INCH-POUND

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SUPERSEDING
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MILITARY SPECIFICATION

CLOTH, WIND RESISTANT SATEEN, COTTON AND NYLON

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

1. SCOPE

1.1 Scope. This specification covers wind resistant sateen cloth made of cotton and nylon blend.

1.2 Classification. The cloth shall be of the following classes as specified (see 6.2).

Class 1 - Dyed
Class 2 - Dyed and Quarpel treated
Class 3 - Woodland camouflage printed and Quarpel treated
Class 4 - Desert camouflage printed (6 color) and Quarpel treated
Class 5 - Desert camouflage printed (3 color) and Quarpel treated

2. APPLICABLE DOCUMENTS

2.1 Government documents.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be used in improving this document should be addressed to: U.S. Army Natick Research, Development, and Engineering Center, Natick, MA 01760-5019 by using the Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A FSC 8305

DISTRIBUTION STATEMENT A. Approved for public release; distribution is unlimited.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

V-T-285 - Thread, Polyester

STANDARDS

FEDERAL

FED-STD-4 - Glossary of Fabric Imperfections
FED-STD-191 - Textile Test Methods
FED-STD-803 - Packaging of Cotton and Cotton-Synthetic Fiber Blend Fabrics (Excluding Duck Fabrics)

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

DRAWINGS

U.S. ARMY NATICK RESEARCH, DEVELOPMENT, AND ENGINEERING CENTER

2-1-1516 - Woodland Pattern - 48 inches
2-1-1516B - Woodland Pattern - 60 inches
2-1-1884 - 6 Color Desert Pattern 48 & 60 inch pattern
2-1-2240 - 3 Color Desert Pattern 48 & 60 inch pattern

(Copies of drawings are available from the U.S. Army Natick Research, Development, and Engineering Center, ATTN: STRNC-UX, Natick, MA 01760-5017.)

FEDERAL TRADE COMMISSION

Rules and Regulations Under the Textile Fiber Products Identification Act

(Copies are available from the Federal Trade Commission, Pennsylvania Avenue at Sixth Street, N.W., Washington, DC 20580-0001.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

Chromatic Transference Scale

(Application for copies should be addressed to the American Association of Textile Chemists and Colorists, P.O. Box 12215, Research Triangle Park, NC 27709.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 1424 - Tear Resistance of Woven Fabrics by Falling-Pendulum (Elmendorf) Apparatus
D 5034 - Breaking Force and Elongation of Textile Fabrics (Grab Test)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103-1187.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 First article. When specified (see 6.2), a sample shall be subjected to first article inspection (see 6.3), in accordance with 4.3.

3.2 Standard sample. The dyed, dyed and treated, or printed and treated finished cloth shall match the standard sample for shade and appearance and shall, unless otherwise indicated (see 3.4.7), be equal to or better than the standard sample with respect to all characteristics for which the standard sample is referenced (see 6.4).

3.3 Material. It is encouraged that recycled material be used when practical as long as it meets the requirements of this specification.

3.3.1 Cotton. The cotton shall be carded and drawn.

3.3.2 Nylon. The nylon shall be first quality, high tenacity, semi-dull staple having a nominal cut length of 1-1/2 inches and a round cross section with a single nominal denier of 2.25 to 2.5. Testing shall be as specified in 4.4.1.1.

3.3.2.1 Nylon staple. The nylon staple shall be carded and drawn.

3.3.3 Yarn. The yarns shall be singles and contain a blend of 50 ± 5 percent nylon and the remaining percentage cotton, based on the dry weight of the desized cloth prior to treatment. Testing shall be as specified in 4.4.1.1.

3.4 Color.

3.4.1 Color, classes 1 and 2. The color of the finished cloth shall be as specified and shall match the standard sample.

3.4.1.1 Spectral reflectance, class 2. When shade Olive Green 107 or Camouflage Green 483 is specified, the spectral reflectance values of the finished cloth shall meet the requirements specified in table I, when tested as specified in 4.4.3.

TABLE I. Spectral reflectance requirements, class 2

Wavelengths, nanometers (nm)	Reflectance values (percent)			
	Olive Green 107		Camouflage Green 483	
	Min.	Max.	Min.	Max.
600	—	9	6	10
620	—	9	6	10
640	—	9	6	10
660	—	9	7	11
680	—	10	9	15
700	—	13	13	22
720	8	—	19	30
740	13	—	26	39
760	20	—	34	49
780	27	—	42	57
800	35	—	47	65
820	42	—	48	70
840	50	—	48	75
860	50	—	48	78

3.4.2 Color, class 3. The cloth shall be dyed to a ground shade approximating Light Green 354. The Woodland Camouflage Pattern shall be obtained by roller or screen printing using four rollers or screens, as appropriate, for the Light Green 354, Dark Green 355, Brown 356, and Black 357 areas of the pattern (see 6.5.2).

3.4.2.1 Pattern execution, class 3. The pattern shall reproduce the standard sample in respect to design, colors, and registration of the respective areas. The pattern repeat of the camouflage printed finished cloth shall be 27.25 + 1.25 - 2.5 inches in the warp direction. Each pattern area shall show solid coverage; skittering exceeding that shown by the standard sample in any of the printed areas will not be acceptable. When the standard sample is not referenced for pattern execution, a pattern drawing shall be provided, and the pattern on the finished cloth shall match that of Drawing 2-1-1516 or 2-1-1516B, as applicable (see 2.1.2, 6.2, and 6.4).

3.4.2.2 Spectral reflectance, class 3. The spectral reflectance values of the colors in the camouflage printed finished cloth shall conform to the requirements specified in table II when tested as specified in 4.4.3.

TABLE II. Spectral reflectance requirements, class 3

Wavelengths, nanometers (nm)	Reflectance values (percent)					
	Black 357		Light Green 354		Dark Green 355 and Brown 356	
	Min.	Max.	Min.	Max.	Min.	Max.
600	—	10	8	21	3	10
620	—	10	8	21	3	10
640	—	10	8	21	3	10
660	—	10	8	22	3	12
680	—	10	10	27	3	16
700	—	10	13	40	4	18
720	—	10	16	53	5	20
740	—	10	21	64	7	28
760	—	10	27	73	11	36
780	—	10	34	80	17	44
800	—	10	41	85	24	52
820	—	10	48	88	32	60
840	—	10	50	90	39	68
860	—	10	52	91	46	74

3.4.3 Color, class 4. The cloth shall be dyed to a ground shade approximating Light Tan 379. The Desert Camouflage pattern shall be obtained by roller or screen printing using the five remaining rollers or screens, as appropriate, for Tan 380, Light Brown 381, Dark Brown 382, Black 383, and Khaki 384 (see 6.5.3).

3.4.3.1 Pattern execution, classes 4 and 5. The pattern shall reproduce the standard sample in respect to design, colors, and registration of the respective areas. The warpwise pattern repeat of the dyed, printed, and finished cloth shall be 16.75 + 1.25 - 1.75 inches. Each pattern area shall show solid coverage. Skitteriness exceeding that shown by the standard sample in any of the printed areas will not be acceptable. When the standard sample is not referenced for pattern execution, a pattern drawing shall be provided and the pattern on the finished cloth shall match that of Drawing 2-1-1884 for class 4 and 2-1-2240 for class 5 (see 2.1.2, 6.2, and 6.4).

3.4.3.2 Spectral reflectance, class 4. The spectral reflectance values for the 6 color Desert Camouflage printed finished cloth shall conform to the requirements specified in table III when tested as specified in 4.4.3.

TABLE III. Spectral reflectance requirements, class 4

Wavelengths nanometers (nm)	Reflectance values (percent)					
	Light Tan 379		Tan 380 and Khaki 384		Light Brown 381 and Dark Brown 382	
	Min.	Max.	Min.	Max.	Min.	Max.
700	38	53	25	44	19	41
720	38	54	25	45	20	41
740	39	55	25	46	20	42
760	40	56	26	47	21	42
780	41	57	27	48	21	42
800	43	58	28	50	22	43
820	45	59	30	52	23	45
840	48	62	33	55	24	46
860	50	65	36	58	25	48

3.4.4 Color, class 5. The cloth shall be three color Desert Camouflage Pattern. The cloth shall be dyed to a ground shade either matching or approximating Light Tan 492 and then overprinted with the camouflage pattern by roller or automatic screen printing. When the ground shade is dyed to match Light Tan 492, the two remaining colors shall be obtained by subsequent printing using two rollers or screens, as appropriate, for Light Brown 493 and Light Khaki 494 areas of the pattern. When the ground shade is dyed to approximate Light Tan 492, all three colors of the camouflage pattern shall be obtained by subsequent printing using three rollers or screens to match all three colors. The ground shade dyeing and the overprinting shall be accomplished by using organic colorants (see 6.5.4) to provide a match to each of the three shades of the pattern and to provide the spectral reflectance levels specified in table IV. Each dyed and printed color area shall match the specified color on the standard sample (see 6.4). Resin bonded pigment printing will not be permitted. The pattern execution shall be as specified in 3.4.3.1.

3.4.4.1 Spectral reflectance, class 5. The spectral reflectance values for the 3 color Desert Camouflage printed finished cloth shall conform to the requirements specified in table IV when tested as specified in 4.4.3.

TABLE IV. Spectral reflectance requirements, class 5

Wavelengths nanometers (nm)	Reflectance values (percent)					
	Light Tan 492		Light Brown 493		Light Khaki 494	
	Min.	Max.	Min.	Max.	Min.	Max.
700	38	53	19	41	25	44
720	38	54	20	41	25	45
740	39	55	20	42	25	46
760	40	56	21	42	26	47
780	41	57	21	42	27	48
800	43	58	22	43	28	50
820	45	59	23	45	30	52
840	48	62	24	46	33	55
860	50	65	25	48	36	58

3.4.5 Labile sulfur. The use of dyes and compounds containing elementary sulfur capable of oxidation to sulfuric acid shall be chosen and applied so that the dyed cloth shall contain no more labile sulfur than shown by the standard sample when tested as specified in 4.4.3. 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 when tested as specified in 4.4.3.

3.4.6 Visual matching. The color of the finished cloth shall match the standard sample when viewed under filtered tungsten lamps that approximate artificial daylight and that have 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.

3.4.6.1 Instrumental matching (class 3 only). As an alternative to visual color matching, the finished cloth printed with Woodland Camouflage Pattern shall be examined by using a spectrophotometer (see 6.6) to compare each color in the pattern with the standard sample in the visible wavelength range 400 to 700 nanometers (nm) of the electromagnetic spectrum. Each of the four colors in the pattern shall conform to the applicable maximum numerical tolerance for acceptability (ΔA) listed below when measured as specified in 4.5.1.

Color	(ΔA)
Light Green 354	1.60
Dark Green 355	1.60
Brown 356	1.30
Black 357	1.00

3.4.7 Colorfastness.

3.4.7.1 Classes 1 and 2. The dyed or dyed and treated finished cloth shall show fastness to light (after 40 standard fading hours), laundering (after 3 cycles), and perspiration equal to or better than the standard sample or equal to or better than a rating of "good". The finished cloth shall show fastness to crocking equal to or better than the standard sample or shall have an AATCC Chromatic Transference Scale rating of not lower than 3.5. Testing shall be as specified in 4.4.3.

3.4.7.2 Class 3. The Woodland camouflage printed and water repellent treated finished cloth shall show fastness to light (after 40 standard fading hours), laundering (after 3 cycles), and perspiration equal to or better than the standard sample or equal to or better than a rating of "good", except for Black 357 which shall be equal to or better than a rating of "fair". The finished cloth shall show fastness to crocking equal to or better than the standard sample or shall have an AATCC Chromatic Transference Scale rating of not lower than 3.5 for all the pattern areas, except Black 357 which shall have an AATCC Chromatic Transference Scale rating of not lower than 1.0. Testing shall be as specified in 4.4.3.

3.4.7.3 Classes 4 and 5. The Desert camouflage printed and water repellent treated finished cloth shall show fastness to light (after 40 standard fading hours), laundering (after 3 cycles), and perspiration equal to or better than the standard sample or equal to or better than a rating of "good", except for Black 383, class 4 which shall be equal to or better than a rating of "fair". The finished cloth shall show fastness to crocking equal to or better than the standard sample or shall have an AATCC Chromatic Transference Scale rating of not lower than 3.5 for all the pattern areas, except for Black 383, class 4 which shall have an AATCC Chromatic Transference Scale rating of not lower than 1.0. Testing shall be as specified in 4.4.3.

3.5 Physical requirements. The physical requirements of the dyed, dyed and treated, or printed and treated finished cloth shall be as specified in table V when tested as specified in 4.4.3.

TABLE V. Physical requirements

Weight oz/sq. yd. Minimum	Yarns per inch Minimum		Breaking strength pounds Minimum		Tearing strength pounds Minimum		Weave 1/
	Warp	Filling	Warp	Filling	Warp	Filling	
8.5	126	72	225	225	9.0	9.0	5-harness sateen

1/ The weave when viewed from the face side (see 3.6) shall appear as shown on figure 1.

3.5.1 Width. The width of the 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 selvage 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(s).

3.6 Finish. The cloth shall be dyed, or dyed and printed on the filling effect side as the face. The cloth shall be closely singed, desized, mercerized, and dyed or dyed and printed. The classes 2, 3, 4, and 5 cloth shall be given a water repellent treatment as specified in 3.10.

3.6.1 Nonfibrous material. The starch and protein content including chloroform-soluble and water-soluble material and prior to the water-repellent treatment shall not exceed 2.0 percent when tested as specified in 4.4.3.

3.7 pH. The pH value of the water extract of the finished cloth shall be no less than 5.0 and no more than 8.5 when tested as specified in 4.4.3.

3.8 Dimensional stability. The shrinkage or elongation both in the warp and in the filling of the finished cloth shall not be greater than 2.5 percent for the individual sample unit and not greater than 2.0 percent for the lot average when tested as specified in 4.4.3. The preshrinkage process used shall not be identified by name or trademark either on the cloth, ticket, or package.

3.9 Face identification (classes 1 and 2). The filling effect side of the class 1 and 2 cloths shall be identified as the face side by stamping that side with the word "Face" at each end of the roll.

3.10 Water repellency and air permeability (classes 2, 3, 4, and 5). The cloth shall be given an approved Quarpel type (see 6.8) water-repellent treatment and shall conform to the water-repellency and air-permeability requirements of table VI when tested as specified in 4.4.3. The use of materials other than approved water repellents and sodium acetate buffer (and acetic acid) is prohibited.

TABLE VI. Water-repellency and air-permeability requirements

	Hydrostatic pressure (centimeter) Minimum Lot Avg.	Dynamic absorption (percent) Maximum Lot Avg.	Air permeability cu. ft./min/sq. ft. Maximum Lot Avg.
Initial	30 1/	20 2/	-
After 3 launderings	30 1/	-	7.0 3/
After 15 launderings	-	20 2/	-

1/ No individual specimen shall fall below 25 centimeters.

2/ No individual specimen shall exceed 25 percent.

3/ No sample unit (average of five specimens) shall exceed 7.5.

3.11 Resistance to organic liquid (classes 2, 3, 4, and 5). The finished cloth shall show no wetting by n-tetradecane initially and after 15 launderings when tested as specified 4.4.3.

3.12 Spray rating (classes 2, 3, 4, and 5). The measurements of the three individual determinations on the sample unit for spray rating shall be equal to or better than 90, 90, 80 when tested as specified 4.4.3.

3.13 Seam efficiency. The dyed, dyed and treated, or printed and treated finished cloth shall have a seam efficiency of not less than 80 percent when tested as specified in 4.4.3.

3.14 Length and put up. Unless otherwise specified (see 6.2), the cloth shall be furnished in continuous lengths, each not less than 50 yards. Each length shall be put up in full width rolls as specified in 5.1.

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

3.16 Workmanship. The finished cloth shall conform to the quality of product established by this specification. The demerit points per 100 square yards when calculated as specified in section 4 shall not exceed the established maximum point value.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, 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 this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items shall 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 ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling

inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.1.2 Certificates of compliance. When certificates of compliance are submitted, the Government reserves the right to inspect such items to determine the validity of the certification.

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

a. First article inspection (see 4.3).
b. Quality conformance inspection (see 4.4).

4.3 First article inspection. When a first article is required (see 3.1 and 6.2), it shall be examined for defects specified in 4.4.2.1 through 4.4.2.4 and tested for the characteristics specified in 4.4.3.

4.4 Quality conformance inspection.

4.4.1 Component and material inspection. In accordance with 4.1, components and materials shall be inspected in accordance with all the requirements of referenced documents unless otherwise excluded, amended, modified, or qualified in this specification or applicable purchase document.

4.4.1.1 Component and material certification. A certificate of compliance may be acceptable as evidence that the characteristics listed below conform to the specified requirements.

Characteristic	Requirement paragraph	Test method
Cotton fiber identification	3.3.1	1200 of FED-STD-191
Nylon identification	3.3.2	1530 of FED-STD-191
nylon tenacity, luster, staple length, cross section, and denier	3.3.2	—
Cotton fiber content	3.3.3	2530 of FED-STD-191 1/
Nylon fiber content	3.3.3	2530 of FED-STD-191

1/ The cotton content shall be calculated as follows:

$$\text{Percent cotton content} = \frac{R}{S} \times 100$$

R = weight of residual fibers
S = weight of dry, desized specimen

4.4.2 End item examination.

4.4.2.1 Yard-by-yard examination. Each roll in the sample shall be examined on the face side only. When the total yardage in the roll does not exceed 100 yards, the entire yardage in the roll shall be examined. When the total yardage in the roll exceeds 100 yards, only 100 yards shall be examined. All defects, as defined in section I of FED-STD-4, which are clearly noticeable at normal inspection distance (3 feet) 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 Scales (see 6.9) "F" or "2" as applicable for slubs and "D" for knots shall be scored. Print color mark-off within 1-1/2 inches from either edge of cloth shall not be scored as a defect. No linear yard (increments of 1 yard on the measuring device of the inspection machine) from any one roll within the sample shall be penalized more than four points. The sample size shall be 20 rolls selected from 20 containers. The lot shall be unacceptable if the points per 100 square yards of the total yardage examined exceeds 30 points. The lot shall be unacceptable if the points per 100 square yards of two or more individual rolls exceeds 45 points. If one roll exceeds 45 points per 100 square yards, a second sample of 20 rolls shall be examined only for individual roll quality. The lot shall be unacceptable if one or more rolls in the second sample exceeds 45.0 points per 100 square yards. Point computation for lot quality and individual roll quality shall be as follows:

$$\frac{\text{Total points scored in sample} \times 3600}{\text{Contracted width of cloth (inches)} \times \text{Total yards inspected}} = \text{Points per 100 square yards}$$

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

For defects up to 3 inches in any direction	- one point
For defects exceeding 3 inches, but not exceeding 6 inches in any dimension	- two points
For defects exceeding 6 inches, but not exceeding 9 inches in any dimension	- three points
For defects exceeding 9 inches in any dimension	- four points

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

Objectionable odor
Baggy, ridgy, or wavy cloth
Width less than specified
Edge ravels when pulled outward
Slack or tight selvages 1/
Overall uncleanness
Excessive nappiness
Poor dye penetration, mottled, streaky, or cloudy
Pattern design not equal to standard sample (classes 3, 4, and 5)
Incorrect color in any part of the pattern (classes 3, 4, and 5)

Pattern repeat less than 24.75 inches or more than 28.50 inches (class 3)
Pattern repeat less than 15.00 inches or more than 18.00 inches (classes 4 and 5)
Skitteriness (mottled, uneven color) of pattern exceeds that shown by the standard sample (classes 3, 4, and 5)
Excessive feathering or spew (fuzziness at color boundries) of pattern as compared to the sample (classes 3, 4, and 5)
Excessive grinning (off register, gap where ground shade shows through) of pattern as compared to the standard sample (classes 3, 4, and 5)
Excessive haloing or trapping (overlapping of colors) of pattern as compared to the standard sample (classes 3, 4, and 5)
Overall application of water repellent not uniform (classes 2, 3, 4, and 5)
Tackiness (sticky to touch) (classes 2, 3, 4, and 5)
Design not printed on face side of cloth (classes 3, 4, and 5)

1/ To determine the presence of unacceptable selvage conditions, the following procedure shall be observed: During the visual examination, the perch shall be stopped a minimum of three times for each roll in the sample, the tension removed, and the finished cloth examined for the selvage conditions. Suspect rolls should be removed from the perch and unrolled on the floor or a table and further examined for the condition. A waviness in the selvage or significant ripples diagonally across the width of the fabric is an indication of slack or tight selvages.

4.4.2.2 Length examination. During the yard-by-yard 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 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 with respect to length, or if the total of the actual lengths of the rolls in the sample is less than the total of lengths marked on the tickets.

4.4.2.3 Shade and finish appearance examination. During the yard-by-yard examination, each roll in the sample shall be examined for shade and finish appearance on the face side. The lot (classes 1 or 2) shall be unacceptable if any roll is off shade, shaded side to side, shaded side to center, or shaded end to end, or if any roll does not have the same finish appearance as the standard sample. The lot (classes 3, 4, or 5) shall be unacceptable if any roll fails to match the standard sample with respect to color for all pattern areas, or if any roll does not have the same finish appearance as the standard sample.

4.4.2.4 Roll identification examination. During the yard-by-yard examination, each roll in the sample shall be examined for the defects listed below. The lot shall be unacceptable if two or more rolls in the sample contain one or more of the following defects:

Face identification missing from either or both ends (classes 1 and 2)
Face identification on wrong side (classes 1 and 2)
Preshrinkage process identified by name or trademark on cloth or ticket
Not labeled in accordance with the Rules and Regulations under the Textile Fiber Products Identification Act

4.4.3 End item testing. The cloth shall be tested for the characteristics listed in table VII. The methods of testing specified in FED-STD-191 whenever applicable and as listed in table VII shall be followed. The sample unit shall be 1/4 yard full width of the dyed cloth (prior to treatment) for determination of fiber content and nonfibrous material content and 5 continuous yards full width for all other physical and chemical tests. The lot shall be unacceptable if one or more sample units or the lot average for dynamic absorption, air permeability, or dimensional stability fail to meet any requirement specified. The sample size shall be in accordance with the following:

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

TABLE VII. End item tests

Characteristic	Requirement paragraph	Test method
Spectral reflectance:		
Class 2	3.4.1.1	4.5.2
Class 3	3.4.2.2	4.5.2
Class 4	3.4.3.2	4.5.2
Class 5	3.4.4.1	4.5.2
Presence of labile sulfur	3.4.5	2020 1/
Colorfastness to:		
Laundering (after 3 cycles)	3.4.7	5610 2/ 3/
Perspiration	3.4.7	5680
Light	3.4.7	5660
Crocking	3.4.7	5651
Weight	3.5	5041
Yarns per inch	3.5	5050
Breaking strength	3.5	ASTM D 5034
Tearing strength	3.5	ASTM D 1424
Weave	3.5	Visual 4/
Singed	3.6	1/
Desized	3.6	1/
Mercerized	3.6	1/

TABLE VII. End item tests (cont'd)

Characteristic	Requirement paragraph	Test method
Nonfibrous material content	3.6.1	2611
pH	3.7	2811
Dimensional stability (cotton procedure)	3.8	5556
Hydrostatic pressure (classes 2, 3, 4, and 5):		
Initial	3.10	5514
After laundering	3.10	5556, 5514
Dynamic absorption (classes 2, 3, 4, and 5):		
Initial	3.10	5500
After laundering	3.10	5556, 5500
Air permeability (after laundering) (classes 2, 3, 4, and 5)	3.10	5556, 5450
Water repellents (classes 2, 3, 4, and 5)	3.10	5/
Resistance to organic liquid (classes 2, 3, 4, and 5):		
Initial	3.11	4.5.3
After 15 launderings (cotton procedure)	3.11	5556, 4.5.3 6/
Spray rating (classes 2, 3, 4, and 5)	3.12	5526
Seam efficiency	3.13	5110 7/

1/ Unless otherwise specified, a certificate of compliance shall be submitted and will be acceptable for the stated requirement.

2/ The specimens must be dried after each of the 3 laundering cycles.

3/ On the color transfer cloth evaluation, only the stain on the cotton and nylon fibers of the color transfer cloth shall be evaluated.

4/ One determination per sample unit and result reported as "pass" or "fail".

5/ The contractor shall report the water repellents used and certify that no other material (except the specified buffer and acetic acid) has been added.

6/ Specimens shall be subjected to 15 complete cycles (wash and dry) prior to determinations of resistance to organic liquid after laundering.

7/ The needle shall measure 0.049 ± 0.001 inch across the blade of the eye. The thread shall be polyester thread conforming to type I, class 1, sub-class A of V-T-285 for class 1 cloth, and polyester thread conforming to type I, class 1, sub-class B of V-T-285 for classes 2, 3, 4, and 5 cloth, with size F for the needle and size E for the looper.

4.4.4 Packaging inspection. The sampling and inspection of the preservation, packaging, and container marking shall be in accordance with the quality assurance provisions of FED-STD-803.

4.5 Methods of inspection.

4.5.1 Colorimetric measurements for the acceptability equation. Each of the four colors from the Woodland Pattern cited in 3.4.6.1 for both the standard sample and the test specimen shall be measured as specified in 4.5.2, except the spectral reflectance factor data shall be obtained in the visible wavelength range 400 to 700 nm only, and at 20 nm (or less) intervals. When the spectrophotometer is operated in the polychromatic mode, a source simulating CIE illuminant source D65 should be used. Colorimetric data (see 6.10), computed from the resulting spectral data, shall be incorporated in the equation of acceptability (see 6.11), and the ΔA for each color shall be calculated. Specimens recording ΔA values equal to or less than those specified for each color in 3.4.6.1 represent acceptable color matches to the standard. Specimens recording a ΔA value greater than that specified in 3.4.6.1 shall be considered a test failure.

4.5.2 Spectral reflectance test. Reflectance data shall be obtained from 600 to 860 nanometer (nm) for class 3, and 700 nm to 860 nm for classes 4 and 5, for each color on a spectrophotometer (see 6.6) relative to a barium sulfate standard, the preferred white reference standard. Other white reference materials may be used provided they are calibrated to absolute white; e.g., Halon, magnesium oxide, or vitrolite tiles (see 6.7).. The spectral band width shall be less than 25 nm at 860 nm. Reflectance measurements shall be made by either the monochromatic or polychromatic mode of operation. When the polychromatic mode is used, the spectrophotometer shall operate with the specimen diffusely illuminated with the full emission of a continuous source that simulates in the visible spectrum either CIE Source A or CIE Source D65. The specimen shall be viewed at an angle no greater than 10° from normal, with the specular component included. Photometric accuracy of the spectrophotometer shall be within 1 percent and wavelength accuracy within 2 nm. The standard aperature size used in the color measurement device shall be 1.0 to 1.25 inches in diameter. Areas to be measured for each color shall be lightly marked with a circle at least 1.50 inches in diameter, on the reverse side of the fabric, and at least 6 inches from either selvage. Specimens for all classes and shades shall be measured as a single layer backed with two layers of the same shade cut from the standard. For classes 4 and 5, Light Tan 379 and Light Brown 493, specimens shall be measured using a small area of view. When presented to the sample port, the specimens shall be oriented so that the diagonal weave lines are

parallel with the horizontal plane. Measurements shall be taken on a minimum of two different areas for each color and the data averaged. When the measured reflectance values for any color at four or more wavelengths do not meet the limits for the class 2 cloth in table I, Woodland Pattern (class 3) in table II, 6 color Desert Pattern (class 4) in table III, and 3 color Desert Pattern (class 5) in table IV, it shall be considered a test failure.

4.5.3 Resistance to organic liquid test. Place a small specimen of the cloth on a smooth horizontal surface, face up. Using a pipette or eye dropper, gently deposit one drop of n-tetradecane on the surface of the specimen. After 1 minute examine the specimen under light at an angle. Absence of light reflectance at the cloth-drop interface shall be taken as evidence of wetting. Three specimens (or areas) taken at various locations across the sample unit shall be tested. Evidence of wetting on one or more specimens shall be considered a test failure.

5 PACKAGING

5.1 Put up and preservation. Put up and preservation shall be level A or Commercial as specified (see 6.2).

5.1.1 Levels A and Commercial. The cloth shall be put up and preserved in accordance with the applicable requirements of FED-STD-803.

5.2 Packing. Packing shall be level A, B, or Commercial as specified (see 6.2).

5.2.1 Levels A, B, and Commercial. The cloth shall be packed in accordance with the applicable requirements of FED-STD-803.

5.3 Marking. In addition to any special marking required by the contract or purchase order, shipments shall be marked in accordance with the applicable requirements of FED-STD-803.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The cloth is intended for use in clothing where a high degree of wind resistance and water resistance is of prime importance.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number and date of this specification.
b. Class required (see 1.2).
c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).

d. When a first article is required (see 3.1, 4.3, and 6.3).
e. Color of cloth required when class 1 or 2 is specified (see 3.4).
f. Woodland or applicable Desert Camouflage Pattern drawing is required (see 3.4.2.1 or 3.4.3.1).
g. Width of cloth required (see 3.5.1).
h. Length of roll, if other than specified (see 3.14).
i. Selection of applicable levels of put up, preservation, and packing (see 5.1 and 5.2).

6.3 First article. When a first article is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209. The first article should be a preproduction sample. The contracting officer should specify the appropriate type of first article and the number of units to be furnished. The contracting officer should include specific instructions in acquisition documents regarding arrangements for selection, inspection, and approval of the first article.

6.4 Standard sample and pattern drawing. For access to the standard shade sample (see 3.2) and the Woodland Camouflage Pattern drawing or appropriate Desert Camouflage Pattern drawing, if applicable (see 3.4.2.1 or 3.4.3.1), address the contracting activity issuing the invitation for bids or request for proposal.

6.5 Dyeing.

6.5.1 Olive Green 107. Olive Green 107 has been satisfactorily dyed with the following colorants:

Nylon	Acid Yellow	219	Cotton	Vat Brown	57
	Acid Blue	258		Vat Brown	3
	Acid Orange	162		Vat Green	1
				Vat Yellow	2
				Vat Orange	2
				Cibanone Olive Green NY	

The above dye combinations are suggested and are not mandatory.

6.5.1.1 Dye combinations for Camouflage Green 483. A suggested but not mandatory dye combination for Camouflage Green 483 is as follows:

Nylon	Acid Blue 258	Cotton	Vat Yellow	33
	Acid Yellow 169		Vat Green	1
	Tectilon Orange GV 4R		Vat Violet	13

6.5.2 Woodland camouflage printing, class 3. The areas of the pattern for class 3 have been found to be satisfactory when dyed or printed with the following colorants. The dyeing of the ground shade approximating Light Green 354 was accomplished using the acid and vat dyes listed below.

Light Green 354

Vat Orange 2
Vat Green 1
Vat Yellow 2

Dark Green 355

Vat Brown 3
Vat Green 1
Vat Yellow 2

Brown 356

Vat Brown 57
Vat Brown 3
Vat Yellow 2
Vat Green 1

Black 357

Sulfur Black 6
Vat Blue 20
Vat Brown 3
Vat Black 11

Ground Shade

Acid Blue 258
Tectilon Orange 4R
Vat Orange 2
Vat Green 1
Vat Yellow 2

Satisfactory printing of shades Light Green 354, Dark Green 355, and Brown 356 has been accomplished by the use of vat dyes only. Shade Black 357 has been satisfactorily printed with a combination of vat and sulfur dyes.

6.5.3 Dye combination, class 4. The areas of the pattern have been found to be satisfactory when dyed and printed with various combinations of the following dyes for 6 colored areas:

Light Tan 379 (ground shade)

Vat Brown 1
Vat Black 25

Tan 380

Vat Yellow 1
Vat Yellow 33
Vat Brown 1
Vat Brown 57
Vat Black 25

Light Brown 381

Vat Yellow 1
Vat Yellow 33
Vat Brown 1
Vat Brown 57

Dark Brown 382

Vat Yellow 1
Vat Yellow 33
Vat Brown 1
Vat Brown 57

Black 383

Sulfur Black 6/Vat Black 14
Cibanone Black R

Khaki 384

Vat Yellow 1
Vat Yellow 33
Vat Brown 1
Vat Black 25

Satisfactory dyeing of the Light Tan 379, ground shade, and printing of Tan 380, Light Brown 381, Dark Brown 382, and Khaki 384 has been accomplished by the use of vat dyes only. Black 383 has been satisfactorily printed with a combination of vat and sulfur dyes.

6.5.4 Dye combination, class 5. The areas of the pattern have been found to be satisfactory when dyed or printed with various combinations of the following dyes for the colored areas:

Ground Shade	Light Brown 493
Vat Green 8	Vat Green 8
Vat Green 8 * similar	Vat Green 8 * similar
Vat Brown 1	Vat Brown 1
Vat Black 25	Vat Black 25
Vat Orange 1	Vat Orange 1
Vat Yellow 2	Vat Yellow 2
Light Tan 492	**Light Khaki 494**
Vat Green 8	Vat Green 8
Vat Green 8 * similar	Vat Green 8 * similar
Vat Brown 1	Vat Brown 1
Vat Black 25	Vat Black 25
Vat Brown 57	Vat Yellow 2
Vat Yellow 2	

6.6 Spectrophotometers. Suitable spectrophotometers for measuring spectral reflectance in the visible/near infrared include the Diano Hardy, Diano Match Scan, Milton Roy Match Scan 2, Hunter D54P-IR, Applied Color Systems Spectro Sensor I & II and CS-5, Hunter VIS/NIR Spectrocolorimeter, and Macbeth 1500 with IR options (see 4.5.2).

6.7 White standard. Barium sulfate of suitable quality for use as white reference standard is available from the Eastman Kodak Company. The same source has available magnesium reagent (ribbon) and Halon. Suitable tiles can be obtained from the National Institute of Standards and Technology or from the instrument manufacturers (see 4.5.2).

6.8 Quarpel water repellent. Approval of components and combination is the responsibility of the U.S. Army Natick Research, Development, and Engineering Center, Natick, MA 01760-5014 and is based on more extensive tests, including those for toxicity, which are not set forth in this specification. Because of the time necessary to conduct 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.

6.9 Fabric defect scales. Fabric Defect Replica Kits are available from Sears Roebuck and Company, Department 817 (ATTN: BSC 23-29), Sears Tower, Chicago, IL 60684.

6.10 CIE Tristimulus, and CIE $L^*a^*b^*$ values. The spectral reflectance values obtained from 400 to 700 nm for a color are used to compute the tristimulus values X, Y, and Z using CIE illuminant D_{65} and the 1964 CIE 10^o Supplementary Standard Colorimetric Observer. The tristimulus values are converted to CIE $L^*a^*b^*$ for use in the acceptability equation (see 6.11). Most spectrophotometers are interfaced to computers that automatically compute CIE tristimulus values and CIE $L^*a^*b^*$ values. Derivation of tristimulus values can be found in "Color in Business, Science and Industry", Third Edition, D.B. Judd and G. Wyszecki, John Wiley & Sons, New York, NY. Conversion of tristimulus values to CIE $L^*a^*b^*$ values is described in CIE publication "Recommendations of Uniform Color Spaces, Color Difference Equations, and Psychometric Color Terms", Supplement No. 2 to CIE Publication No. 15, "Colorimetry", E-1.3.1 (1971), Bureau Central de la CIE, Paris (1978).

6.11 Acceptability equation. Color acceptability is determined by the following equation:

$$\Delta A = [g_{11}(\Delta a^*)^2 + 2g_{12}\Delta a^*\Delta b^* + g_{22}(\Delta b^*)^2 + g_{33}(\Delta L^*)^2]^{1/2}$$

where ΔA is an acceptability figure, scaled according to color (see 3.4.6.1); and the quantities Δa^*, Δb^*, ΔL^* are sample minus standard in CIELAB coordinates. The coefficients g_{11}, $2g_{12}$, g_{22} and g_{33} are given by the following equations, where a^*_o and b^*_o represent the CIELAB a^* and b^* values of the standard, c is the chroma tolerance, h is the hue tolerance, and v (for value) is the lightness tolerance:

$$\theta = \tan^{-1}(b^*_o/a^*_o)$$

$$g_{11} = (\cos^2\theta/c^2) + (\sin^2\theta/h^2)$$

$$2g_{11} = 2 \sin\theta \cos\theta [(1/c^2) - (1/h^2)]$$

$$g_{22} = (\sin^2\theta/c^2) + (\cos^2\theta/h^2)$$

$$g_{33} = 1/v^2$$

Hue, chroma and lightness tolerance for the Woodland Pattern

	Lightness (v)	Chroma (c)	Hue (h)
Light Green 354	2.26	1.32	1.16
Dark Green 355	2.20	1.30	1.11
Brown 356	1.88	1.28	0.74
Black 357	2.70	1.50	1.25

Specimens recording ΔA values less than those listed for each color in 3.4.6.1 represent acceptable matches for color to the standard; those specimens with higher ΔA values are unacceptable.

Natick TR-80/036, Investigations to Define Acceptability Tolerance Ranges in Various Regions of Color Space, E. Allen and B. Yuhas, U.S. Army Natick RD&E Center, Natick, MA 01760-5019, Sept. 1981, is available from Natick for those interested in writing a software program for the acceptability equation.

6.12 Subject term (key word) listing.

Camouflage pattern
Clothing
Printed cloth
Quarpel
Water repellent treated

6.13 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:

Army - GL
Navy - NU
Air Force - 99

Preparing activity:

Army - GL

(Project 8305-0429)

Review activities:

Army - MD
Air Force - 82
DLA - CT

User activity:

Navy - MC

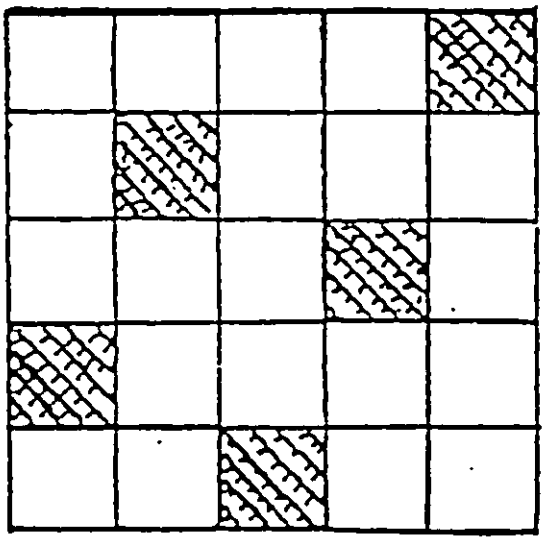

Figure 1

5-Harness Sateen Weave