

INCH-POUND

MIL-C-44034D

31 March 1992

SUPERSEDING

MIL-C-44034C

28 March 1986

MILITARY SPECIFICATION

CLOTH, TWILL, CAMOUFLAGE PATTERN, COTTON AND NYLON FOR DESERT UNIFORM

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

1. SCOPE

1.1 Scope. This specification covers blended cotton and nylon twill cloth which is dyed and overprinted with the prescribed camouflage print.

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

- Class 1 - Camouflage pattern (6 color) for desert uniform
- Class 1A - Camouflage pattern (6 color) for desert uniform,
quarrel treated
- Class 2 - (Deleted see 6.9)
- Class 3 - Camouflage pattern (3 color) for desert uniform
- Class 3A - Camouflage pattern (3 color) for desert uniform,
quarrel treated
- Class 3B - Camouflage pattern (3 color) for desert uniform,
permethrin 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.

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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

- A-A-50199 - Thread, Polyester Core, Cotton- or Polyester Covered
- P-S-683 - Sour, Laundry (Fluoridated)

MILITARY

- MIL-D-43362 - Detergent, Laundry (Anionic: A Standard for Testing)
- MIL-I-44411 - Insect Repellent, Permethrin

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

- 2-1-1884 - 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.)

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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 27709-2215.)

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)

(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 organizations which prepare or which 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 finished cloth shall match the standard sample for shade and appearance and shall, unless otherwise indicated (see 3.4.5) be

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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.

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 nominal denier of 2.25 to 2.5. The use of any form of nylon waste is prohibited, such as undrawn fiber, mixtures of deniers, lusters or cross sections, and waste from any stage of fiber production: whether drawn, undrawn, or mixed or garnetted fiber. The contractor shall submit the fiber producer's certification that each lot of nylon staple used conforms to the requirements specified herein.

3.3.3 Yarns. The warp and filling yarn shall be singles made from a blend of 50 ± 5 percent nylon and the remaining percentage cotton, based on the dry weight of the desized cloth. Testing shall be performed as specified in 4.4.3.

3.4 Color.

3.4.1 Color, classes 1 and 1A. The color shall be the six color Desert Camouflage Pattern. The cloth shall be dyed to a ground shade either matching or approximating Light Tan 379 and then overprinted with the camouflage pattern by roller or automatic screen printing. When the ground shade is dyed to match Light Tan 379, the five remaining colors shall be obtained by subsequent printing using five rollers or screens as appropriate for the Tan 380, Light Brown 381, Dark Brown 382, Black 383, and Khaki 384 areas of the pattern. When the ground shade is dyed to approximate Light Tan 379, all six colors of the camouflage pattern shall be obtained by subsequent printing using six rollers or screens to match all six colors. The ground shade dyeing and the overprinting shall be accomplished with organic colorants (see 6.6.1). Resin bonded pigments are not permitted. The dyed and printed cloth shall conform to the spectral reflectance requirements specified in 3.6.1.

3.4.2 Color, classes 3, 3A, and 3B. The color shall be the 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 the 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

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overprinting shall be accomplished using organic colorants (see 6.6.2). Resin bonded pigments are not permitted. The dyed and printed cloth shall conform to the spectral reflectance requirements specified in 3.6.2.

3.4.3 Labile sulfur. The use of dyes and compounds containing elementary sulfur capable of oxidation to sulfuric acid is prohibited. The dyestuff shall be chosen and applied so that the dyed and printed finished cloth shall contain no more labile sulfur than shown by the standard sample when tested as specified in 4.4.3. When no standard sample is available, the finished cloth shall show no more than a slight trace of labile sulfur when tested as specified in 4.4.3.

3.4.4 Matching. All colors 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.

3.4.5 Colorfastness. The printed 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" for all the pattern areas, except fastness to light shall be equal to or better than "fair" for classes 3, 3A and 3B. The 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, classes 1 and 1A, which shall have an AATCC Chromatic Transference Scale rating of not lower than 1.5. The light tan areas should be tested for crocking on the back side. Testing shall be as specified in 4.4.3.

3.5 Pattern execution, classes 1, 1A, 3, 3A and 3B. The pattern of the finished cloth shall match the standard sample with respect to design, colors, and registration of the respective areas. The warpwise pattern repeat of the dyed and printed finished cloth shall be $16.75 +1.25 -1.75$ inches (see 6.10). 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 a standard sample is not referenced for pattern execution, a pattern drawing shall be provided and the pattern of the finished cloth shall match that of Drawing 2-1-1884 for classes 1 and 1A and 2-1-2240 for classes 3, 3A and 3B (see 2.1 and 6.4).

3.6 Spectral reflectance.

3.6.1 Spectral reflectance, classes 1 and 1A. The spectral reflectance of each color area, except Black 383, of the (6 color) Desert Camouflage pattern printed cloth shall conform to the requirements specified in table I when tested as specified in 4.4.3.

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TABLE I. Spectral reflectance requirements classes 1 and 1A

Wavelengths nanometers	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

3.6.2 Spectral reflectance, classes 3, 3A and 3B. The spectral reflectance factors for Light Tan 492, Light Brown 493 and Light Khaki 494 for the three color Desert Camouflage pattern shall conform to the requirements specified in table II, when tested as specified in 4.4.3.

TABLE II. Spectral reflectance requirements classes 3, 3A and 3B

Wavelengths nanometers	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

3.7 Physical requirements. The finished cloth shall conform to the requirements in table III when tested as specified in 4.4.3.

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TABLE III. Physical requirements

Class	Wt. per sq. yd. <u>minimum</u> Ounces	Yarns per inch <u>minimum</u>		Breaking strength <u>minimum</u>		Tearing strength <u>minimum</u>		Air permea- bility (cu. ft./min./sq. ft.) max. ave. (see 6.16)
		Warp	Filling	Warp Pounds	Filling Pounds	Warp Pounds	Filling Pounds	
1,3 & 3B	6.8	86	54	200	125	11	8	25.0
1A&3A	7.0	86	54	190	115	10	7	10.0

3.7.1 Weave. The weave shall be 2/1 left hand twill.

3.7.2 Width. The width of the cloth shall be as specified (see 6.2), and shall be the minimum acceptable width inclusive of selvage 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).

3.8 Finish. The cloth shall be dyed and overprinted with the warp effect side as the face. The cloth shall be closely singed, desized, mercerized, dyed, and printed. The classes 1A and 3A cloth shall be given a water repellent treatment as specified in 3.8.2 and the class 3B cloth shall be given an insect repellent treatment as specified in 3.8.3.

3.8.1 Non-fibrous material. The starch and protein content including chloroform-soluble and water-soluble material of the printed cloth (prior to treatment) shall not exceed 2.0 percent when tested as specified in 4.4.1.1 or 4.4.3.

3.8.2 Water repellency (classes 1A and 3A). The classes 1A and 3A cloth shall be given an approved quarpel-type water repellent treatment (see 6.15) and shall conform to the requirements specified in table IV, 3.8.2.1 and 3.8.2.2. The use of materials other than approved water repellents is prohibited. The cured fabric shall be afterwashed to remove all unreacted reagents. Testing shall be as specified in 4.4.3.

TABLE IV. Water repellency requirements (classes 1A and 3A)

Hydrostatic height (centimeters) Lot avg. min. <u>1/</u>	Dynamic absorption (percent) Lot avg. max. <u>2/</u>
18.0	20.0

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1/ No individual specimen shall fall below the specified minimum.

2/ No individual specimen shall exceed the specified maximum.

3.8.2.1 Spray rating. The results of the three individual determinations on the sample unit for spray rating shall be equal to or better than ratings 100, 100, 90 when tested as specified in 4.4.3.

3.8.2.2 Liquid repellency. The treated finished classes 1A and 3A cloth shall show no wetting by n-dodecane after 30 seconds and no wetting by tri-ethyl phosphate, di-methyl methyl phosphonate and bis (2-ethyl-hexyl) hydrogen phosphite after 8 hours when tested as specified in 4.4.3.

3.8.3 Insect repellency (class 3B). The class 3B cloth shall be given a permethrin insect repellent treatment in accordance with the industrial pad roll method specified in MIL-I-44411. The finished treated cloth shall contain 0.100 to 0.125 mg/cm² permethrin. The use of a treatment other than the one specified herein is prohibited. Testing shall be as specified in 4.4.3.

3.9 Dimensional stability. The shrinkage or elongation both in the warp and in the filling of the finished cloth shall not be greater than 3.5 percent for the individual sample unit and not greater than 3.0 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.

3.10 pH. The pH value of the water extract of the finished cloth shall be not less than 5.0 and not greater than 8.5 when tested as specified in 4.4.3.

3.11 Seam efficiency. The finished cloth shall have a seam efficiency of not less than 75 percent when tested as specified in 4.4.3.

3.12 Length and put-up. Unless otherwise specified (see 6.2), the cloth shall be furnished in continuous lengths, each not less than 40 yards. Each length shall be put up on a roll as specified in 5.1.

3.13 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.

3.14 Workmanship. The finished cloth shall conform to the quality established by this specification. The demerit points per 100 square yards 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.

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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 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 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 indicted or actual, nor does it commit the Government to accept defective material.

4.1.2 Certificates of compliance. Where 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 document or applicable purchase document.

4.4.1.1 In-process inspection. Prior to the application of the water repellent treatment to class 1A and 3A, or the insect repellent treatment to class 3B, the cloth shall be tested for starch and protein content including chloroform-soluble and water-soluble material in accordance with Method 2611 of FED-STD-191. The sample unit shall be 1/4 yard of cloth full width. The lot shall be unacceptable if any sample unit fails to meet the requirement specified in 3.8.1. The sample size shall be in accordance with the following:

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

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 (printed side). 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 maximum limits shown on Sears Fabric Defect Scales (see 6.5), E or 3 as applicable for slubs and D for knots, shall be scored. No linear yard (increments of 1 yard on the measuring device of the inspection machine) from any 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 in the sample size of 20 exceeds 45 points per 100 square yards, a second sample of 20 rolls shall be examined for individual roll quality only. 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 and including 3 inches in any dimension - 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

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Baggy, ridgy, or wavy cloth
 Width less than specified
 Edge ravels when pulled outward
 Slack or tight selvages 1/
 Overall uncleanness
 Pattern design not equal to standard sample
 Incorrect color in any part of the pattern
 Pattern repeat not equal to the standard sample
 Warpwise pattern repeat less than 15.0 inches or more than 18.0 inches
 (classes 1, 1A, 3, 3A and 3B)
 Skitteriness (mottled, uneven color) of pattern exceeds that shown by
 standard sample
 Excessive feathering or spew (fuzziness at color boundaries) of pattern as
 compared to the standard sample
 Excessive grinning (off register, gap where ground shade shows through) of
 pattern as compared to the standard sample
 Excessive haloing or trapping (overlapping of colors) of pattern as
 compared to the standard sample

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 rolls in the
 sample is less than the total of the lengths marked on the ticket.

4.4.2.3 Shade and appearance examination. During the yard-by-yard
 examination, each roll in the sample shall be examined for shade and
 appearance. If any one component color in any roll of the sample is off
 shade or does not have the same appearance as the standard sample it shall be
 cause for rejection of the entire lot represented by the sample.

4.4.2.4 Roll identification examination. During the yard-by-yard examina-
 tion, each roll in the sample shall be examined for proper identification.
 The lot shall be unacceptable if two or more rolls in the sample are not
 labeled or ticketed in accordance with the Textile Fiber Products
 Identification Act.

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4.4.3 End item testing. The cloth shall be tested for the characteristics listed in table V. The methods of testing specified in FED-STD-191 whenever applicable and as listed in table V shall be followed. All test reports shall contain the individual values utilized in expressing the final results. The sample unit shall be 3 continuous yards full width of the finished cloth (for classes 1, 3 and 3B) or 4 continuous yards full width of the finished cloth (for classes 1A and 3A), for all physical and chemical tests except dimensional stability (see 4.4.3.1). The lot shall be unacceptable if one or more sample units or the lot average for dimensional stability fail to meet any requirement specified. The maximum lot size shall be 150,000 linear yards. The sample size except for dimensional stability shall be in accordance with the following:

<u>Lot size (yards)</u>	<u>Sample size (sample units)</u>
800 or less	2
801 up to and including 22,000	3
22,001 up to and including 150,000	5

TABLE V. End item tests

<u>Characteristic</u>	<u>Requirement paragraph</u>	<u>Test method</u>
Material		
Cotton fiber identification	3.3.1	1200 <u>1/</u>
Nylon:		
Identification	3.3.2	1530 <u>1/</u>
Luster	3.3.2	<u>1/</u>
Denier	3.3.2	<u>1/</u>
Absence of nylon waste	3.3.2	<u>1/</u>
Fiber content:		
Cotton content	3.3.3	2530 <u>1/</u> <u>2/</u>
Nylon content	3.3.3	2530 <u>1/</u>
Presence of labile sulfur	3.4.3	2020 <u>1/</u>
Colorfastness to:		
Light (after 40 standard fading hours)	3.4.5	5660
Laundering (after 3 cycles)	3.4.5	5610
Perspiration	3.4.5	5680
Crocking	3.4.5	5651
Spectral reflectance:		
Classes 1 and 1A	3.6.1	4.5.1
Classes 3, 3A and 3B)	3.6.2	4.5.1
Weight	3.7	5041
Yarns per inch	3.7	5050
Breaking strength	3.7	ASTIM D 5034
Tearing strength	3.7	ASTIM D 1424
Air permeability	3.7	5450

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TABLE V. End item tests (cont'd)

Characteristic	Requirement paragraph	Test method
Weave	3.7.1	Visual <u>1/</u>
Singed	3.8	<u>1/</u>
Desized	3.8	<u>1/</u>
Mercerized	3.8	<u>1/</u>
Non-fibrous material (classes 1 and 3)	3.8.1	2611 <u>1/</u>
Water repellent (classes 1A and 3A)	3.8.2	<u>3/</u>
Hydrostatic pressure (classes 1A and 3A)	3.8.2	5514
Dynamic absorption (classes 1A and 3A)	3.8.2	5500
Spray rating (classes 1A and 3A)	3.8.2.1	5526
Liquid repellency (classes 1A and 3A)	3.8.2.2	4.5.2
Insect repellent (class 3B)	3.8.3	4.5.4
Dimensional stability	3.9	4.4.3.1
pH	3.10	2811
Seam efficiency	3.11	5110 <u>4/</u>

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

2/ The cotton content shall be calculated as follows:

$$\text{Cotton content, percent} = \frac{R}{S} \times 100$$

R = Weight of residual fibers

S = Weight of dry desized specimen

3/ The contractor shall report the water repellents used and certify that no other material has been added.

4/ The needle shall measure 0.040 ± 0.001 inch across the blade at the eye. The thread shall be polyester, cotton- or polyester-covered in accordance with A-A-50199, ticket no. 50, 2 or 3 ply for the needle and ticket no. 70 2 or 3 ply for the looper.

4.4.3.1 Dimensional stability testing. The cloth shall be tested for dimensional stability in accordance with 4.5.3 through 4.5.3.6.3. The sample unit shall be 2 continuous yards full width of the finished cloth. The lot size shall not exceed 150,000 yards. The sample size shall be in accordance with the following:

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<u>Lot size (yards)</u>	<u>Sample size (number of sample units)</u>
10,000 or less	5
10,001 up to and including 35,000	8
35,001 up to and including 150,000	13

4.4.4 Packaging inspection. The inspection shall be in accordance with the quality assurance provisions of FED-STD-803.

4.5 Methods of inspection.

4.5.1 Spectral reflectance test (classes 1, 1A, 3, 3A and 3B). Reflectance shall be obtained from 700 to 860 nm relative to barium sulfate, the preferred white reference standard. Other reference white materials may be used (Halon, magnesium oxide, or vitrolite tile), provided they are calibrated to absolute white (see 6.7). The spectral band width at 860 nm shall be less than 26 nm. Reflectance measurements may be made by either the monochromatic or polychromatic mode operation. When the polychromatic mode operation is used, the spectrophotometer (see 6.8) 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. Specimens shall be measured as a single layer backed with two layers of the same shade cut from the standard. Readings shall be taken on a minimum of two different areas, and the data averaged. The specimen shall be viewed at any angle no greater than 10 degrees from normal. Photometric accuracy of the spectrophotometer shall be within 1 percent and the wavelength accuracy shall be within 2 nm. When the measured reflectance values for any color at four or more of the listed wavelengths do not meet the limits specified for the classes 1 and 1A cloth in table I and for the classes 3, 3A and 3B in table II, it shall be considered a test failure.

4.5.2 Liquid repellency test. Place a small specimen of the treated finished camouflage cloth (comprised of all three or six colors in the pattern) on a smooth horizontal surface, face-up. Using a pipette or eye dropper, gently deposit a drop of each liquid specified in 3.8.2.2 on the surface of each shade of the camouflage pattern. After 30 seconds, examine each color of the specimen under light at an angle. Absence of light reflectance at the cloth-drop interface for the n-dodecane drop shall be taken as evidence of wetting. The test shall be continued for 8 hours for the drops of tri-ethyl phosphate, di-methyl methyl phosphonate, and bis (2-ethyl-hexyl) hydrogen phosphite. Absence of light reflectance at the cloth-drop interface for the three liquids after the 8-hour period shall be taken as evidence of wetting. Three specimens taken at various locations across the sample unit shall be tested. Evidence of wetting on any color of one or more specimens shall be considered a test failure.

4.5.3 Dimensional stability testing procedures.

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4.5.3.1 Test specimen. The test specimen shall be a square of cloth 24 inches by 24 inches.

4.5.3.1.1 Number of determinations for dimensional stability. Three specimens from each sample unit shall be tested in each of the warp and filling directions.

4.5.3.2 Apparatus.

4.5.3.2.1 Wash wheel (see 6.11). A cylindrical wash wheel of the reversing type shall be used. The wheel (cage) shall be 20 to 24-1/2 inches inside diameter and 20 to 24 inches inside length. There shall be three fins each approximately 3 inches wide extending the full length of the inside of the wheel. One fin shall be located every 120 degrees around the inside diameter of the wheel. The wash wheel shall rotate at a speed of 30 ± 4 revolutions per minute making 5 to 10 revolutions before reversing. The water inlets shall be large enough to permit filling the wheel to an 8 inch level in less than 2 minutes, and the outlet shall be large enough to permit discharge of this same amount of water in less than 2 minutes. The wash wheel shall be equipped with a pipe for injecting live steam that shall be capable of raising the temperature of water at an 8-inch level from 100° to 140° F in less than 2 minutes.

4.5.3.2.2 Wash wheel equipment. The wash wheel shall be equipped with a thermo-meter or other equivalent equipment for determining the temperature of the water during the washing and rinsing procedures, and with an outside water gage that will indicate the level of the water in the wheel.

4.5.3.2.3 Preheating tank or other device. A preheating device to supply water in quantity within $\pm 4^{\circ}$ F.

4.5.3.2.4 Extractor (see 6.12). A centrifugal extractor of the laundry type with a perforated basket, approximately 11 inches deep by 17 to 20 inches in diameter with an operating speed of approximately 1500-1725 revolutions per minute.

4.5.3.2.5 Drier (see 6.11). A drier of the rotary, tumble type having a cylindrical basket approximately 36 inches in diameter and 24 inches in length and rotating at 35 ± 2 revolutions per minute. The drier shall be capable of maintaining a stack temperature within $\pm 5^{\circ}$ F of the specified test temperature. The stack temperature shall be measured 20 ± 2 inches from the exhaust opening of the drier.

4.5.3.2.6 Stamping device (see 6.14). A device capable of marking off an 18 inch distance with fine indelible ink lines.

4.5.3.2.7 Measuring device (see 6.14). An 18-inch plastic ruler or 18-inch metal tape, graduated to give percent change directly in 0.2 percent increments and read to the nearest 0.1 percent. (Based on an original 18-inch marking.)

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4.5.3.2.8 Balance. Balance or scale capable of weighing the specimen to an accuracy of ± 0.01 g.

4.5.3.3 Reagents.

4.5.3.3.1 Synthetic detergent (see 6.13). Synthetic detergent shall conform to MIL-D-43362.

4.5.3.3.2 Sour. Sour shall conform to type I of P-S-683.

4.5.3.3.3 Water of not over 50 parts per million hardness.

4.5.3.4 Procedure.

4.5.3.4.1 Preparation of cloth. Prior to initial markings for determining dimensional stability and prior to determining the change after laundering, the cloth shall be brought to equilibrium under standard atmospheric conditions as defined in section 4 of FED-STD-191. (A minimum of 4 hours is required.) A flat, open mesh screen rack is recommended for this purpose.

4.5.3.4.2 Preparation of specimen for dimensional stability.

4.5.3.4.2.1 Selection of specimens. The three specimens shall be cut from the cloth (sample unit) as follows: One specimen from each side of the cloth to within 3 inches of the selvage and one specimen from the center of the cloth. No two specimens shall contain the same filling yarns. The cloth edges shall be slit by 1 inch diagonal cuts at intervals of about 6 inches on all four sides of the test specimen. The specimens shall be laid without tension on a flat surface, care being taken that the cloth is free from wrinkles or creases. Three distances, each 18 inches apart shall be measured and marked off parallel to each of the warp and filling directions of the specimen. The distance shall be a minimum of 6 inches apart and 2 inches from any edge of the specimen. The distance should be marked with indelible ink by a stamping device. The measured distance shall be parallel to the respective yarns.

4.5.3.4.2.2 Standard load. A standard load comprising the specimens under test and clean ballast of comparable size, weight, and type of cloth shall be utilized. A total weight of 20 pounds consisting of specimens and ballast shall be used for the test.

4.5.3.4.2.3 Laundering procedure. Water of not over 50 parts per million hardness at the required temperature $\pm 4^{\circ}\text{F}$ shall be introduced into the wash wheel to the designated level. The schedule of table VI shall be followed. At the end of each time interval, the machine shall be stopped, drained without removing the load, and refilled to the proper level before starting again. The wheel shall be in motion a total of 22 minutes during the period of testing.

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TABLE VI. Laundering schedule

Operation	Composition	Water volume gallons	Water level inches <u>1</u> /	Temperature °F	Time (minutes)
1. Suds	Synthetic detergent (13 g)	14.3	6	100	5
2. Suds	Synthetic detergent (7 g)	9.3	4	140	5
3. Rinse		20.5	8	140	3
4. Rinse		20.5	8	120	3
5. Rinse	Sour (24 g)	20.5	8	100	3
6. Rinse		20.5	8	100	<u>3</u> 22

1/ The water levels are based on a machine with an inside diameter of 28-1/2 inches and an inside length of 23-1/2 inches and may have to be adjusted to give the specific volumes.

4.5.3.4.2.4 Drying, procedure. After laundering, the standard load shall be extracted in two equivalent portions, a minimum of 3 minutes each. The specimens shall be separated, opened to full width and dried together with the ballast at $190^{\circ} \pm 5^{\circ}\text{F}$ for 60 minutes in a rotating tumble drier.

4.5.3.5 Evaluation.

4.5.3.5.1 Evaluation of cloth for dimensional stability. Immediately after tumble drying, each specimen shall be laid out, without tension or pressing, on a flat surface in the standard atmosphere until moisture equilibrium is reached. (A minimum of 4 hours is required.) Care shall be taken that the specimen is smooth and free from wrinkles or creases. The previously measured distance marked on the specimen shall again be measured in both the warp and filling direction using the measuring device specified in 4.5.3.2.7.

4.5.3.5.2 Calculation of results. The dimensional stability of the specimens shall be calculated as follows:

Shrinkage, percent =

Average of percent measurements after laundering (three specimens)

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4.5.3.6 Report of test results.4.5.3.6.1 Dimensional stability.

4.5.3.6.2 Shrinkage. The shrinkage of the sample unit in the warp direction and in the filling direction shall be the average of three specimens tested from each direction, respectively, and shall be reported separately to the nearest 0.1 percent.

4.5.3.6.3 Elongation. When a test result registers elongation rather than shrinkage, each elongation result shall be prefixed with a minus sign with both the minus sign and the value inclosed in parenthesis.

4.5.4 Permethrin content analysis. The permethrin content of treated fabric shall be determined by a gas chromatographic procedure and directly compared to an external standard containing a known permethrin content.

4.5.4.1 Apparatus.

4.5.4.1.1 Gas chromatograph. The gas chromatograph shall be equipped with an electron capture detector.

4.5.4.1.1.1 Gas tank. The gas tank shall contain an Argon/Methane (95 percent/5 percent) mixture and be equipped with an appropriate gas regulator.

4.5.4.1.1.2 Glass column. The glass column shall be 6 feet by 1/8 inch inside diameter (I.D.).

4.5.4.1.1.3 Column packing. The packing shall be 3.0 percent OV-225 on 10/120 mesh Gas Chrom Q (or equivalent).

4.5.4.1.1.4 GC septa.

4.5.4.1.2 10 microliter syringe.

4.5.4.1.3 Analytical balance.

4.5.4.1.4 Electrical heater with variable control.

4.5.4.1.5 Heat resistant glass flask. The glass flask shall be a 250 mL, flat bottom, single neck, heat resistant glass flask.

4.5.4.1.6 Soxhlet extractor.

4.5.4.1.7 Extractor condenser.

4.5.4.1.8 50 mL volumetric flask.

4.5.4.1.9 Graduated cylinder.

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4.5.4.1.10 Funnel.4.5.4.1.11 Pipettes.4.5.4.1.12 Boiling chips.4.5.4.2 Reagents.

4.5.4.2.1 Permethrin. The permethrin shall consist of 40 percent Technical, a minimum of 35 percent (\pm) cis and a maximum 65 percent (\pm) trans.

4.5.4.2.2 Mixture. The mixture shall be of 80 percent 190 UV cutoff reagent grade acetonitrile and 20 percent reagent grade methanol.

4.5.4.3 Preparation.

4.5.4.3.1 Stock solution. Prepare a stock solution by weighing 1.250 g permethrin solution (see 4.5.4.2.1) to the nearest 1 mg into a 100 mL volumetric flask and dilute to volume with acetonitrile/methanol (80/20) (see 4.5.4.2.2). The stock solution shall then contain 500 mg permethrin.

4.5.4.3.2 Standard preparation. Place 1 mL of the stock solution into a 50 mL volumetric flask and dilute to volume with acetonitrile/methanol (80/20) (see 4.5.4.2.2). Two microliters of this standard shall then contain 200 ng permethrin. This amount is within the linear portion of the permethrin concentration x peak area standard curve performed under the gas chromatographic procedure described in 4.5.4.3.3 (the curve is linear from 0 - 400 ng permethrin).

4.5.4.3.3 Standard injection. Inject 2 microliters of the standard solution into a gas chromatograph equipped with an electron capture detector. Use carrier gas containing 95 percent argon, 5 percent methane and a 6-foot by 1/8 inch I.D. glass column packed with 3 percent OV-225 on 100/120 mesh Gas Chrom Q or equivalent. Use the following gas chromatograph settings in the analysis:

- a. Oven temperature - 245°C
- b. Injector temperature - 255°C
- c. Detector temperature - 275°C
- d. Injection volume - 2 microliters
- e. Carrier gas flow rate - 50 mL/minute
- f. Run time - 100 minutes

Repeat the standard injection three times and determine the average area for permethrin.

4.5.4.3.4 Test specimen. Three specimens, (3 inches x 4 inches (77.4 cm²)) shall be cut from the permethrin treated material.

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4.5.4.3.5 Number of determinations. Unless otherwise specified in the procurement document, three specimens for each sample unit shall be tested.

4.5.4.4 Test procedure. Place each specimen into a Soxhlet extraction thimble. Add 160 mL of acetonitrile/methanol mixture and several boiling chips into a 250 mL heat resistant flask. Assemble the Soxhlet extraction apparatus and extract the permethrin impregnated specimens for 6 hours. After 6 hours of extraction, concentrate the extract by heating in an electric heater to 50 mL in a volumetric flask. Inject 2 uL of the extract into a gas chromatograph using the conditions outlined in 4.5.4.3.3.

4.5.4.5 Calculations. The mg permethrin/cm² shall be calculated from the peak area of the gas chromatographic curve as follows:

$$\text{mg Permethrin/cm}^2 = \frac{W_S \times A_t \times V_E}{V_S \times A_S \times A_m}$$

Where: W_S = weight of injected standard in mg
 A_t = peak area of test specimen
 V_E = volume of specimen extract in uL
 V_S = volume of injected test specimen in uL
 A_S = peak area of standard
 A_m = test specimen area in cm²

4.5.4.6 Report. The mg permethrin/cm² shall be reported as the mean of the values obtained for the sample and reported to the nearest 0.001 mg. The individual values of each specimen used to calculate the mean shall be reported to the nearest 0.001 mg.

NOTE: The conditions described in this method are optimum for the gas chromatograph employed. These conditions may vary depending on the gas chromatograph used.

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.

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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 class 3 cloth is intended for use in both the Daytime and Nighttime Desert Camouflage Uniforms. Class 3 cloth is a replacement for both class 1 and class 2 cloths. Class 3A cloth is the replacement for class 1A cloth and is intended for use in both Daytime and Nighttime Desert Camouflage Uniforms which require a water repellent treatment. Class 3B cloth is intended for use in both Daytime and Nighttime Desert Camouflage Uniforms which require an insect repellent treatment.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Class of cloth 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. Pattern drawing if required (see 3.5).
- f. Width of cloth required (see 3.7.2).
- g. Length required, if other than specified (see 3.12).
- h. Selection of applicable levels of preservation and packing (see 5.1 and 5.2).

6.3 First article. When a first article sample is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209-4. 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 all acquisition instruments regarding arrangements for selection, inspection, and approval of the first article.

6.4 Samples. For access to samples, address the contracting activity issuing the invitation for bids or request for proposal.

6.5 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.

6.6 Dye combinations.

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6.6.1 Dye combination, classes 1 and 1A. The areas of the pattern have been found to be satisfactory when dyed or 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

6.6.2 Dye combination, classes 3, 3A and 3B. 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

Vat Green 8
Vat Green 8 * similar
Vat Brown 1
Vat Black 25
Vat Orange 1
Vat Yellow 2

Light Tan 492

Vat Green 8
Vat Green 8 * similar
Vat Brown 1
Vat Black 25
Vat Brown 57
Vat Yellow 2

Light Brown 493

Vat Green 8
Vat Green 8 * similar
Vat Brown 1
Vat Black 25
Vat Brown 57
Vat Yellow 2

Light Khaki 494

Vat Green 8
Vat Green 8 * similar
Vat Brown 1
Vat Black 25
Vat Yellow 2

6.7 White standard. Barium sulfate of suitable quality for use as a white reference standard is available from the Eastman Kodak Company. The same

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source has available, magnesium reagent (ribbon) and Halon. Suitable tiles can be obtained from the National Institute of Standards and Technology or the instrument manufacturers.

6.8 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 D-54P-IR, Applied Color Systems Spectro Sensor I and II and CS-5, Hunter VIS/NIR Spectrocolorimeter and Macbeth 1500 with IR options.

6.9 Supersession data. The class 2 Grid pattern print for desert night parka has been deleted since it is no longer required.

6.10 Heat setting. The contractors are cautioned to ensure that the cloth prior to printing has been properly heat set in order that the final dimensions of the pattern will be within the limits set forth in 3.5.

6.11 Wash wheel and drier. The wash wheel and drier as described may be obtained from Ewing Division of Powercom, P. O. Box 454, Troy, NY 12181.

6.12 Extractor. The extractor may be obtained from Ewing Division of Powercom, P.O. Box 454, Troy, NY 12181, American Laundry Machinery Company, 5050 Section Avenue, Cincinnati, OH 45212, Bock Co., 3600 Summit Street, Toledo, OH 43611, Troy Machinery, East Moline, IL 61244, and Pellerin Milnor Corporation, Kenner, LA 70062.

6.13 Detergent. Synthetic Laundering Detergent (under the name of Igepon T-77) may be obtained from GAF Corporation, Dyestuff and Chemical Division, 140 West 51st Street, New York, NY 10020.

6.14 Measuring device, stamping device, and ink. The measuring device, stamping device and indelible ink may be obtained from the Sanforized Co., 433 River Street, Troy, NY 12180.

6.15 Quarapel water repellent (classes 1A and 3A). The "Quarapel type" water repellent treatment consists of the co-application of an emulsified fluorocarbon and a fluorocarbon extender. Approval of components and combinations is the responsibility of U.S. Army Natick Research, Development, and Engineering Center, Natick, MA 01760-5019 and is based on extensive tests, including those for toxicity which are not set forth in this specification. Because of the time necessary to conduct full evaluation (approximately 6 months) 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.

6.16 Air permeability. Not all untreated cloth meeting the air permeability requirement for classes 1 and 3 will, after quarapel treatment, be capable of meeting classes 1A and 3A air permeability requirements.

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6.17 Subject term (key word) listing.

Clothing
Desert
Insect repellent, treated
Permethrin
Printed cloth
Quarrel
Water repellent treated

6.18 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 - 11

Preparing activity:

Army - GL
(Project 8305-0448)

Review activities:

Army - MD
Navy - MC
Air Force - 82, 99
DLA - CT

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

1. RECOMMEND A CHANGE:		1. DOCUMENT NUMBER MIL-C-44034D	2. DOCUMENT DATE (YYMMDD) 1992 March 31
3. DOCUMENT TITLE CLOTH, TWILL, CAMOUFLAGE PATTERN, COTTON AND NYLON FOR DESERT UNIFORM			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME (Last, First, Middle initial)		b. ORGANIZATION	
c. ADDRESS (Include Zip Code)		d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY			
a. NAME U.S. Army Natick RD&E Center		b. TELEPHONE (Include Area Code) (1) Commercial 508-651-4532	(2) AUTOVON/DSN 256-4532
c. ADDRESS (Include Zip Code) Commander, U.S. Army Natick RD&E Center ATTN: STRNC-IRT Natick, MA 01760-5019		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	