INCH-POUND

MIL-DTL-44436A
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SUPERSEDING
MIL-C-44436(GL)
13 July 1992

DETAIL SPECIFICATION

CLOTH, CAMOUFLAGE PATTERN, WIND RESISTANT POPLIN, NYLON/COTTON BLEND

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 poplin nylon/cotton cloth, dyed and overprinted with the specified camouflage pattern.

1.2 Classification. (see 6.2).

Class 1 – Woodland Camouflage Printed
Class 2 – Woodland Camouflage Printed, Water Repellent Treated (Quarpel Type)
Class 3 – Desert Camouflage Printed
Class 4 – Desert Camouflage Printed, Permethrin Treated
Class 5 – Black 357
Class 6 – Universal Camouflage Printed
Class 7 – Universal Camouflage Printed, Water Repellent Treated (Quarpel Type)
Class 8 – Universal Camouflage Printed, Wrinkle Free Finish

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has

Comments, suggestions, or questions on this document should be addressed to: Defense Supply Center Philadelphia, Clothing and Textiles Directorate, Attn: DSCP-COET (Bldg 6), 700 Robbins Avenue, Philadelphia, PA 19111-5092 or emailed to: trina.gooding@dla.mil. Since contact information can change, you may want to verify the currency of this address information using Acquisition Streamlining and Standardization Information System (ASSIST) online database at http://assist.daps.dla.mil .

been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 or 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 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 cited in the solicitation or contract (see 6.2).

FEDERAL STANDARDS

FED-STD-4 - Glossary of Fabric Imperfections

COMMERCIAL ITEM DESCRIPTIONS

A-A-50199 - Thread, Polyester-Core, Cotton- or Polyester-Covered

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-44411 - Insect Repellent, Permethrin

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 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 or contract.

DRAWINGS

U.S. ARMY RESEARCH, DEVELOPMENT, AND ENGINEERING COMMAND

2-1-1516 - Woodland Camouflage Pattern
2-1-2240 - Desert Camouflage Pattern
2-1-2519 - Universal Camouflage Pattern

(Copies of drawings are available from the Natick Soldier Center, ATTN: AMSRD-NSC-IP-E, Natick, MA 01760-5019.)

FEDERAL TRADE COMMISSION

Rules and Regulations Under the Textile Fiber Products Identification Act

(Copies are available online at www.ftc.gov or from the Federal Trade Commission, 600 Pennsylvania Avenue, N.W., Washington, DC 20580-0001.)

CODE OF FEDERAL REGULATIONS (CFR)

40 CFR 152 - Pesticide Registration and Classification Procedures

(Copies are available online at www.access.gpo.gov or from Superintendent of Documents, P.O. Box 371954, Pittsburgh, PA 15250-7954.)

ENVIRONMENTAL PROTECTION AGENCY

Regulations for the Enforcement of the Federal Insecticide, Fungicide and Rodenticide Act (40 CFR Part 162)

(Copies are available online at www.epa.gov/pesticides or from the Environmental Protection Agency, 1200 Pennsylvania Avenue, N.W., Washington, DC 20460)

(Copies of documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting activity.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract (see 6.2).

AMERICAN SOCIETY FOR QUALITY

ANSI/ASQ Z1.4 - Sampling Procedures and Tables for Inspection of Attributes

(Copies are available online at http://www.asq.org or from the American Society for Quality, 600 Plankinton Avenue, Milwaukee, WI 53203.)

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC - 8	-	Colorfastness to Crocking: AATCC Crockmeter Method
AATCC – 15	-	Colorfastness to Perspiration
AATCC – 16	-	Colorfastness to Light
AATCC - 20	-	Fiber Analysis: Qualitative
AATCC - 20A	-	Fiber Analysis: Quantitative
AATCC - 22	-	Water Repellency: Spray Test
AATCC - 61	-	Colorfastness to Laundering, Home and Commercial: Accelerated
AATCC - 70	-	Water Repellency: Tumble Jar Dynamic Absorption Test
AATCC - 81	-	pH of the Water-Extract from Bleached Textiles
AATCC – 96	-	Dimensional Changes in Commercial Laundering of Woven and Knitted Fabrics Except Wool
AATCC - 118	-	Oil Repellency: Hydrocarbon Resistance Test

AATCC - 143 - Fabric Appearance/smoothness
AATCC 3-D Smoothness Appearance Replicas
AATCC Evaluation Procedure 1, Gray Scale for Color Change

AATCC Evaluation Procedure 2, Gray Scale for Staining
AATCC Evaluation Procedure 8, AATCC 9-Step Chromatic Transference Scale
AATCC Evaluation Procedure 9, Visual Assessment of Color Difference of Textiles

(Copies of documents are available on line at www.aatcc.org or from 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)

ASTM-D-276 - Identification of Fibers in Textiles
ASTM-D-629 - Quantitative Analysis of Textiles
ASTM-D-737 - Air Permeability of Textile Fabrics
ASTM-D-1424 - Tear Resistance of Woven Fabrics by Falling-Pendulum Type (Elmendorf) Apparatus
ASTM-D-3775 - Fabric Count of Woven Fabric
ASTM-D-3776 - Mass per Unit Area (Weight) of Fabric, Option C
ASTM-D-5034 - Breaking Force and Elongation of Textile Fabrics (Grab Test) G-E or GT
ASTM-D-6193 - Standard Practice for Stitches and Seams

(Copies of documents are available online at www.astm.org or from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19426-2959.)

Principle and Methods of Toxicology, A Wallace Hayes (editor), pp 394-396, 1989.

(Copies of this document is available from Raven Press, 1185 Avenue of the Americas, New York, NY 10036)

Marzulli, F. and H. Maibach, “Contact Allergy: Predictive Testing in Humans,” Advances in Modern Toxicology, Volume 4, pp 353-372, 1977.

(Copies of this document are available from the U.S. Army Center for Health Promotion and Preventative Medicine, ATTN: MCHB-DC-TTE, Bldg., E-2100, Aberdeen Proving Ground, MD 21010-5422.)

2.4 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 4.2).

3.2 Standard sample. The finished cloth shall match the standard sample for shade and appearance, and shall, unless otherwise indicated, be equal to or better than the standard sample with respect to all characteristics for which the standard sample is referenced (see 6.3).

3.3 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

3.3.1 Cotton. The cotton shall be carded and combed.

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 1.6 to 1.8. 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 Yarn. The warp and filling yarn shall be made from a blend of 50 $\pm$ 5 percent nylon with the remaining percentage cotton based on the dry weight of the desized cloth. The warp yarn shall be 2-ply and the filling yarn shall be 2-ply or singles.

3.4 Color.

3.4.1 Class 1 and 2, Woodland Camouflage. The cloth shall be dyed to a ground shade either matching or approximating Light Green 354 and then overprinting with the camouflage pattern by roller or screen printing. When the ground shade is dyed to match Light Green 354, the remaining colors shall be obtained by subsequent printing using three rollers or screens, as appropriate for the Dark Green 355, Brown 356, and Black 357 areas of the pattern. When the ground shade is dyed to approximate Light Green 354, all four colors of the camouflage pattern shall be obtained by subsequent printing using four rollers or screens to match all four colors (see 6.5). Resin bonded pigments are not permitted.

3.4.1.1 Class 3 and 4, Desert Camouflage. The cloth shall be dyed to a ground shade either matching or approximating Light Tan 492 and then overprinting with the camouflage pattern by roller or screen printing. When the ground shade is dyed to match Light Tan 492, the 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 (see 6.5). Resin bonded pigments are not permitted.

3.4.1.2 Class 5, Black 357. The cloth shall be dyed to a ground shade approximating

Black 357. Resin bonded pigments are not permitted.

3.4.1.3 Class 6, 7 and 8, Universal Camouflage. The cloth shall be dyed to a ground shade either matching or approximating Desert Sand 500 and then overprinting with the camouflage pattern by roller or screen printing. When the ground shade is dyed to match Desert Sand 500, the remaining colors shall be obtained by subsequent printing using two rollers or screens, as appropriate for the Urban Gray 501 and Foliage Green 502 areas of the pattern. When the

ground shade is dyed to approximate Desert Sand 500 all three colors of the camouflage pattern shall be obtained by subsequent printing using three rollers or screens to match all three colors (see 6.5). Resin bonded pigments are not permitted.

3.4.2 Labile sulfur. When dyes and compounds containing elementary sulfur capable of oxidation to sulfuric acid are used, they shall be chosen and applied so that the dyed cloth shall contain no more than a rating of "slight" or better for labile sulfur. Testing shall be as specified in 4.4.3.

3.4.3 Visual shade matching (all classes). The color and appearance of the camouflage printed cloth shall match the standard sample when viewed using the AATCC Evaluation Procedure 9, Option A, under filtered tungsten lamps that approximate artificial daylight D75 illuminant with a color temperature of 7500 ± 200 K illumination of 100 ± 20 foot candles, and shall be a good match to the standard sample under horizon lamplight at 2300 ± 200 K.

3.4.4 Colorfastness (all classes). The finished cloth shall conform to the colorfastness requirements listed below in Table I when tested as specified in 4.4.3 and 4.5.1.

TABLE I. Colorfastness requirements (all classes).

Colors Evaluation	Laundering (4 cycles) 1/ (min.)	Light (40 hrs or 170 KJ) 2/ (min.)	Perspiration (acid & alka-line) 1/ (min.)	Crocking 3/ (min.)
All colors			3-4	
All colors except Black 357	3-4			3.5
Black 357	3.0			1.0
Dk. Green 355, Brown 356, Black 357		3-4		
Lt. Green 354, Lt. Tan 492, Lt. Khaki 494, Desert Sand 500, Urban Gray 501, Foliage Green 502		3		

1/ Rated using the AATCC Gray Scale for Color Change and AATCC Gray Scale for Staining.
2/ Rated using the AATCC Gray Scale for Color Change
3/ Rated using the AATCC 9-Step Chromatic Transference Scale

3.5 Pattern execution (all classes except 5). The pattern on the printed finished cloth(s) shall reproduce the standard sample in respect to design, colors and registration of the respective areas. The pattern repeat of Class 1 and 2 shall be 27.25 (+1.25, -2.50) inches in the warp direction. The pattern repeat of Class 3 and 4 shall be 16.75 (+1.25, -1.75) inches in the warp direction. The pattern repeat of Class 6, 7 and 8 shall be 36.00 (+1.25, –2.50) inches in the warp direction. The various areas of the pattern shall be properly registered in relation to each other and shall present definite sharp demarcations with a minimum of feathering or spew. Each pattern area shall show solid coverage; skitteriness exceeding that shown on 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 for Class 1 and 2 shall match that of Drawing 2-1-1516; Class 3 and 4 shall match that of Drawing 2-1-2240 and Class 6, 7 and 8 shall match that of Drawing 2-1-2519 (see 2.2.2, 6.2, and 6.3).

3.6 Spectral reflectance.

3.6.1 Class 1 and 2, Woodland Camouflage. The reflectance values shall conform to the requirements listed below, in Table II, when tested as specified in 4.4.3.

TABLE II. Spectral reflectance requirements, Class 1 and 2

Reflectance values (percent)						
Wavelength, Nanometers (nm)	Light Green 354		Dark Green 355 and Brown 356		Black 357	
	Min.	Max.	Min.	Max.	Min.	Max.
600	8	18	3	9	-	10
620	8	18	3	9	-	10
640	8	18	3	9	-	10
660	8	18	3	12	-	10
680	10	22	3	14	-	10
700	18	33	5	18	-	10
720	22	45	7	20	-	10
740	30	55	12	28	-	10
760	35	65	18	36	-	10
780	40	75	26	44	-	10
800	45	80	34	52	-	10
820	50	86	42	60	-	10
840	55	88	50	68	-	10
860	60	90	56	74	-	10

3.6.2 Class 3 and 4, Desert Camouflage. The reflectance values shall conform to the requirements listed below, in Table III, when tested as specified in 4.4.3.

TABLE III. Spectral reflectance requirements, Class 3 and 4

Reflectance values (percent)						
Wavelength, Nanometers (nm)	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

3.6.3 Class 5, Black 357. The reflectance values shall conform to the requirements listed below, in Table IV, when tested as specified in 4.4.3.

TABLE IV. Spectral reflectance requirements, Class 5

Wavelength, Nanometers (nm)	Black 357	
	Min.	Max.
600	2	10
620	2	10
640	2	11
660	2	13
680	2	15
700	4	20
720	9	30
740	14	40
760	18	49
780	23	55
800	29	60
820	34	64
840	39	69
860	45	75

3.6.4 Class 6, 7 and 8, Universal Camouflage. The reflectance values shall conform to the requirements listed below, in Table V, when tested as specified in 4.4.3.

TABLE V. Spectral reflectance requirements, Class 6, 7 and 8

Reflectance values (percent)						
Wavelength, Nanometers (nm)	Desert Sand 500 Min.	Max.	Urban Gray 501 Min.	Max.	Foliage Green 502 Min.	Max.
600	28	40	12	26	8	18
620	30	42	14	26	8	18
640	34	48	14	28	8	20
660	38	56	14	30	10	26
680	44	60	18	34	10	26
700	46	66	24	38	12	28
720	48	68	26	42	16	30
740	48	72	30	46	16	30
760	50	74	32	48	18	32
780	54	76	34	48	18	34
800	54	76	34	50	20	36
820	54	76	36	54	22	38
840	56	78	38	54	24	40
860	56	78	40	56	26	42

3.7 Physical requirements. The finished cloth shall conform to the requirements, listed below, in Table VI, when tested as specified in 4.4.3.

TABLE VI. Physical requirements

Characteristic	Class 1, 3, 4, 5 & 6	Class 2 & 7	Class 8
Weight, oz./sq.yd.			
Minimum	6.0	6.0	6.0
Maximum	7.0	7.0	7.0
Yarns per inch, (minimum)			
Warp	104	104	104
Filling	52	52	52
Breaking strength (pounds), minimum			
Warp	200	200	190
Filling	90	90	80
Tearing strength (pounds), minimum			
Warp	7.0	7.0	7.0
Filling	5.0	5.0	5.0
Air permeability, (3/min./ft.),	15.0	10.0	10.0
Fabric Appearance/Smoothness			
Initial	----	----	5
After 20 launderings	----	----	4.5

3.7.1 Weave. The weave shall be a plain weave with reinforcement ribs in both the warp and filling directions forming a uniform pattern. The ribs shall be formed by having every twenty-forth warp end contain two ends weaving as one and every thirteenth filling contain two picks weaving as one. Testing shall be as specified in 4.4.3.

3.7.2 Width. For government procurements only, the width of the finished cloth shall be as specified (see 6.2) and shall be the minimum acceptable width inclusive of the selvage.

3.8 Finish. The Class 2 and 7 cloth shall be given a water repellent treatment as specified in 3.8.1 and the class 4 cloth shall be given an insect repellent treatment as specified in 3.8.2. The Class 8 cloth shall be given a wrinkle free finish as specified in 3.8.3.

3.8.1 Water repellency (Class 2 and 7). The Class 2 and 7 shall be given a fluorocarbon (Quarpel Type) water repellent treatment. Testing shall be as specified in 4.4.3.

TABLE VII. Water repellency (Class 2 and 7)

	Dynamic absorption (percent)		
	Max. lot avg.	Max. 1/	Spray rating 2/
Initial	25	30	90, 90, 80
After 15 launderings	25	30	----

1/ No individual specimen shall exceed the specified maximum.
2/ The results of the three individual determinations on the sample unit for spray rating shall be equal to or better than the specified ratings when tested as specified in 4.4.3.

3.8.2 Insect repellency (Class 4). The Class 4 cloth shall be given a permethrin insect repellent treatment in accordance with the Type II industrial fabric application method specified in MIL-DTL-44411 or other EPA approved method. 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.

3.8.3 Wrinkle free finish (Class 8). The Class 8 cloth shall be given a wrinkle free finish treatment to match the “hand” crispness, fabric appearance and smoothness of the guide sample provided.

3.8.4 pH. The pH of the water extract of the finished cloth shall be not lower than 5.0 or higher than 8.5 when tested as specified in 4.4.3.

3.8.5 Resistance to organic liquid. The Class 2 and 7finished cloth shall show no wetting by n-tetradecane, initially and after 15 laundering when tested as specified in 4.4.3.

3.9 Dimensional stability. The shrinkage or elongation both in the warp and filling of the finished cloth shall be not 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.

3.10 Seam efficiency. The finished cloth shall have a seam efficiency of not less than 80 percent when tested as specified in 4.4.3.

3.11 Length and put-up. For Government procurements only, 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 full width on a roll as specified in 5.1.

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

3.13 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 applicable established maximum point values.

3.14 Toxicity. The finished fabric shall not present a health hazard when used as intended and tested as specified in 4.4.3.

4. VERIFICATION

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

a. First article inspection (see 4.2).
b. Conformance inspection (see 4.3).

4.2 First article inspection. A first article, submitted in accordance with 3.1, shall be inspected, examined for appearance, color and finished defects and tested for the characteristics as specified in Table VIII.

4.3 Conformance inspection. Conformance inspection shall include the examination of 4.4 and the tests of 4.4.2 through 4.5.3 as applicable. Sampling for inspection shall be performed in accordance with ANSI/ASQ Z1.4 and with quality acceptance levels as specified in the contract and/or order, except where otherwise indicated.

4.3.1 Material inspection. In accordance with 4.1 above, the material shall be inspected in accordance with all the requirements of referenced documents, unless otherwise excluded, amended, modified or qualified in this specification or applicable procurement documents.

4.4 Examination. Each roll in the sample shall be examined yard-by-yard on the printed 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, that are clearly noticeable at normal inspection distance (3 feet) shall be scored and assigned demerit points as listed in 4.4.1 except that only those slubs and knots which exceed the limits shown on the Sears Fabric Defect Scale (see 6.6), "D" or "3-1/2" as applicable for slubs and "C" for knots, shall be scored and coarse yarn shall only be scored as a defect when the coarse yarn is twice the diameter of the normal yarn used in the fabric. No linear yard (increments of 1 yard on the measuring device of

the inspection machine) from any one roll 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 examined exceeds 30.0 points. The lot shall be unacceptable if the points per 100 square yards of two or more individual rolls exceeds 45.0 points. If one roll in the sample exceeds 45.0 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:

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

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

For defects up to 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
Baggy, ridgy, or wavy cloth
Overall uncleanness
Uneven weaving throughout
Pattern design not equal to the standard sample
Incorrect color in any part of the pattern
Pattern repeat not equal to the standard sample
Pattern repeat less than 24.75 inches or more than 28.50 inches (Class 1 and 2)
Pattern repeat less than 14.50 inches or more than 18.00 inches (Class 3 and 4)
Pattern repeat less than 33.50 inches or more than 37.25 inches (Class 6, 7 and 8)
Skitteriness (mottled, uneven color) of pattern exceeds that shown by the 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

4.4.2 Toxicity test. The contractor must furnish information, which certifies that the finished product is composed of materials, which have been safely used commercially or provide sufficient toxicity data to show compatibility with prolonged, direct skin contact. At a minimum,

toxicity data should include results from a primary dermal irritation study in laboratory animals and a repeated insult human patch test (Modified Draize Procedure). The latter must be conducted under the supervision of a qualified dermatologist using at least 100 free-living individuals.

4.4.2.1 Toxicity documents. All finishes/chemicals used to process the garment shall be identified and accompanied by the appropriate Material Safety Data Sheet (MSDS) information. The use of chemicals recognized by the Environmental Protection Agency (EPD) as human carcinogens is prohibited.

4.4.3 End item testing. The cloth shall be tested for the characteristics listed in Table VIII. The methods of testing as specified wherever applicable and as listed in Table VIII shall be followed. All test reports shall contain the individual values utilized in expressing the final results. The sample unit shall be 5 continuous yards full width of the finished cloth for all physical and chemical tests. 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 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 VIII. End item tests

Characteristic	Requirement paragraph	Test method
Material		
Cotton:		
Identification	3.3.1	AATCC-20 or ASTM-D-276 1/ 2/
Combed cotton	3.3.1	1/

TABLE VIII. End item tests - Continued

Characteristic	Requirement paragraph	Test method
Nylon:		
Identification	3.3.2	AATCC-20 or ASTM-D-276 1/ 2/
Luster	3.3.2	1/
Denier	3.3.2	1/
Absence of nylon waste	3.3.2	1/
Fiber content:		
Cotton content	3.3.3	AATCC-20A or ASTM-D-629 1/ 2/ 3/
Nylon content	3.3.3	AATCC-20A or ASTM-D-629 1/ 2/
Yarn Ply	3.3.3	Visual 4/

Presence of labile sulfur	3.4.2	1/
Visual shade matching	3.4.3	AATCC Evaluation Procedure 9,Option A
Colorfastness:		
Light (after 40 hrs or 170 kilojoules)	3.4.4	AATCC-16 Opt 1 or 3
Laundering (after 4 cycles)	3.4.4	AATCC-61 Test 3A 5/
Crocking	3.4.4	AATCC-8
Perspiration (acid & alkaline)	3.4.4	AATCC-15
Spectral reflectance:		
Class 1 and 2	3.6.1	4.5.2
Class 3 and 4	3.6.2	4.5.2
Class 5	3.6.3	4.5.2
Class 6, 7 and 8	3.6.4	4.5.2
Weight	3.7	ASTM-D-3776
Breaking Strength	3.7	ASTM-D-5034
Tearing strength	3.7	ASTM-D-1424
Yarns per Inch	3.7	ASTM-D-3775
Air Permeability	3.7	ASTM-D-737
Weave	3.7.1	Visual 1/
Water repellent treatment (Class 2 & 7) 6/:		
Dynamic absorption:		
Initial	3.8.1	AATCC-70
After 15 launderings	3.8.1	AATCC-96 VIc 7/ and AATCC-70
Spray rating:		
Initial	3.8.1	AATCC-22
Insect repellency (Class 4)	3.8.2	4.5.3
Fabric Appearance/Smoothness:		
Initial	3.8.3	AATCC-143
After 20 Launderings	3.8.3	AATCC-143, Table II, 3VAiii
PH	3.8.4	AATCC-81

TABLE VIII. End item tests - Continued

Characteristic	Requirement paragraph	Test method
Resistance to organic liquids (Class 2 & 7):		
Initial	3.8.5	AATCC-118
After 15 launderings	3.8.5	AATCC-96 Vic 7/ and AATCC-118
Dimensional stability	3.9	AATCC 96 VIc 8/
Seam efficiency	3.10	ASTM-5034 9/

1/ Unless otherwise specified, a certificate of compliance shall be submitted and acceptable for the stated requirement (see 6.4).
2/ In case of dispute, the ASTM method prevails.
3/ The cotton content shall be calculated as follows:
Cotton content, percent = R/S x 100
R = Weight of residual fibers
S = Weight of dry desized specimen
4/ One determination shall be made from each sample unit and the result reported as "pass or fail".
5/ Only the stain on the nylon and cotton fibers of the color transfer cloth shall be evaluated and the stain shall be "3-4" or better for all colors, except Black 357 which shall be "3.0" or better.
6/ The contractor shall report the approved water repellent used, and certify that no other material (except the specified buffer and acetic acid) has been added.
7/ Specimens shall be subjected to 15 complete cycles (wash and dry) prior to determinations of dynamic absorption, spray rating and resistance to organic liquid after laundering. The last two (2) wash cycles shall be performed without the addition of detergent.
8/ The dimensional stability shall be performed after 1 cycle. The cloth shall not be pressed after tumble drying prior to measurement.
9/ The needle shall measure 0.040 ± 0.001 inch across the blade at the eye. The thread for all types shall be 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.

4.5 Methods of inspection.

4.5.1 Colorfastness evaluation testing. When testing for colorfastness properties, each color shall be evaluated, whenever possible, separately and reported as such. In cases where the print pattern does not allow for the evaluation of each color separately, the test results should indicated which colors were evaluated together.

4.5.2 Spectral reflectance test. Spectral reflectance data shall be obtained from 600 to 860 nanometers (nm) for Class 1, 2, 5, 6, 7 and 8 and 700 to 860 nm for class 3 and 4 on a spectrophotometer (see 6.5) relative to the barium sulfate standard, the preferred white standard. Other white reference materials may be used provided they are calibrated to absolute white, e.g. magnesium oxide or vitrolite tiles. The spectral band width shall be less than 26 nm at 860 nm. Reflectance measurements shall be made by either the monochromatic or polychromatic mode of operation. When the polychromatic mode of operation is used, the spectrophotometer shall operate with the specimen diffusely illuminated with the full emission of a continuous source that simulates either CIE Source A or CIE Source D65. Measurements shall be taken on a minimum of two (2) different areas and the data averaged. The measured areas should be at least 6 inches away from the selvage. 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 diameter for standard aperture size used in the color measurement device shall be 1.0 to 1.25 inches for Woodland and Desert camouflage and 0.3725 inches or larger for the Universal camouflage. Any color having

spectral reflectance values falling outside the limits at four or more of the wavelengths specified shall be considered a test failure.

4.5.3 Permethrin content analysis (class 4). 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.

4.5.3.1 Apparatus.

4.5.3.1.1 Gas chromatograph. The gas chromatograph shall be equipped with a mass spectrometer detector.

4.5.3.1.1.1 Gas cylinder. The gas cylinder shall contain high purity Helium and be equipped with the appropriate gas regulator.

4.5.3.1.1.2 Capillary column. The capillary column shall be 30 meters in length with an inside diameter of 0.25 mm and a 0.25 µm film thickness of (5%-Phenyl)-methylpolysiloxane or equivalent.

4.5.3.1.1.3 GC septa.

4.5.3.1.2 10 microliter syringe.

4.5.3.1.3 Analytical balance.

4.5.3.1.4 Electrical heater with variable control when using Soxhlet extractor.

4.5.3.1.5 Heat resistant glass flask when using Soxhlet extractor. The glass flask shall be a 250 mL, flat bottom or round bottom, single neck, and heat resistant glass flask.

4.5.3.1.6 Soxhlet extractor or Accelerated Solvent Extractor (ASE) with Liquid Nitrogen, high pressure gas withdrawal.

4.5.3.1.7 Extractor condenser when using Soxhlet extractor.

4.5.3.1.8 100 mL and 1000 mL volumetric flasks.

4.5.3.1.9 Graduated cylinder.

4.5.3.1.10 Funnel.

4.5.3.1.11 Pipettes.

4.5.3.1.12 Boiling chips.

4.5.3.2 Reagents.

4.5.3.2.1 Permethrin. The permethrin shall consist of permethrin, analytical standard, mixture of cis and trans isomers.

4.5.3.2.2 Solvent Mixture. The mixture shall be of 80 percent 190 UV cutoff reagent grade acetonitrile and 20 percent chromatographic grade methanol (volume/volume).

4.5.3.3 Preparation.

4.5.3.3.1 Stock solution. Prepare a stock solution by weighing 0.010g permethrin crystals (see 4.5.3.2.1) to the nearest 1 mg into a 25 mL volumetric flask and dilute to volume with acetonitrile/methanol (80/20) solution (see 4.5.3.2.2). The stock solution shall then contain 10 mg permethrin with a final concentration of 0.4 mg/mL.

4.5.3.3.2 Standard preparation. Place 1 mL of the stock solution into a 100 mL volumetric flask and dilute to volume with acetonitrile/methanol (80/20) (see 4.5.3.2.2). One microliter (µl) of this standard shall then contain 4 nanograms (ng) of 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 4.5.3.3.3 (the curve is linear from 0 – 10 ng permethrin).

4.5.3.3.3 Standard injection. Inject 1 µl of the standard solution into a gas chromatograph equipped with a mass spectrometer. Use the high purity helium (see 4.5.3.1.1.1) carrier gas and the 30 meter capillary column (see 4.5.3.1.1.2). The following gas chromatograph settings shall be used in the analysis:

a. Oven temperature – 250°C
b. Injector temperature – 275°C
c. Detector temperature – 280°C
d. Injection volume – 1 µl
e. Carrier gas flow rate – 1.2 mL/minute
f. Run time – 15 minutes
g. Split ratio 1:1
h. Purge – Off initially, On 0.5 min., flow rate 1.0 mL/min.

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

4.5.3.3.4 Test specimen. Three specimens (1 inch by 3 inches (3 Sq. In. equiv. to 19.35 cm^2) shall be cut from the permethrin treated material. The mass of the specimen shall be recorded to the nearest milligram.

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

4.5.3.4 Test procedure. Place each specimen into a cellulose Soxhlet extraction thimble. Add 160 mL of the acetonitrile/methanol mixture and several boiling chips into a 250 mL heat resistant glass flask. Assemble the Soxhlet extraction apparatus and extract the permethrin impregnated specimens for 6 hours. After 6 hours of extraction, concentrate the extract by rotoevaporation of 35°C to a final volume of less than 10 mL and pour the resulting solution into the 10 mL volumetric flask and fill to volume with the acetonitrile/methanol solution. Inject 1 µl of the extract into the gas chromatograph using the conditions outlined in 4.5.3.3.3.

Accelerated Solvent Extraction (ASE): Place each specimen into a cell and fill the void with glass beads. Label the 60 mL vials and place them below the cell. Use the following method:

Cell size – 22 mL
Gas pressure (constant for any kind of samples):

System – 50 psi	Solvent – 10 psi
Oven compression – 130 psi	
Preheat – 0 min	
Heat – 5 min	Temperature – 100°C
Static – 10 min	Pressure – 1500
Flush volume – 90%	Solvent – Acetronitrile:Methanol (80:20)
Purge – 90 sec	Cycles – 2

After extraction, the samples were diluted or concentrated to 40 mL. Inject 1 µl of the extract into the gas chromatograph using the conditions outlined in 4.5.3.3.3.

4.5.3.5 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
V_s = volume of injected test specimen in µl
A_s = peak area of standard
A_m = test specimen area in cm²

4.5.3.6 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. THE CARRIER GAS FLOW RATE SHALL BE ADJUSTED SO THAT THE ELUTION OF THE FIRST PERMETHRIN ISOMER IS GREATER THAN 5 MINUTES.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of material is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain requisite packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Department or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

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 camouflage pattern or black clothing.

6.2 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.
b. Class of cloth required (see 1.2)
c. ASSIST will be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.2).
d. When first article is required (see 3.1 and 4.2).
e. Woodland, desert or universal camouflage pattern drawing if required (see 3.5).
f. Width of cloth required (see 3.7.2).
g. Length required if other than specified (see 3.11).
h. Packaging (see 5.1).

6.3 Standard sample. For access to samples and pattern drawings, address the contracting activity issuing the invitation for bids or request for proposal.

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

6.5 Dye Combination (all classes). Both colorfastness and infrared spectral reflectance requirements have been satisfactorily met by the use of both acid and vat dyes.

6.6 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.

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

6.8 Subject term (key word) listing.

Clothing
Desert
Insect repellent treated
Permethrin
Printed cloth
Quarpel Type
Water repellent treated
Woodland
Black
Universal

Custodian:

Army – GL

Preparing activity:

DLA – CT

Review activities:

Army – MD

Project No. 8305-0845

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using ASSIST Online database at http://assist.daps.dla.mil .