

MIL-C-44187A  
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SUPERSEDING  
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## MILITARY SPECIFICATION

### CLOTH, LAMINATED, WATERPROOF AND MOISTURE VAPOR PERMEABLE

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

#### 1. SCOPE

1.1 Scope. This document covers a three-layered laminated cloth which is waterproof and moisture vapor permeable.

#### 2. APPLICABLE DOCUMENTS

2.1 Government documents. Unless otherwise specified, the following documents of the issue in effect on date of invitation for bids or request for proposal, form a part of this document to the extent specified herein.

### SPECIFICATIONS

#### FEDERAL

O-I-503	-	Insect Repellent, Clothing and Personal Application
P-D-245	-	Detergent, Laundry and Hand Dishwashing (Granular)
PPP-P-1136	-	Packaging of Coated (Plastic; Rubber) and Laminated Fabrics

#### MILITARY

MIL-C-21852 - Cloth, Taffeta, Nylon

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 and Development Center, Natick, MA 01760-5014, by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 8305

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MIL-C-44187A

STANDARDS

FEDERAL

- FED-STD-101 - Test Procedures for Packaging Materials
- FED-STD-191 - Textile Test Methods

MILITARY

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

DRAWINGS

U.S. ARMY NATICK RESEARCH AND DEVELOPMENT CENTER

- 2-1-1516B - Woodland Pattern - 60 inches.

(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.)

OTHER GOVERNMENT DOCUMENTS

Laws and Regulations

Rules and Regulations Under the Textile Fiber Products Identification Act

(Copies may be obtained without charge from the Federal Trade Commission, Washington, DC 20580.)

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

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 2582 - Puncture Propagation Tear Resistance of Plastic Film and Thin Sheeting

- E96 - Water Vapor Transmission of Materials, Procedure B and BW

MIL-C-44187A

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

(Technical society and technical association documents are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

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 shall take precedence.

### 3. REQUIREMENTS

3.1 Standard sample. The printed laminated cloth shall match the standard sample for shade and appearance and shall be equal to or better than the standard with respect to all characteristics for which the standard sample is referenced (see 6.3).

3.2 First article. When specified, a sample shall be subjected to first article inspection (see 4.3, 6.2, and 6.8).

#### 3.3 Materials.

##### 3.3.1 Base cloths.

3.3.1.1 Plain weave. The plain weave cloth shall be nylon,  $2.8 \pm 0.2$  ounces per square yard, Woodland Pattern Camouflage. The cloth shall be woven with a minimum of 101 ends per inch and 63 two-ply textured picks per inch.

3.3.1.2 Tricot knit. The tricot knit cloth shall be nylon,  $1.5 \pm 0.3$  ounces per square yard, Olive Green 106. The cloth shall be knit on 2 bars using 40 denier multifilament and 15 denier monofilament yarn.

3.3.2 Plastic film. The plastic film shall be microporous polytetrafluoroethylene, weighing  $0.5 \pm 0.2$  ounces per square yard.

3.3.3 Adhesive. The adhesive for laminating the layers together shall be such that the laminated cloth will meet the requirements of this document. The adhesive shall have no adverse health hazard when used as intended.

3.4 Laminated cloth. The cloth specified in 3.3.1.1 shall be laminated to one side of the plastic film specified in 3.3.2 and the cloth specified in 3.3.1.2 shall be laminated to the other side of the plastic film. The face side of the laminated cloth shall be the side with the cloth specified in 3.3.1.1. An approved water repellent finish shall be applied to the face side of the laminated cloth (see 3.5.1 and 6.4). The laminated cloth shall conform to all the requirements of table II.

## MIL-C-44187A

3.4.1 Color. The color of the face side of the laminated cloth shall be Woodland Pattern Camouflage. The color of the back side of the laminated cloth shall be OG 106. Both sides of the fabric shall match the respective sides of the standard sample.

3.4.2 Matching. The color and appearance of the camouflage printed laminated cloth shall match the standard sample when viewed under filtered tungsten lamps which approximate artificial daylight having a correlated color temperature of  $7000 \pm 500$  K with illumination of  $100 \pm 20$  foot candles, and shall be a good match to the standard sample under incandescent lamplight at  $2850 \pm 100$  K.

3.4.3 Colorfastness. The camouflage printed and laminated cloth shall show fastness to light, laundering (after three cycles), perspiration, and crocking equal to or better than the standard sample. When no standard sample has been established or designated as applicable to colorfastness, except for Black 357, the finished cloth shall show "good" fastness to laundering (after three cycles), perspiration, light after 40 hours, and shall show an AATCC Chromatic Transference Scale rating for crocking not less than 3.5. Black 357 shall show "fair" colorfastness to laundering (after three cycles), perspiration, light after 40 hours and shall show an AATCC Chromatic Transference Scale rating for crocking not less than 1.5.

3.4.4 Pattern execution. The pattern shall reproduce the standard sample in respect to design, colors and registration of the respective areas. The pattern repeat of the printed and laminated cloth shall be  $27.25 \pm 1.25 - 2.50$  inches in the warp direction. 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 on design, the pattern on the base cloth shall match the standard Woodland Camouflage pattern drawing 2-1-1516 B (see 2.1).

3.4.5 Infrared reflectance. The infrared reflectance of the camouflage printed and finished cloth shall be as specified in 1) and 2). Failure of the near-infrared spectral reflectance requirements will occur when spectral reflectance limits are exceeded at four or more of the specified wavelengths.

1) Black 357. Spectral reflectance values in the wavelength region 700 to 860 nm shall be 10 percent or less relative to barium sulfate, the preferred white reflectance standard, or any other white reference standard specified in paragraph 4.5.1.

2) Light Green 354, Dark Green 355, and Brown 356. Spectral reflectance values between 600 and 860 nm shall meet the requirements specified in table I.

## MIL-C-44187A

TABLE I.  
Spectral reflectance limits for Light Green 354, Dark Green 355,  
and Brown 356 Reflectance

Wavelength (nanometers)	Light Green 354			Dark Green 355 Brown 356		
	Max	Percent	Min	Max	Percent	Min
600	20		10	8		4
620	20		10	8		4
640	20		9	8		4
660	20		8	8		3
680	32		8	22		3
700	53		14	41		9
720	67		35	60		25
740	73		55	73		50
760	78		60	78		55
780	80		60	80		57
800	81		60	81		59
820	82		60	82		60
840	82		60	82		60
860	82		60	82		60

3.5 Physical requirements. The laminated cloth shall conform to the requirements in table II when tested as specified in 4.4.3.

TABLE II. Physical requirements

Characteristics	Minimum	Maximum
Weight, oz/sq.yd.	-	5.9
Breaking strength, lb.		
Warp	135	-
Filling	100	-
Tearing resistance, KGF		
Warp	3.5	-
Filling	3.2	-
Moisture vapor transmission rate, g/m <sup>2</sup> /24 hr	-	-
Procedure B		
Initial	700	-
After synthetic perspiration	700	-
Procedure BW		
Initial	3600	-

## MIL-C-44187A

TABLE II. Physical requirements (cont'd)

Characteristics	Minimum	Maximum
Hydrostatic resistance, psi		
Initial	150	-
After strength of coating	150	-
After abrasion		-
Face	100	-
Back	100	-
After high humidity	150	-
After insect repellent	120	-
Stiffness (warp only), cm	-	12.0
Water permeability		
Initial	no leakage	
After synthetic perspiration	no leakage	
After Flex (70°F)		
Warp	no leakage	
Filling	no leakage	
After cold flex (-25°F)		
Warp	no leakage	
Filling	no leakage	

3.5.1 Water repellency. The laminated cloth shall be given an approved Quarpel type water repellent treatment on the face side of the cloth and shall conform to the water repellency requirements. The use of materials other than approved water repellents are prohibited(see 6.4).

3.5.2 Spray ratings. The results of the three individual determinations on the sample unit for spray rating shall be equal to or better than ratings 100, 90, 90 initially and the ratings shall be equal to or better than ratings of 90, 90, 80 after 3 launderings.

3.5.3 Resistance to organic liquids. The finished cloth shall show no wetting by n-tetradecane, initially and after 3 launderings.

3.5.4 Resistance to delamination. When tested as specified in 4.5.5, delamination between the cloth and film after 5 launderings shall not exceed 0.25 linear inches.

3.6 Width. The minimum overall width shall be as specified (see 6.2). Selvages shall be trimmed to give straight, uniform, fully laminated edges.

3.7 Length and put-up. Unless otherwise specified the laminated cloth shall be furnished in rolls. Each roll shall contain no more than 5 pieces and no

## MIL-C-44187A

single piece shall be less than 10 yards in length. Acceptance of shorter lengths, if permitted, shall be based on the conditions stipulated in the contract, or purchase order (see 6.2). The cloth shall be put-up on full width rolls as specified in 5.1.

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

3.9 Workmanship. The laminated cloth shall conform to the quality of product established by this document. The occurrence of defects shall not exceed the applicable acceptable quality levels.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements 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 the document where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

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

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

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

4.3 First article inspection. When a first article is required (see 6.2), it shall be examined for appearance, color and finish defects and shall be tested for the characteristics specified in table IV. The presence of any defect or failure of any test shall be cause for rejection of the first article.

4.4 Quality conformance inspection. Unless otherwise specified, sampling for inspection shall be performed in accordance with MIL-STD-105.

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.

## MIL-C-44187A

4.4.1.1 Plastic film overall weight test. The plastic film shall be tested in accordance with Method 5041 of FED-STD-191 except that each specimen shall be 25 square inches and shall be cut in diagonal fashion from each sample unit. The specimens shall be equally spaced across the full width of the sample unit no closer than 2 inches to the edges of the sample unit. The distance between the top of a specimen and the bottom of the next specimen shall be 3 inches. The sample unit shall be 1.5 yards full width of the plastic film. The lot shall be rejected if any specimen weighs less than 0.3 or greater than 0.7 ounces per square yard, or if the difference in weight between any two specimens in the sample unit is greater than 0.25 ounces per square yard. The sample size 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

4.4.1.2 Certification. Components listed below shall be inspected on the basis of a contractor's certificate of compliance with the indicated requirements.

<u>Component</u>	<u>Requirement paragraph</u>
Plain weave nylon cloth	3.3.1.1
Tricot knit nylon cloth	3.3.1.2

#### 4.4.2 End item examination.

4.4.2.1 Yard-by-yard examination. The cloth shall be examined on both sides for the defects listed below. All defects found shall be counted regardless of their proximity to each other except where two or more defects represent a single local condition, in which case only the more serious defect shall be counted. A continuous defect shall be counted as one defect for each warpwise yard or fraction thereof in which it occurs. The lot size shall be expressed in yards. The sample unit shall be 1 linear yard. The inspection level shall be II and the acceptable quality level (AQL), expressed in terms of defects per hundred units, shall be 4.0 for major defects and 10.0 for total (major and minor combined) defects. The number of rolls from which the sample yardage is to be selected shall be in accordance with table III. An approximately equal number of yards shall be examined in each roll sampled.



## MIL-C-44187A

Defects	Classification	
	Major	Minor
Any hole, cut or tear, including edges	X	
Abrasion-resulting in a thin or weak place	X	
Floats or skips - multiple 1/2 inch, or more in either warp or filling direction		X
Blisters, tunnels or delamination of cloths	X	
Crease or wrinkle - resulting in doubling that cannot be corrected by manual pressure, or adhesion of surfaces against each other, or any diagonal distortions of surface	X	
Any solid lump, defined as a slub or knot which exceeds level C on the respective Sears Fabric Defect Scale.	X	
Fabric edges rolled, folded, doubled, scalloped or wavy	X	
Any spot, stain, or foreign matter		X
Width less than minimum specified	X	
Any odor other than that which is characteristic of the laminating compound or water-repellent finish		X
Any color off shade, not uniform, mottled, or spotted		X
Any tackiness	X	

TABLE III Sample size

Lot size in yards	Sample size in rolls
1200 or less <u>1</u> /	3
1201 up to and including 3200	5
3201 up to and including 10,000	8
10,001 up to and including 35,000	13
35,001 up to and including 150,000	20
150,001 and over	32

1/ If lot contains fewer than three rolls, each roll in the lot shall be examined.

## MIL-C-44187A

4.4.2.2 Length examination.

4.4.2.2.1 Individual rolls. 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 in respect to length.

4.4.2.2.2 Total yardage in sample. The lot shall be unacceptable if the total of the actual lengths of rolls in the sample is less than the total of the lengths marked on the ticket.

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 examination, 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.

4.4.3 End item testing. The cloth shall be tested for the characteristics listed in table IV. The methods of testing specified in FED-STD-191 wherever applicable and as listed in table IV shall be followed. All test reports shall contain the individual values utilized in expressing the final results. The sample unit for all testing shall be 5 continuous yards full width of the finished cloth supplied on a tube to prevent folding. The lot shall be rejected if one or more sample units fail to meet the requirement specified. The maximum lot size shall be 150,000 linear yards. The sample size 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

## MIL-C-44187A

TABLE IV End item tests

Characteristic	Requirement paragraph	Test method <u>1/</u>
Colorfastness to:		
Light	3.4.3	5660
Laundering (after 3 cycles)	3.4.3	5614
Crocking	3.4.3	5651
Perspiration	3.4.3	5680
Infrared reflectance	3.4.5	4.5.1
Laminated cloth:		
Overall weight	3.5	5041
Breaking strength	3.5	5100
Tearing resistance	3.5	ASTM D2582 <u>2/</u>
Moisture vapor transmission rate		
Procedure B		
Initial	3.5	ASTM E-96, <u>3/</u>
After synthetic perspiration	3.5	4.5.8 and ASTM E-96, <u>3/</u>
Procedure BW		
Initial	3.5	ASTM E-96, <u>4/</u>
Hydrostatic resistance:		
Initial	3.5	5512 <u>5/</u>
After strength of coating	3.5	5972 <u>6/</u> and 5512 <u>5/</u>
After abrasion		
Face	3.5	5302 <u>7/</u> and 5512 <u>5/</u>
Back	3.5	5302 <u>7/</u> and 5512 <u>5/</u>
After high humidity	3.5	<u>8/</u>
After insect repellent	3.5	<u>9/</u>
Stiffness (warp only), cm	3.5	5204
Water permeability		
Initial	3.5	5516 <u>10/</u>
After synthetic perspiration	3.5	4.5.7 and 5516 <u>10/</u>
After flex (70°F)		
Warp	3.5	4.5.2 and 5516 <u>10/</u>
Filling	3.5	4.5.2 and 5516 <u>10/</u>
After cold flex (-25°F)		
Warp	3.5	4.5.3 and 5516 <u>10/</u>
Filling	3.5	4.5.3 and 5516 <u>10/</u>
Water repellency	3.5.1	<u>11/</u>

## MIL-C-44187A

TABLE IV End item tests (cont'd)

Requirement Characteristic	Test paragraph	method <u>1/</u>
Spray rating		
Initial 3.5.2	5526	
After 3 launderings 3.5.2		5552 and 5526
Resistance to organic liquid		
Initial 3.5.3	4.5.4	
After 3 launderings 3.5.3		5552 and 4.5.4
Resistance to delamination	3.5.4	4.5.5

- 1/ The face side of the laminated cloth shall be used to orient the test specimens in either the warp or filling direction as required by the applicable test method.
- 2/ Five warp and five filling specimens shall be tested after conditioning in accordance with section 4 of FED-STD-191. Specimen size shall be 8 by 8 inches. Only one tear shall be made on a single specimen. The specimen shall be positioned with the face side toward the probe and with the designated yarns of the face fabric at right angles to the direction of tear. The test shall be conducted using carriage number 4 of (0.4536 kgs) and the standard drop height of  $508 \pm 2$  mm. If the tear is not straight on both sides of the laminate, the result shall be considered invalid and another specimen shall be tested.
- 3/ The back side of the laminated cloth shall face the water, the free stream air velocity shall be  $550 \pm 50$  FPM as measured 2 inches above the fabric specimen. The air flow shall be measured at least 2 inches from any other surface. The test shall be run for 24 hours and weight measurements shall be taken at only the start and completion of the test. At the start of the 24 hour test period, the air gap between the water surface and the back of the specimen shall be  $3/4$  inch. Five specimens shall be tested.
- 4/ The back side of the laminated cloth shall face the water. The free stream air velocity shall be  $550 \pm 50$  FPM as measured 2 inches below the fabric specimen. The airflow shall be measured at least 2 inches from any other surface. The test shall be run for 2 hours and weight measurements shall be taken at only the start and completion of the test. Five specimens shall be tested.

## MIL-C-44187A

- 5/ The water pressure shall be applied to the face side of the laminated cloth. A taffeta fabric restraint, conforming to type III of MIL-C-21852 shall be placed across the back of the laminate during testing. No area of the taffeta restraint may be used more than once.
- 6/ Except that the specimens shall be stretched at 20 pounds.
- 7/ The abrasion test shall be conducted in multidirectional mode using the face side of the laminate as the abradant. A load of 6 lbs. shall be applied to the abradant. The test shall be completed at 10,000 cycles.
- 8/ Three 4 by 4 inch specimens shall be laid flat, face side up, on a supporting plate and the assembly placed in a desiccator containing water in the lower portion. The water level shall be approximately 1 inch below the specimens. The lid of the desiccator shall be put in place and the desiccator placed in a circulating air oven having a temperature of  $160^{\circ} \pm 20^{\circ}\text{F}$  for a period of seven days. At the end of the aging period, each specimen shall be removed from the desiccator and tested immediately in accordance with Method 5512 of FED-STD-191, with the water pressure being applied to the face side. A taffeta fabric restraint, conforming to type III of MIL-C-21852 shall be placed across the back of the laminate during testing. No area of the taffeta restraint may be used more than once.
- 9/ Each of five 4 by 4 inch specimens shall be laid flat, face side up, on a glass plate. Three drops of insect repellent conforming to type II, concentration A of O-I-503 shall be applied to the center of each specimen. A glass plate shall be placed on each specimen and a four pound weight placed on top. After 16 hours, remove the five specimens and test immediately in accordance with Method 5512 of FED-STD-191, with the water pressure being applied to the face side. A taffeta fabric restraint, conforming to type III of MIL-C-21852 shall be placed across the back of the laminate during testing. No area of the taffeta restraint may be used more than once.
- 10/ The water permeability shall be measured as specified in Method 5516 of FED-STD-191, except that the face side of the laminated cloth shall contact the water. The hydrostatic head shall be 50 centimeters and shall be held for 5 minutes. The report shall only include measurement of the appearance of water drops. Leakage is defined as the appearance of water any place within the 4-1/2 inch diameter test area. The test may be performed using any device which tests the same specimen area at the equivalent pressure. In cases of dispute, the apparatus described in Method 5516 of FED-STD-191 shall be used.
- 11/ The contractor shall report the water repellents used and certify that no other material has been added.

4.4.4 Packaging inspection. The inspection shall be in accordance with the quality assurance provisions of PPP-P-1136.

## MIL-C-44187A

4.5 Methods of inspection.

4.5.1 Infrared reflectance test. Reflectance data shall be obtained from 600-860 nm relative to a barium sulfate standard, the preferred white reference standard. Other reference white standards may be used provided they are calibrated to an absolute white; e.g., Halon, magnesium oxide or vitrolite tile. The spectral bandwidth at 860 nm shall be less than 26 nm. Reflectance measurements may 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 source that simulates either CIE Source A or CIE Source D65. Each shade of the pattern shall be measured as a single layer of laminate backed with 6 layers of un laminated outer shell material of the same shade. Readings will be taken on a minimum of two different areas and the data averaged. The specimen shall be viewed at an angle no greater than 10 degrees from normal with specular component included. Photometric accuracy of the spectrophotometer shall be within 1 percent and the wavelength accuracy shall be within 2 nm. The standard aperture size used in the color measurement device shall be 1.0 to 1.25 inches in diameter.

4.5.2 Water permeability after flex (70°F) test. One 8 by 12 inch area shall be cut from the sample unit with the 12 inch dimension in the indicated direction (warp or filling as applicable). The specimen shall be conditioned and flexed as specified in Method 2017 of FED-STD-101 except the specimen shall not be aged, the short edges shall not be heat sealed or otherwise joined, and the specimen shall be flexed for 1500 cycles. Two 6 by 8-inch specimens shall be cut from the 8 by 12 inch flexed specimen and tested for hydrostatic resistance in accordance with Method 5516 of FED-STD-191 with water pressure applied to the face side.

4.5.3 Water permeability after cold flex (-25°F) test. The water permeability after cold flex (-25°F) test shall be as specified in 4.5.2 except that the 8 by 12 inch specimen shall be mounted on the flex test apparatus, placed in a test chamber at -25°F for 1 hour, and then flexed in the test chamber at -25°F.

4.5.4 Resistance to organic liquid test. Place a small specimen of the cloth on 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 30 seconds 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.

4.5.5 Delamination test. Place  $2 \pm 0.2$  lbs. Extended Cold Weather Clothing System material (one sample unit, twenty four inches by full width plus ballast) in a top-loading, commercially available, home-type washer set on the permanent press (10 min. sudsing) cycle using a high water level (10 inches). The water temperature shall be warm ( $100 \pm 10^\circ\text{F}$ ). Place 0.5 ounces of type II (P-D-245)

## MIL-C-44187A

detergent to provide suds. The duration of each laundering cycle shall be  $30 \pm 5$  minutes. After laundering, place sample and ballast in a commercially-available home-type dryer set on the permanent press cycle using medium heat ( $100 \pm 10^\circ\text{F}$ ) and dry for approximately 15 minutes. Repeat laundering and drying cycle 5 times. After the 5th drying cycle, examine both sides for delamination. The sample shall be considered delaminated if the separation between any two plies exceeds 0.25 inch in any direction.

4.5.6 Exposure to synthetic perspiration procedure. The synthetic perspiration solution shall be made up in a 500 mL glass beaker by combining 3.0 g sodium chloride, 1.0 g trypticase soy broth powder, 1.0 g normal propyl propionate, and 0.5 g of liquid lecithin. Add 500 mL of distilled water, add a magnetic stirring bar, and cover the beaker. Place the beaker on a combination hot plate/magnetic stirrer apparatus. While stirring, heat the solution to  $50^\circ\text{C}$  until all ingredients are dissolved. While stirring, cool the solution to  $35^\circ\text{C}$ , remove cover, and dispense immediately with a pipet or other suitable measuring device. Dispense 2 mL of perspiration solution at  $35^\circ\text{C}$  onto the center of an 8 inch by 8 inch glass plate. Place a specimen on the glass plate with the knit side facing the glass. Dispense an additional 2 mL of the synthetic perspiration solution onto the center of the specimen. Place an 8 inch by 8 inch glass plate on top of the specimen with a 4 lb. weight positioned in the center.

4.5.7 Water permeability after perspiration test. Three specimens, 8 inches by 8 inches, shall be cut and exposed to perspiration as specified in 4.5.6. After 16 hours, remove the specimen (Do Not Rinse) and test after air drying for water permeability.

4.5.8 Moisture vapor transmission rate after perspiration test. Air dry the specimen used in 4.5.7. Cut out a 3 inch diameter specimen from the center and test for moisture vapor transmission rate.

## 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 PPP-P-1136.

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 PPP-P-1136.

5.3 Marking. In addition to any special marking required in the contract or purchase order, shipments shall be marked in accordance with the requirements of PPP-P-1136.

## MIL-C-44187A

## 6. NOTES

6.1 Intended use. The cloth is intended for use in the parka and trousers of the Extended Cold Weather Clothing System.

6.2 Ordering data. Acquisition documents should specify the following:

- a. Title, number and date of this document.
- b. First article (see 3.2, 4.3, 6.8)
- c. Width of cloth required (see 3.6).
- d. Length required, if other than specified (see 3.7).
- e. Selection of applicable levels of preservation and packaging (see 5.1 and 5.2).

6.3 Standard sample. For access to standard sample, address the contracting activity issuing the invitation for bids.

6.4 Quarapel water repellent. 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 and Development Center, Natick, MA 01760-5014 and is based on extensive tests, including those for toxicity which are not set forth in this document. Because of the time necessary to conduct full evaluation (approximately 6 months), only those chemical treatments already approved and so listed in the invitation for bids or request for proposals shall be considered acceptable for the related procurement.

6.5 Spectrophotometers. Suitable spectrophotometers for measuring spectral reflectance in the near-infrared are the Diano Hardy, Diano Match Scan, Hunter D54P-IR and Macbeth 1500 with IR option.

6.6 White standards. Barium sulphate of suitable quality for use as a white reference standard is available from the Eastman Kodak Company.

6.7 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.

6.8 First article. When a first article sample is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209. The first article should be a preproduction sample consisting of 3 yards of the finished cloth. The contracting officer should include specific instructions in all acquisition documents regarding arrangements for inspection and approval of the first article.



MIL-C-44187A

Custodians:

Army - GL  
Navy - NU

Preparing activity:

Army - GL

Project No. 8305-0077

Review activities:

Army - MD  
Navy - MC  
DLA - CT

**INSTRUCTIONS:** In a continuing effort to make our standardization documents better, the DoD provides this form for use in submitting comments and suggestions for improvements. All users of military standardization documents are invited to provide suggestions. This form may be detached, folded along the lines indicated, taped along the loose edge (*DO NOT STAPLE*), and mailed. In block 5, be as specific as possible about particular problem areas such as wording which required interpretation, was too rigid, restrictive, loose, ambiguous, or was incompatible, and give proposed wording changes which would alleviate the problems. Enter in block 6 any remarks not related to a specific paragraph of the document. If block 7 is filled out, an acknowledgement will be mailed to you within 30 days to let you know that your comments were received and are being considered.

**NOTE:** This form may not be used to request copies of documents, nor to request waivers, deviations, or clarification of specification 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.

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**DEPARTMENT OF THE ARMY**

US ARMY NATICK RESEARCH  
and DEVELOPMENT CENTER  
ATTN: STRNC-ES  
Natick, MA 01760-5014

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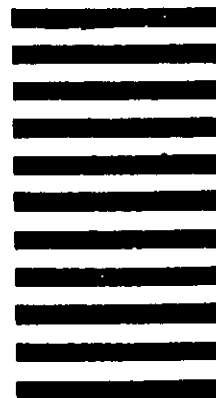
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Natick, MA 01760-5014



## STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions - Reverse Side)

1. DOCUMENT NUMBER MIL-C-44187A		2. DOCUMENT TITLE CLOTH, LAMINATED, WATERPROOF AND MOISTURE VAPOR PERME.	
3a. NAME OF SUBMITTING ORGANIZATION		4. TYPE OF ORGANIZATION (Mark one)	
b. ADDRESS (Street, City, State, ZIP Code)		<input type="checkbox"/> VENDOR	
		<input type="checkbox"/> USER	
		<input type="checkbox"/> MANUFACTURER	
		<input type="checkbox"/> OTHER (Specify): _____	
5. PROBLEM AREAS			
a. Paragraph Number and Wording:			
b. Recommended Wording:			
c. Reason/Rationale for Recommendation:			
6. REMARKS			
7a. NAME OF SUBMITTER (Last, First, MI) - Optional		b. WORK TELEPHONE NUMBER (Include Area Code) - Optional	
c. MAILING ADDRESS (Street, City, State, ZIP Code) - Optional		8. DATE OF SUBMISSION (YYMMDD)	