

MIL-C-85101(AS)

16 November 1979

## MILITARY SPECIFICATION

## CLOTH, WARP KNIT, ARAMID, HIGH TEMPERATURE RESISTANT

This specification is approved for use by the Naval Air Systems Command, Department of the Navy, and is available for use by all Departments and Agencies of the Department of Defense.

## 1. SCOPE

1.1 Scope. This specification covers high temperature resistant aramid, two-bar raschel warp knit fabric for use in the manufacture of aeronautical clothing.

## 2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents of the issue in effect on date of invitation for bids or request for proposal form a part of this specification to the extent specified herein.

## SPECIFICATIONS

FEDERAL

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

## STANDARDS

FEDERAL

FED-STD-191 -Textile Test Methods

MILITARY

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Engineering Specifications and Standards Department, (Code 9321), Naval Air Engineering Center, Lakehurst, NJ 08733, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

2.2 Other publications. The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply

RULES AND REGULATIONS UNDER THE TEXTILE FIBER PRODUCTS IDENTIFICATION ACT

(Application for copies should be addressed to the Federal Trade Commission, Washington, DC 20580.)

TECHNICAL MANUAL OF THE AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS METHOD NUMBER 76-1975, ELECTRICAL RESISTIVITY OF FABRICS

(Application for copies of the AATCC Manual should be addressed to the AATCC National Headquarters, P. O. Box 12215, Research Triangle Park, North Carolina 27709)

3. REQUIREMENTS

3.1 Standard sample The finished cloth shall match the standard sample for shade and shall be equal to or better than the standard sample with respect to all characteristics for which the standard sample is referenced (see 6.4)

3.2 First article When specified (see 6.2), the contractor shall furnish one sample unit for first article inspection and approval (see 4.4 and 6.3)

3.3 Material. The cloth shall be produced from a 200 denier, 100 filament high temperature resistant aramid yarn with a maximum twist of one turn per inch (25 mm) (see 6.5). The yarn shall not char at a temperature below 357°C (675°F).

3.4 Color Unless otherwise required, the cloth shall be natural or sage green 1565 as specified (see 6.2). The color shall be obtained by the use of melt spun solution dyed fibers.

3.4.1 Matching. The color shall match the standard sample under artificial daylight having a color temperature of 7500° Kelvin and shall be a good approximation to the standard sample under incandescent lamp-light at 2800° Kelvin.

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3.4.2 Colorfastness. The finished sage green 1565 cloth shall show fastness to light and laundering equal to or better than the standard sample. When no standard sample has been established or designated as applicable to colorfastness, the finished sage green 1565 cloth shall show "fair" fastness to light at 20 Standard Fading Hours and "good" fastness to laundering when tested as specified in 4.6

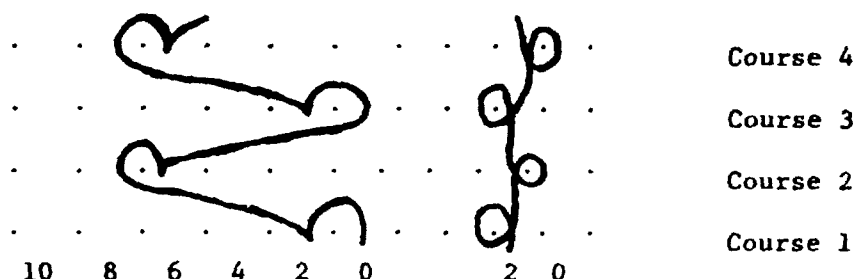
3.5 Physical requirements. The physical requirements of the finished cloth shall be as specified in Table I when tested as specified in 4.6.

TABLE I. Physical properties.

Characteristic	Requirement
Weight, oz./yd. <sup>2</sup> (kg/m <sup>2</sup> )	8.0±0.5 (0.271±0.017)
Wales per inch (Wales/cm)	29±1 (11±1)
Courses per inch (Courses/cm)	26±1 (10±1)
Thickness, mils (mm), min.	24 (0.6)
Bursting strength, lbs. (N), Min.	320 (1423)
Air Permeability, min. ft <sup>3</sup> /min/ft <sup>2</sup> at 1/2 inch water (Cm <sup>3</sup> .S <sup>-1</sup> .cm <sup>2</sup> at 124 Pa water)	150
Flame resistance (wales direction only)	
Flame time, sec., max.	2.0
Glow time, sec., max.	25.0
Char length, in. (cm), max.	5.0 (12.7)

3.6 Construction. The fabric shall be made on a 48 gauge raschel warp knit machine using two bars (see 6.6) and the following stitch:

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FRONT GUIDE BAR #1 - 2/4-2/0 fully threaded

BACK GUIDE BAR #2 - 0/2-8/6 fully threaded

3.7 Width. Unless otherwise specified by the procuring activity, the overall minimum width shall be sixty inches (1524 mm) (see 6.2).

3.8 Finish. The cloth shall be scoured and given a durable antistatic finish (see 3.8.1). The cloth shall be autoclaved to meet the requirements of 3.9.

3.8.1 Antistatic finish. The cloth shall be given a durable antistatic finish so that the maximum resistivity of any one sample before laundering shall be  $3.0 \times 10^{11}$  ohms per square and the maximum resistivity of any one sample after five launderings shall be  $8 \times 10^{11}$  ohms per square when tested as specified in 4.6. Only those chemical treatments already approved by the appropriate medical service and so listed herein (see 6.7) or the invitation for bids or request for proposal shall be considered acceptable for the related procurement.

3.8.2 Nonfibrous material. Prior to the application of the antistatic finish the cloth shall contain no more than 1.0 percent starch and protein including chloroform-soluble and water-soluble material when tested as specified in 4.6.

3.9 Dimensional stability. The cloth shall not shrink more than 6.0 percent in the direction of the wales and not more than 1.5 percent (extended) in the direction of the courses, after fifteen launderings when tested as specified in 4.6. The preshrinkage process shall not be identified by name or trademark, either on the cloth or on the ticket or package.

3.10 Curling. When tested as specified in 4.6, the finished cloth shall lie flat, without distortion, and show no evidence of curling.

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3.11 pH. The pH value of the water extract of the finished cloth shall be no less than 5.0 nor more than 8.0 when tested as specified in 4.6.

3.12 Length and put up. Unless otherwise specified, the cloth shall be furnished in continuous lengths, each not less than 40 yards (36.4m), and shall be put up in rolls as specified in PPP-P-1133.

3.13 Fiber identification. Each roll shall be labeled for fiber content in accordance with the Textile Fiber Products Identification Act.

3.14 Workmanship. The finished cloth shall conform to the quality and grade of product established by this specification. The occurrence of defects shall not exceed the applicable acceptable quality levels.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Certificate of compliance. Where certificates of compliance are submitted, the Government reserves the right to check test such items to determine the validity of the certification.

4.2 Classification of inspection. The inspection requirements specified herein are classified as follows:

- a. First article inspection (see 4.4)
- b. Quality conformance inspection (see 4.5)

4.3 Inspection conditions. Unless otherwise specified, all inspections shall be performed in accordance with the test conditions specified in FED-STD-191.

4.4 First article inspection. When required (see 6.3), the first article sample submitted in accordance with 3.2 shall be visually inspected for appearance and color. The sample shall be tested in accordance with the methods specified in 4.6.

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4.5 Quality conformance inspection. Sampling for inspection shall be performed in accordance with MIL-STD-105, except where otherwise indicated hereinafter.

4.5.1 Examination of end item. Examination of the end item shall be in accordance with 4.5.1.1 through 4.5.1.4.

4.5.1.1 Yard-by-yard examination. The required yardage of each roll shall be examined on the face side and visual defects as defined herein shall be classified as listed in Table II. All defects found shall be counted regardless of their proximity one to another, except where two or more defects represent a single local condition of the cloth, in which case only the more serious defect shall be counted. A continuous defect shall be counted as one defect for each lengthwise yard or fraction thereof in which it occurs. The sample unit for this examination shall be one linear yard (0.91m). The sample size shall be in accordance with Inspection Level II of MIL-STD-105. The Acceptable Quality Level (AQL) shall be 2.5 major defects and 6.5 total defects per 100 units (yards) (91m). The lot size shall be expressed in units of one linear yard (0.91m) each. An approximate equal number of yards (meters) shall be examined from each roll selected in accordance with Table III.

TABLE II Classification of defects.

Defects	Classification	
	Major	Minor
Hole, cut, tear, any	X	
Run or dropped stitch, end out	X	
Tucking defect		X
Float, pulled stitch or needle streak		X
Mend	X	
Abrasion $\frac{1}{2}$	X	
Thin place $\frac{1}{2}$	X	
Thin yarn $\frac{1}{2}$	X	
Tight yarn $\frac{1}{2}$		X

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TABLE II. Classification of defects. (cont'd)

Defects	Classification	
	Major	Minor
Broken filaments <u>2/</u>		X
Slubs or slug, more than twice the size of normal yarn		X
Foreign matter <u>1/</u>		X
Knots extending above the surface of the cloth <u>1/</u>		X
Kinks or untrimmed ends		X
Crease or wrinkle (embedded)		X
Stop mark	X	
Tension too tight or too loose	X	
Barre, shade bar <u>1/</u>		X
Spot or stain	X	
Bowing		X
<u>1/</u> Clearly visible at normal inspection distance (3 feet) (0.91m)		
<u>2/</u> Defects caused by broken filaments should not exceed one per four running yards (3.64m)		

4.5 1 2 Overall examination. Each defect listed below shall be counted not more than once in each roll examined. The sample unit shall be one roll. The sample size and the acceptance number shall be as specified in Table III.

Overall Defects

Objectionable odor

Overall uncleanness

Uneven knitting throughout the piece

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Overall Defects (cont'd)

Off shade, shaded end to end, side to side, side to center or throughout the roll.

Poor dye penetration, mottled, streaky or cloudy

Overall width less than specified

4.5.1.3 Examination for length.

4.5.1.3.1 Individual rolls During the yard-by-yard (meter-by-meter) 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 yards (1.82m) less than the length marked on the ticket shall be considered a defect with respect to length. The maximum number of defects acceptable in the sample shall be in accordance with Table III.

TABLE III. Sample size

Lot size in yards (meters)	Sample size in rolls	Maximum number of defects acceptable in sample
Up to 1200 (1092) <sup>1/</sup>	3	0
1201 (1093) up to and including 3200 (2912)	5	0
3201 (2913) up to and including 10,000 (9100)	8	0
10,001 (9101) up to and including 35,000 (31,850)	13	0
35,001 (31,851) up to and including 150,000 (136,500)	20	1
150,001 (136,501) and over	32	2

<sup>1/</sup> If lot is fewer than three rolls, each roll in the lot shall be examined.

4.5.1.3.2 Total yardage in sample. The lot shall be unacceptable if the total of the actual lengths in rolls in the sample is less than the total of the lengths marked on the tickets. The rolls examined shall be those selected for the examination of individual rolls.

4.5.1.4 Examination for compliance with Textile Fiber Products Identification Act. During the yard-by-yard (meter-by-meter) examination, each roll in the sample shall be examined for conformance to the



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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.

4.5.2 Packaging inspection. The sampling and inspection of the unit pack, packing and container marking shall be in accordance with the requirements of PPP-P-1133.

4.6 Methods of examination and test. The methods of testing specified in FED-STD-191, wherever applicable and as listed in Table IV, shall be followed. The physical values specified in Section 3, except where otherwise specified, apply to the results of the determinations made on the sample unit for test purposes as specified in the applicable test method. All test reports shall contain the individual values utilized in expressing the final result. The sample unit shall be 3-1/2 yards (3.19m) (full width) of the finished cloth and 1/4 yard (0.23m) (full width) of unfinished cloth. The lot size shall be expressed in units of one yard (0.91m) each. The lot shall be unacceptable if one or more units fail to meet any test requirement specified. The sample size (number of sample units) shall be in accordance with the following:

<u>Lot size (yards)(meters)</u>	<u>Sampling size (units)</u>
800 (728) or less	2
801 (729) up to and including 22,000 (20,020)	3
22,001 (20,021) and over	5

TABLE IV. Test methods.

Characteristics	Requirement paragraph	Test method
Denier/filament	3.3	<u>1</u> /
Twist	3.3	<u>1</u> /
Material identification	3.3	<u>1</u>
Weight	3.5	5041
Wales	3.5	5070
Courses	3.5	5070
Thickness	3.5	5030

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TABLE IV. Test methods. (Cont'd)

Characteristics	Requirement paragraph	Test method
Bursting strength	3.5	5120
Air permeability	3.5	5450
Flame resistance		
Flame time	3.5	5903
Glow time	3.5	5903
Char length	3.5	5903
Construction	3.6	<u>1/</u>
Antistatic finish		
Before laundering	3.8.1	<u>3/ 4/</u>
After laundering	3.8.1	5556 <u>2/ 3/ 4/</u>
Nonfibrous material	3.8.2	2611
Dimensional stability		
After laundering		
Wales	3.9	5556 <u>2/</u>
Courses	3.9	5556 <u>2/</u>
Curl	3.10	<u>5/</u>
pH	3.11	2811

- 1/ Unless otherwise specified, a certificate of compliance shall be submitted and will be acceptable for the stated requirement
- 2/ Cotton laundering procedure shall be followed.
- 3/ AATCC Test Number 76-1975, Electrical Resistivity of Fabrics.
- 4/ Average of three determinations to nearest  $1.0 \times 10^{11}$  ohms per square.
- 5/ Two specimens of cloth, 1-1/2 inches (38mm) wide by 6 inches (152 mm) long shall be cut, one having the long dimension parallel

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to the wales and the other with the long dimension perpendicular to the wales. Both shall be placed on a flat surface for at least five minutes and then visually examined for evidence of curling.

5. PACKAGING

5.1 Unit pack. Unit pack shall be level A or C as specified (see 6.2).

5.1.1 Levels A and C. The cloth, put up as specified, shall be unit packed in accordance with the applicable requirements of PPP-P-1133

5.2 Packing Packing shall be Level A, B, or C as specified (see 6.2)

5.2.1 Levels A, B, or C. The cloth shall be packed in accordance with the applicable requirements of PPP-P-1133.

5.3 Marking In addition to any special marking required by the contract or order, shipments shall be marked in accordance with the requirements of PPP-P-1133.

6. NOTES

6.1 Intended use. The cloth covered by this specification is intended for use in the manufacture of aviator flight coveralls.

6.2 Ordering data - Procurement documents should specify the following:

- (a) ~~Title and number~~ of this specification
- (b) Color required (see 3.4)
- (c) Width required (see 3.7)
- (d) Length required (see 3.12)
- (e) Level of unit pack and packing (see 5.1 and 5.2)
- (f) When first article is required (see 3.2, 4.4, and 6.3)
- (g) Quantity required

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6.3 First article. When a first article is required, it shall be tested and approved under the appropriate provisions of ASPR 7-104.55 of the Armed Services Procurement Regulations. The first article should be a preproduction sample. The first article should consist of one unit, 3-1/2 yards (3.19m) (full width) of the finished cloth. The Contracting Officer should include specific instructions in all procurement instruments regarding arrangements for inspection, test and approval of the first article.

6.4 Standard sample. For access to standard sample, address the procuring office issuing the invitation for bids.

6.5 Twist Interlace level R-79, developed by E. I. DuPont DeNemours and Company, Inc. Wilmington, Delaware, has been found to produce satisfactory results

6.6 Knit construction The following is for information only. The fabric has been successfully knitted using the following machine set-up.

Take up gears. Drive - 15  
Cam - 10  
Reducer - 15  
Runner length of front bar - 92 Inches (2357mm)  
Runner length of back bar - 128 Inches (3251mm)  
Quality - 19 50 Inches (495 mm)

6.7 Finishing procedure. The following is for information only and is not mandatory. The following procedure has given satisfactory results:

- a. Scour - Open width, 180°F using 5.0 g/l Varsol, 2% Triton X-100 and 0.75% Trisodium Phosphate (TSP)
- b. After Scour - Open width, 210°F using 0.5 g/l Duponol-RA and 0.5 g/l TSP
- c. Frame Dry - 250°F wet width
- d. Anti-Static Finish - Pad with durable anti-static agent with minimum add-on that will adequately meet the requirements of this specification (see 3.8.1)
- e. Autoclave - The procedure that has given satisfactory results is as follows: Autoclave with steam at 30 pounds per square inch (psi) (206843 Pa) minimum for at least 40 minutes. The steam shall be drawn through the cloth by the application of a vacuum for a period of five minutes

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in order to adequately saturate the cloth with steam. The steam pressure shall be held at 30 psi (206843Pa) minimum for approximately 20 minutes after which the steam is cut off and a vacuum placed on the material for five minutes. The steam shall then be reapplied for the remaining time of the autoclaving period followed by a vacuum for five minutes, to remove all moisture from the cloth. Care must be taken to avoid the presence of creases in the cloth and any roll deformation since autoclaving will permanently set the cloth.

The requirements for the durable anti-static treatment can be met with Aston 123, Onyx Chemical Company, 190 Warren Street, Jersey City, NJ 07032 and Stanax (not Stanax 1166), Standard Chemical Products Inc., Hoboken, NJ 07030. Other products considered for this use must have the prior approval of the Contracting Officer

Preparing activity:  
Navy-AS  
(Project Number 8305-N700)

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