
Filling	5556	3	
Acidity	2811	2	Avg. of 2 det. to nearest 0.1 pH
Sewability	5110	7	Avg. of 7 det. to nearest 0.1%
Sewability, seam efficiency	5110 2/	7	Avg. of 7 det. to nearest 0.1%
Weave	Visual	1	Pass or Fail
Stiffness	5202	10	Avg. of 10 det. to nearest 0.001 lb (0.004 N)
Starch and protein content including chloroform-soluble and water-soluble material	2611	2	Avg. of 2 det. to nearest 0.1%
Finish			
Identification of mercerization	Microscopic examination for swelling of cotton fiber	1	Pass or Fail
Fire retardancy			
Initial			
Flame time	5903	5	Avg. of 5 det. to nearest 1/5 sec

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TABLE II

TEST METHODS (Continued)

Requirement	Test Method FED-STD-191, and Visual Method	No. of Determinations per Unit of Product	Results Reported As
Glow Time	5903	5	Avg. of 5 det. to nearest 1/5 sec
Char Length	5903	5	Avg. of 5 det. to nearest 0.1 in. (2.5 mm)
After Laundering	5556 1/		
Flame time	5903	5	Avg. of 5 det. to nearest 1/5 sec
Glow Time	5903	5	Avg. of 5 det. to nearest 1/5 sec
Char Length	5903	5	Avg. of 5 det. to nearest 0.1 in. (2.5 mm)
Colorfastness			
Sulfur dyes	2020	1	Pass or Fail
Fastness to light (40 standard fading hr)	5660	1	Pass or Fail
Salt water & soap	5632	1	Pass or Fail
Perspiration	5680	1	Pass or Fail
Laundering	5610	1	Pass or Fail
Crocking	5651	1	Pass or Fail

1/ Cotton laundering procedures.

2/ The needle size shall be 0.040 in. ± 0.001 (1.02 mm ± 0.02) across the blade at the eye. The needle thread shall be ticket No. 40, 3 ply and the looper thread shall be ticket No. 60, 3 ply. The thread shall conform to V-T-276, Type IA1.

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4.5.1 Yard-by-Yard (Metre-by-Metre) 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 in 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, Section I, which are clearly noticeable at normal inspection distance [3 ft (1 m)], shall be scored and assigned demerit points, as listed in 4.3.1.3, except that only those slubs and knots which exceed the limits shown in Fig. 1, 2, and 3, shall be scored. No linear yard (linear metre) [increments of 1 yd (1 m) on the measuring device of the inspection machine] from any one roll within the sample shall be penalized more than 4 points.

4.5.1.1 The lot shall be unacceptable if the points per 100 sq yd (85 m^2) of the total length examined exceeds 35 points. The lot shall be unacceptable if the points per 100 sq yd (85 m^2) of two or more individual rolls exceeds 50 points. If no individual roll exceeds 53 points per 100 sq yd (85 m^2), the lot shall be acceptable with respect to this characteristic. If one roll exceeds 53 points per 100 sq yd (85 m^2), a second sample of 20 rolls shall be examined for individual roll quality examination only. The lot shall be unacceptable if one or more rolls in the second sample exceeds 53 points per 100 sq yd (85 m^2). For individual roll quality, examination of local type defects only shall be scored. Overall type of defects shall be scored only in determining compliance with the lot average quality requirements. Point computation for lot quality and individual roll quality shall be as follows:

4.5.1.1.1 Using Inch/Pound Units:

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

4.5.1.1.2 Using SI Units:

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

4.5.2 Examination for Length:

4.5.2.1 Individual Rolls: During the yard-by-yard (metre-by-metre) examination, each roll in the sample shall be examined for length. Any length found to be less than the minimum specified or more than 2 yd (2 m) less than the length marked on the ticket shall be considered a defect with respect to length. The lot shall be unacceptable if two or more rolls in the sample are defective in respect to length.

4.5.2.2 Total Yards (Metres) in the Sample: The lot shall be unacceptable if the total of the actual lengths of rolls in the sample is less than the total of the lengths marked on the ticket.

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4.5.3 Examination for Shade: During the yard-by-yard (metre-by-metre) examination, each roll in the sample shall be examined for shade. Any roll in the sample found to be off shade, shaded side to side, side to center, or end to end shall be cause for rejection of the entire lot represented by the sample.

4.5.4 Examination for Compliance with the Textile Fiber Products Identification Act: During the yard-by-yard (metre-by-metre) examination, each roll in the sample shall be examined for compliance with the Rules and Regulations under the Textile Fiber Products Identification Act. Each roll not labeled in accordance with this Act shall be a defect. The lot shall be unacceptable if two or more of these defects occur.

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 acceptance test requirements and stating that the cloth conforms to the other technical requirements of this specification. This report shall include the purchase order number, AMS 3841, vendor's material designation, lot number, width, and quantity.

4.6.1.1 The supplier shall submit a list of the finishing materials which will be used, stipulating the amounts, grades, and the standards of all of the materials, including the solvents, and the manufacturer's name(s).

4.6.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 3841, contractor or other direct supplier of cloth, supplier's product identification, part number, and quantity. When cloth for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of cloth to determine conformance to the requirements of this specification and shall include in the report either a statement that the cloth conforms or 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 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.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

5.1.1 The finished cloth shall be furnished on rolls not less than 40 yd (37 m) in length.

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