

MIL-C-21851E
4 May 1988
SUPERSEDING
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MILITARY SPECIFICATION

CLOTH, TWILL, POLYESTER AND COTTON

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for a cotton and polyester fabric of one type only.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

PPP-P-1134	- Packaging of Cotton and Cotton-Synthetic Fiber Blend Fabrics (Excluding Duck Fabrics)
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STANDARDS

FEDERAL

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

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Officer in Charge, Navy Clothing and Textile Research Facility, 21 Strathmore Road, Natick, MA 01760 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 8305

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MILITARY

MIL-STD-105

- Sampling Procedures and Tables for Inspection by Attributes

(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.)

* 2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein. Unless otherwise specified, the issues shall be those in effect on the date of the solicitation.

LAWS AND REGULATIONS

Rules and Regulations Under the Textile Fiber Products Identification Act

(Application for copies should be addressed to the Federal Trade Commission, Washington, D.C. 20580-0001.)

* 2.2 Other publications. The following document(s) form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solicitation.

TECHNICAL MANUAL OF THE AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS

Method No. 8-1985 Colorfastness to Crocking: AATCC Crockmeter Method

(Application for copies should be addressed to the AATCC National Headquarters, P.O. Box 12215, Research Triangle Park, NC 27709-2215.)

* 2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

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 6.3).

3.2 First article. When specified (see 6.2), the contractor shall furnish sample unit(s) for first article inspection and approval (see 4.3).

3.3 Material.

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3.3.1 Fibers.

3.3.1.1 Polyester fibers. The fiber shall be polyethylene glycol terephthalate (see 4.4.1).

3.3.1.2 Cotton fibers. The cotton shall be carded and combed (see 4.4.1).

3.3.2 Yarns. The yarns shall be a blend of polyester and cotton drawn and evenly spun into singles yarn for both warp and the filling when tested as specified in 4.5.

3.3.3 Fiber content. The finished cloth shall contain 65 percent, plus or minus 5 percent polyester fiber and not less than 30 percent cotton based on the dry weight of the desized specimens when tested as specified in 4.5.

3.4 Physical requirements. The finished cloth shall conform to the requirements as shown in Table I when tested as specified in 4.5.

TABLE I. Physical requirements

Characteristics	Minimum	Maximum
Weight, oz/sq yd (g/sq m)	5.0 (169)	6.0 (203)
Yarns per inch (2.54 cm)		
Warp	125 (125)	
Filling	54 (54)	
Breaking strength, lbs (N)		
Warp	165 (734.3)	
Filling	65 (289.3)	
pH	5.5	8.5

3.4.1 Weave. The weave shall be a 2 up, 1 down, right or left hand twill.

* 3.4.2 Width. The width of the finished cloth shall be as specified (see 6.2) and shall be the minimum acceptable width, inclusive of selvages when fly shuttle looms or shuttleless with tuck-in selvedge looms are used. For all other shuttleless looms the width measurement shall be made between the last warp yarn on each side excluding the protruding fringe.

3.5 Color. The color shall be as specified (see 6.2).

3.5.1 Sulfur content. The use of sulfur dyes or dyes containing elementary sulfur or sulfur compounds capable of oxidation to sulfuric acid is prohibited. The finished cloth shall contain no more labile sulfur than shown by the standard sample when tested as specified in 4.5. When a standard sample is not available, the dyed cloth shall show no more than a slight trace of labile sulfur as defined in the test method specified in 4.5.

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* 3.5.2 Matching. The finished cloth shall match the standard sample when viewed under filtered tungsten lamps which approximate artificial daylight having a correlated color temperature of 7500 ± 200 K, with illumination of 100 ± 20 foot candles, and shall be a good match to the standard sample under incandescent lamplight at 2300 ± 200 K.

* 3.5.3 Colorfastness. The finished cloth shall show fastness to laundering, light, crocking and perspiration equal to or better than the standard sample when tested as specified in 4.5. As a limit of acceptability or when no standard sample is available, the finished cloth shall show a minimum of "good" fastness to laundering, light, and perspiration and shall have an AATCC reading not lower than 3.0 for dry crocking and an AATCC reading not lower than 2.0 for wet crocking.

3.6 Nonfibrous materials. The nonfibrous material of the finished cloth shall not exceed 6.0 percent starch and protein content including acid hydrolyzable material when tested as specified in 4.5.

3.7 Length and put up. Unless otherwise specified (see 6.2 and 5.1.1), the cloth shall be in continuous pieces each not less than 40 yards (36.6m) in length and shall be put up in rolls, full width, as specified in PPP-P-1134.

3.8 Fiber identification. Each roll of cloth shall be labeled or ticketed for fiber content in accordance with the Rules and Regulations of the Textile Fiber Products Identification Act.

3.9 Dimensional stability. The finished cloth shall not shrink nor elongate more than 2.0 percent in either the warp or the filling when tested as specified in 4.5. The pre-shrinking process used shall not be identified by name or by trademark, either on the cloth, ticket or package.

3.10 Finish. The cloth shall be singed, desized, scoured, dyed, heat set and treated with an approved resin to provide a crease-resistant finish and hand equal in characteristic to that of the standard sample (see 6.7). Testing shall be in accordance with 4.5.

3.11 Face identification. The face side of the cloth shall be identified by applying a stamping on that side of the cloth with the word "Face" at each end of the roll.

3.12 Workmanship. The finished cloth shall conform to the quality established by this document. The occurrence of defects shall not exceed the applicable point level specified.

4. QUALITY ASSURANCE PROVISIONS

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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 or order, the contractor may use his own or any other facilities suitable for 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 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material.

4.1.2 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:

1. First article inspection (see 4.3).
2. Quality conformance inspection (see 4.4).

4.3 First article inspection. When required (see 3.2 and 6.2), the first article shall be visually examined for appearance, color and finish, and shall be tested for physical and chemical properties in accordance with methods specified in 4.5.

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

4.4.1 Component and material inspection. In accordance with 4.1 above, components and materials shall be tested in accordance with all the requirements of referenced specifications, drawings, and standards unless otherwise excluded, amended, modified, or qualified in this specification or applicable procurement documents. In addition, the contractor shall furnish a certificate of compliance for the fiber requirements of 3.3.1.1 and 3.3.1.2.

4.4.2 Examination of the end item. Examination of the end item shall be in accordance with 4.4.2.1 through 4.4.2.4.

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4.4.2.1 Yard-by-yard examination. Each roll in the sample shall be examined on face side only. When the total yardage in the roll does not exceed 100 yards, (91.4m) the entire yardage in the roll shall be examined. When the total yardage in the roll exceeds 100 yards (91.4m), only 100 yards (91.4m) shall be examined. All defects as defined in Section I of FED-STD-4, which are clearly visible at normal inspection distance (3 feet) (0.9m) shall be scored and assigned demerit points as listed in 4.4.2.1.1, except that only those slubs and knots which exceed the limits shown on Sears Fabric Defect Scale (see 6.4), "D" or "3 1/2" for slubs and "C" for knots, shall be scored. No linear yard (increments of 1 yard (0.9m) on the measuring device of the inspection machine) from any one roll within the sample shall be penalized more than 4 points. The sample size shall be 20 rolls selected from 20 containers. The lot shall be unacceptable if the points per 100 square yards (83.6m²) of the total yardage examined exceeds 30.0 points. The lot shall be unacceptable if the point per 100 square yards (83.6m²) of two or more individual rolls exceed 45.0 points. If one roll exceeds the point level, a second sample of 20 rolls shall be examined only for individual roll quality examination. If one or more rolls in the second sample of 20 exceeds the individual point value, the lot shall be rejected. Point computation for lot quality and individual roll quality shall be as follows:

Total points scored in sample size	X	3600	=	Points per 100 sq
Contracted width of cloth (inches)	X	Total yards inspected		yards (83.6m ²)

4.4.2.1.1 Demerit points. Demerit points shall be assigned as follows:

For defects up to and including 3 inches (7.62cm) in any dimension	- one point
For defects exceeding 3 inches (7.62cm) but not exceeding 6 inches (15.24cm) in any dimension	- two points
For defects exceeding 6 inches (15.24cm) but not exceeding 9 inches (22.86cm) in any dimension	- three points
For defects exceeding 9 inches (22.86cm) in any dimension	- four points

NOTE: The following defects, when present, shall be scored 4 points for each yard (0.91m) in which they occur:

Baggy, ridgy or wavy cloth
 Width less than specified
 Non-uniformity of shade (poor dye penetration, mottled, streaky or (cloudy)
 Excessive neppiness

4.4.2.2 Examination for length.

4.4.2.2.1 Individual rolls. During the yard-by-yard examinations, each roll in the sample shall be examined for length. Any length found to be less than the minimum specified, or more than two yards (1.8m) 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.

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4.4.2.2.2 Total yardage in 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. The rolls examined shall be those selected for the examination of individual rolls.

4.4.2.3 Examination for shade variation. During the yard-by-yard examination, each roll in the sample shall be examined for shade. Any roll in the sample 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.

4.4.2.4 Examination for face identification, identification of pre-shrinking process and non-conformance with the Textile Fiber Products Identification Act. During the yard-by-yard examination, each roll in the sample shall be examined for these defects. The lot shall be unacceptable if two or more rolls in the sample have face identification missing from either or both ends, two or more rolls in the sample contain identification of the pre-shrinking process by name or trademark on the cloth or ticket, or two or more rolls in the sample are not labeled or ticketed in accordance with the Textile Fiber Products Identification Act.

4.4.2.5 Examination for Shade and Finish Appearance.

4.4.2.5.1 Sampling. Each lot shall be examined visually for shade match (see para. 3.5.2) and finish appearance (see 3.10) in accordance with the table listed below and the provisions contained in the contract. The lot shall be unacceptable if one or more pieces fails to meet the requirement for shade match or finish appearance. The sample unit shall be a 4 inch by 20 inch swatch of the cloth. The sample unit shall be drawn from each piece in the sample size:

<u>Lot size</u>	<u>Piece to be Sampled</u>
1 - 8 pieces	each piece
9 - 25 pieces	8 pieces
26 - 90 pieces	20 pieces
91 - 160 pieces	32 pieces
over 160 pieces	1 of 5 pieces

4.4.3 Examination of packaging requirements. An examination shall be made in accordance with the provisions of PPP-P-1134 to determine that packaging, packing and marking comply with the Section 5 requirements of this specification.

4.5 Testing of the end item. The methods of testing specified in FED-STD-191, wherever applicable and as listed in Table II shall be followed. The physical and chemical values specified in Section 3, except where otherwise indicated, apply to the results of the determinations made on a sample unit for test purposes as specified in the applicable test methods. All test reports shall contain the individual values utilized in expressing the final result. The sample unit shall be 3-1/2 yards (3.2m), full width of the finished cloth. The lot size shall be expressed in units of one yard. The sample size shall be as follows and the lot shall be unacceptable if one or more sample units fail to meet any requirements specified.

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<u>Lot size (yards)</u>	<u>Sample size (units)</u>
800 or less	2
801 up to and including 22,000	3
22,001 and over	5

Table II - Test Methods

<u>Characteristic</u>	<u>Requirement Paragraph</u>	<u>Test Method</u>
Yarn (singles)		
Warp	3.3.2	Visual 1/
Filling	3.3.2	Visual <u>1</u> /
Fiber content		
Polyester (percent)	3.3.3	2100, 4.5.1
Cotton (percent)	3.3.3	2100, 4.5.1
Weight	3.4	5041
Yarns per inch		
Warp	3.4	5050
Filling	3.4	5050
Breaking strength		
Warp	3.4	5100
Filling	3.4	5100
pH	3.4	2811
Weave	3.4.1	Visual <u>1</u> /
Sulfur content	3.5.1	2020
Colorfastness to:		
Crocking	3.5.3	AATCC TM 8-1985
Perspiration	3.5.3	5680
Laundering	3.5.3	5610 <u>2</u> /
Light	3.5.3	5660 <u>3</u> /
Nonfibrous materials	3.6	2610
Dimensional stability	3.9	5556 <u>4</u> /
Finish	3.10	<u>5</u> /

- 1/ One determination per sample unit and the result reported as "pass" or "fail."
- 2/ On the color transfer cloth evaluation, only the stain on the cotton and polyester fibers of the color transfer cloth shall be evaluated.
- 3/ The calibration of the fadeometer and the definition of AATCC Fading Units shall be according to AATCC Test Method 16-1982. Using the formula below, 16 to 22 AFU's are acceptable as 20 SFH's.

$$\text{AATCC Fading Units} = \frac{(\Delta E^*)}{1.7} (20)$$

Where (ΔE^*) is the color difference in CIELAB^{*} units of color difference.

- 4/ Cotton procedure shall be used.
- 5/ Unless otherwise specified, a certificate of compliance shall be submitted and will be acceptable for the stated requirements.

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4.5.1 Fiber content. The general procedure of method 2100 shall be followed and the fiber content percentages calculated as follows:

$$\frac{\text{Weight of dry residual fiber} \times 100}{\text{Weight of dry desized specimen}} = \text{percent polyester}$$

$$100 - \text{percent polyester} = \text{percent cotton}$$

4.5.1.1 Report. Two specimens shall be tested from each sample unit and the average percent polyester and the average percent cotton of the two specimens reported to the nearest 1.0 percent.

5. PACKAGING

5.1 Preservation-packaging. Packaging shall be level A or C, as specified (see 6.2).

5.1.1 Levels A and C. The cloth, put up and preserved as specified (see 3.7), shall be packaged in accordance with the applicable requirements of PPP-P-1134.

5.2 Packing. Packing shall be level A, B, or C (see 6.2).

5.2.1 Levels A, B, and C. The cloth shall be packed in accordance with the applicable requirements of PPP-P-1134.

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-1134.

6. NOTES

6.1 Intended use. The cloth covered by this specification is intended for use in clothing worn by Department of Defense Personnel.

6.2 Ordering data. Procurement documents should specify the following:

- a. Title, number and date of this specification
- b. Width of cloth as specified (see 3.4.2)
- c. When a first article inspection is required (see 3.2), the item will be tested and should be a first article sample. The contracting officer should include specific instructions in acquisition documents regarding arrangements for examinations, quantity, and testing and approval of the first article.
- d. Minimum and maximum lengths for cloth (see 3.7).
- e. Applicable levels of packaging and packing (see 5.1 and 5.2).
- f. Color of cloth required (see 3.5).

6.3 Standard sample. For access to standard sample, address the procuring activity issuing the invitation for bids (see 3.1).

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6.4 Sears Fabric Defect Scales. Sears Fabric Defect Scales are available from Sears, Roebuck and Company, Department 817 (ATTN: BSC 23-29), Sears Tower, Chicago, Illinois 60684.

* 6.5 Changes from previous issue. The margins of this specification are marked with an asterisk to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

* 6.6 Subject term (key word) listing.

Cloth, Polyester and Cotton

Cloth, Twill

Twill, Left Hand

Twill, Right Hand

* 6.7 Approval of Components. Approval of such components and combinations are the responsibility of the U.S. Army Natick Research, Development, and Engineering Center, Natick, MA 01760-5014, and is based on extensive tests, including those for toxicity, which are not set forth in this document. Because of the time necessary to conduct a full evaluation, only those chemical treatments already approved and so listed in the invitation for bids or request for proposal shall be considered acceptable for the related procurement (see 3.10).

Custodian:

Navy - NU

Air Force - 11

Army - GL

Preparing Activity:

Navy - NU

Review Activity:

Project No. 8305-0229

Navy - MC

Air Force - 82,99

DLA - CT

Army - MD

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