

INCH-POUND

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SUPERSEDING

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## MILITARY SPECIFICATION

## CLOTH, FUSIBLES

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

## 1. SCOPE

1.1 Scope. This document covers woven, knitted, nonwoven, and web type fusible cloth.

1.2 Classification. The fusible cloth shall be of the following types, classes, and styles as specified (see 6.2).

- |           |   |
|-----------|---|
| Type I    | - Plain weave substrate                                     |
| Type II   | - Twill weave substrate                                     |
| Type III  | - Weft inserted knit substrate                              |
| Type IV   | - Tricot knit substrate                                     |
| Type V    | - Thermal bonded nonwoven substrate                         |
| Type VI   | - Saturate bonded nonwoven substrate                        |
| Type VII  | - Spun bonded nonwoven substrate                            |
| Type VIII | - Spunlaced nonwoven substrate                              |
| Type IX   | - Open net webb substrate                                   |
| Class 1   | - Polyamide adhesive  |
| Class 2   | - Polyester adhesive  |
| Class 3   | - Polyethylene, high density adhesive                       |
| Class 4   | - Polyvinyl chloride (PVC)/polyvinyl acetate (PVA) adhesive |
| * Class 5 | - Polyvinyl acetate co-polymer (double sided)               |
| Style     | - (see 3.4)   |

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 01760-5014 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

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## 2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this 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

PPP-P-1132 - Packaging of Woolen, Worsted and Wool Blend  
(Synthetic Fiber Cotton) Fabrics  
PPP-P-1133 - Packaging of Synthetic Fiber Fabrics  
PPP-P-1134 - Packaging of Cotton and Cotton-Synthetic Fiber Blend  
Fabrics (Excluding Duck Fabrics)

## STANDARDS

## FEDERAL

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

\* (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 specification to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

## 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.)

\* 2.2 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.

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## 3. REQUIREMENTS

3.1 Materials. The fiber shall be nylon, polyester, acrylic, rayon, carded or combed cotton, or wool as required (see 3.4). The use of reprocessed or re-used wool is prohibited.

3.1.1 Yarns. For types I, II, and III fusible substrates, the yarns shall be drawn and spun staple single ply yarns for warp, filling, or knit structure. For type IV courses or wales, the yarns shall be bright or semi-dull multifilament polyester or nylon.

3.1.2 Substrates.

3.1.2.1 Type I. Type I shall be plain weave. When specified (see 6.2), the face side shall be napped.

3.1.2.2 Type II. Type II shall be a twill weave; either one over two or one over three. When specified (See 6.2), the face side shall be napped.

3.1.2.3 Type III. Type III shall be a weft inserted warp knit. When specified (see 6.2), the face side shall be napped.

3.1.2.4 Type IV. Type IV shall be a lightweight cloth produced by a series of interlocking loops using either one or two sets of warp yarns continuously in one direction.

3.1.2.5 Type V. Type V shall be a nonwoven web, thermally bonded by heat activated fibers or powders. The web shall be either flat or print bonded.

3.1.2.6 Type VI. Type VI shall be a nonwoven bonded together by any chemical binder system (impregnation, print bonded, sprayed, or foamed).

3.1.2.7 Type VII. Type VII shall be a nonwoven formed by a continuous extrusion of filaments into a web and simultaneously bonded either thermally or chemically.

3.1.2.8 Type VIII. Type VIII shall be a nonwoven formed by entangling a continuous fibrous web by high velocity water jets and shall be bonded mechanically. No chemical binders shall be used for this web.

3.1.2.9 Type IX. Type IX shall be any lightweight, thermally bonded, open net structure formed from pure polyamide or polyester extruded adhesive.

3.1.3 Adhesives.

3.1.3.1 Class 1 - polyamide. The class 1 adhesive shall be nylon 6, 6,6, 11, 12 or any co-polymer blends thereof and shall be applied to the substrate by powder dot, paste dot, hot melt dot, bicomponent dot, sintered, or spunfused process.

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3.1.3.2 Class 2 - polyester. The class 2 adhesive shall be polyester resin applied to the substrate by powder dot, paste dot, hot melt dot, bicomponent dot, sintered, or spunfused process.

3.1.3.3 Class 3 - polyethylene. The class 3 adhesive shall be a high density type polyethylene applied to the substrate by powder dot, sintered process, or pre-formed web.

3.1.3.4 Class 4 - polyvinyl chloride/polyvinyl acetate. The class 4 adhesive shall be a blend of PVC and PVA applied to the substrate by paste dot process.

3.1.3.5 Class 5 - polyvinyl acetate co-polymer (double sided). The class 5 adhesive shall be a modified PVA applied to each side of the substrate by either paste dot (Gravure), or sintered process. This class of adhesive offers no laundering resistance.

3.2 Adhesive applications. Unless otherwise specified (see 6.2) in the end item documents, all fusible types and classes shall have a uniformly distributed powder dot, paste dot, hot melt dot, bicomponent dot, or sintered fusible adhesive evenly applied to one side in accordance with good commercial practice.

3.2.1 Powder dot. The adhesive powder shall be transferred from a hopper fed, engraved, and heated roll of predetermined dots per square inch and particle size onto the fusible substrate.

3.2.2 Paste dot. The adhesive shall be dispersed and transferred from a circular perforated screen with predetermined dots per square inch onto the fusible substrate. Process includes Gravure method using finely engraved rolls.

3.2.3 Hot melt dot. The adhesive shall be polymer chips melted and transferred from an engraved roll of predetermined dot per square inch onto the fusible substrate.

3.2.4 Bicomponent dot. The adhesive shall be a blend of two polymers of differing melt properties transferred onto the fusible substrate using a predetermined dots per square inch.

3.2.5 Sintered. The adhesive shall be randomly scattered in equal amounts on the substrate which in turn is heated to melt-fuse the adhesive onto the fusible substrate.

3.2.6 Spunfused. The adhesive shall be polymer chips melted and extruded in a web formation either in unsupported configuration (type IX) or onto one or both sides of a substrate.

3.2.7 Net adhesive dot. Uniform dot pattern obtained by laminating a pre-formed net adhesive having the dot pattern.

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3.3 Color. Unless otherwise specified (see 6.2), the color shall be natural. When dyed fusible material is required, it shall meet the requirements in 3.3.1 and 3.3.2.

3.3.1 Labile sulfur. The use of dyes and compounds containing elementary sulfur capable of oxidation to sulfuric acid is prohibited for use in cotton or cotton-blended fabrics. The dyes shall be chosen and applied so that the dyed cloth shall contain no more labile sulfur than shown by the standard sample or no more than a slight trace of labile sulfur when tested as specified in 4.2.3.

3.3.2 Colorfastness. The dyed and finished cloth shall show colorfastness to dry cleaning, laundering, and dry heat equal to or better than a rating of "good" when tested as specified in 4.2.3.

3.4 Physical requirements. The specified type, class, and style (see 6.2) of finished cloth shall conform to the applicable requirements in table I, II, III, IV, V, VI, or VII when tested as specified in 4.2.3.

TABLE I. Physical requirements for type I

Style	Class	Weight (including adhesive) oz/sq yd		Yarns per inch minimum		Breaking strength pounds minimum		Fiber content
		Min	Max	Warp	Filling	Warp	Filling	
A	1	1.4	2.9	55	45	20	15	Cotton
B	1	2.5	3.0	58	45	30	15	Cotton <u>1/</u>
C	2,3 or 4	3.0	4.1	60	50	30	10	Cotton
D	3	4.0	5.0	44	40	35	25	Cotton
E	4	4.5	5.5	55	35	160	100	Polyester
* F	5	1.8	2.5	40	30	20	6	Cotton
* G	5	2.4	3.3	70	30	110	45	Polyester
* H	3	2.0	4.0	70	38	100	80	Polyester

\* 1/ As an alternate, the cloth may contain 50 ± 5 percent polyester or rayon in combination with the cotton.

TABLE II. Physical requirements for type II

Style	Class	Weight (including adhesive) oz/sq yd		Yarns per inch minimum		Breaking strength pounds minimum		Fiber content
		Min	Max	Warp	Filling	Warp	Filling	
A	1	3.0	4.0	60	20	20	20	<u>1/</u>
B <u>2/</u>	1	3.5	4.5	68	25	25	25	<u>1/</u>

\* 1/ 50 percent minimum polyester or cotton with the remaining percentage acrylic, rayon, or wool, or any combination thereof. The cloth shall have a minimum of 175 fusible dots per square inch.

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- 2/ Fusibles using a certifiable warp yarn count of 24/1 or heavier, meeting minimum style B weight and style A yarns per inch requirements may be used for style B application.

TABLE III. Physical requirements for type III

Style	Class	Weight (including adhesive) oz/sq yd		Weft inserts per inch minimum	Bursting strength pounds (minimum)	Fiber content
		Min	Max			
A	1	1.8	2.3	18	30	<u>1/</u>
B	1	2.4	3.0	26	50	<u>1/</u>
C	1	3.1	4.2	32	70	<u>1/</u>

- 1/ 100 percent polyester warp and 50 percent minimum rayon weft with the remaining percentage polyester or acrylic. The cloth shall have a minimum of 175 fusible dots per square inch.

TABLE IV. Physical requirements for type IV

Style	Class	Weight (including adhesive) oz/sq yd		Wales per inch (min)	Courses per inch (min)	Bursting strength pounds (minimum)	Fiber content
		Min	Max				
A	1	2.0	2.7	34	29	60	<u>1/</u>

- 1/ 100 percent multifilament polyester or multifilament nylon. The cloth shall have a minimum of 175 fusible dots per square inch.

TABLE V. Physical requirements for types V, VI, and VII

Style	Class	Weight (including adhesive) oz/sq yd		Breaking strength pounds (minimum)		Fiber content
		Min	Max	Machine (warp)	Cross (filling)	
A	1,2,3, or 4	1.0	1.6	2.0	1.0	<u>1/</u>
B	1,2,3, or 4	1.7	2.4	3.0	2.0	<u>2/</u>
C	1,2,3, or 4	2.5	2.9	3.0	2.0	<u>3/</u>

- 1/ 50 to 100 percent polyester with the remaining percentage nylon and/or rayon.

- 2/ 50 to 100 percent polyester with the remaining percentage nylon.

- 3/ 20 to 100 percent polyester with the remaining percentage nylon.

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TABLE VI. Physical requirements for type VIII

Style	Class	Weight (including adhesive) oz/sq yd		Breaking strength pounds (minimum)		Fiber content
		Min	Max	Machine (warp)	Cross (filling)	
A	2 or 4	2.3	3.2	25.0	10.0	<u>1/</u>

1/ 100 percent polyester.

TABLE VII. Physical requirements for type IX

Style	Class	Weight, oz/sq yd	
		Min	Max
A	1 or 2	0.5	1.0
B	1 or 2	1.1	1.5
C	1 or 2	1.6	2.0

\* 3.4.1 Bonding strength. Unless otherwise specified in the end item document, all fusible interlining (except class 5) after fusing to the basic cloth, shall meet an initial warp, wale, or machine direction bond strength of 32.0 ounces minimum per inch and 24.0 ounces minimum per inch after three launderings (classes 2, 3, and 4) or three dry cleanings (class 1) with steam pressings as specified in 4.3.1.1. Additionally, the nonwoven fusible will be accepted if it either begins to debond from the outershell material (end item material or sheeting material) at a value equivalent to the minimum bond strength or higher and then splits from itself, debonds at a minimum of 20 ounces (initial state), 17 ounces (laundered or dry cleaned state) without splitting or if the nonwoven readily splits from itself at a minimum split strength of 6.0 ounces per inch. Splits occur when the adhesive bonding strength is higher than the cohesive strength of the nonwoven substrate resulting in the shredding of the fibers in either the machine or cross machine direction. Testing shall be as specified in 4.2.3.

\* 3.4.2 Maximum fusing press temperature. Under no circumstances shall the dry heat temperature for bonding strength test procedure, as specified in 4.3.1.1, exceed 315°F when testing any polyester/wool blended outershell materials.

\* 3.5 Dimensional stability. The fusible cloth shall not shrink or elongate in excess of 3.0 percent, in either the warp or filling direction, after one laundering (classes 2, 3, and 4) or 2.0 percent after one drycleaning (class 1). Dimensional stability requirements are not applicable to type IX. Testing shall be as specified in 4.2.3.

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3.6. Width. The width of the cloth shall be specified (see 6.2) and shall be the minimum acceptable width exclusive of selvage.

3.7. Length and put-up. Unless otherwise specified (see 6.2), the cloth shall be furnished in continuous lengths each not less than 40 yards. The cloth shall be put-up on rolls as specified in 5.1.

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

3.9. Workmanship. The fusible cloth shall conform to the quality 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.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1. Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1. Responsibility for compliance. All items 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 indicated or actual, nor does it commit the Government to accept defective material.

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

#### 4.2. Quality conformance inspection.

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

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4.2.2 End item examination.

4.2.2.1 Yard-by-yard examination. Each roll in the sample shall be examined on the back (fusible side) only for all defects listed in 4.2.2.1.1 as defined in FED-STD-4. 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 which are clearly noticeable at normal inspection distance (3 feet) shall be scored and assigned demerit points as listed in 4.2.2.1.1 except that only those slubs and knots which exceed those shown on Sears Fabric Defect Scale (see 6.3), E or 3 as applicable for slubs and B 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 in accordance with the following:

<u>Lot size (yards)</u>	<u>Sample size (rolls)</u> 1/
3200 or less	8
3201 to 10,000 inclusive	13
10,001 or over	20

1/ No more than one roll shall be taken from any shipping container unless the number of shipping containers in the lot is less than the required number of rolls in which case all shipping containers shall be present in the sample.

The lot shall be unacceptable if the points per 100 square yards of the total yardage 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 exceeds 45.0 points per 100 square yards, a second sample of the size indicated above shall be examined only for individual roll quality. The lot shall be unacceptable if one or more rolls in the second sample exceeds the point level. Point computation for lot quality and individual roll quality shall be as follows:

<u>Total points scored in sample x 3600</u>	= Points per 100
<u>Contracted width of cloth (inches) x Total yards inspected</u>	square yards

4.2.2.1.1 Demerit points. The following defects shall be assigned demerit points:

Heavy filling or knit course	Tear drop or teariness
Heavy warp end or knit wale	Dirty filling
Heavy place	Broken or missing end
Slub or slug, bunch or lump	End out
Kink, loop, snarl or curl	Soiled end
Knot	Spot
Broken pick	Stain

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Missing pick	Pile or napping missing (if specified)
Crack	
Shyer (snier)	
Thin place	

Demerit points shall be assigned as follows:

For defects 3 inches or less 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

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

Holes, cuts or tears	Excessive neppiness
Baggy, ridgy, or wavy cloth	Missing fusible adhesive
Width less than specified	Wrinkle mark
Overall uncleanliness	Seam mark
Oily filling	Dots per square inch less than specified
Crease	Hard crease
Mill wrinkle	

4.2.2.2 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 tickets.

4.2.2.3 Roll identification examination. During the yard-by-yard examination, each roll in the sample shall be examined for identification of fiber content. The lot shall be unacceptable if two or more rolls in the sample are not labeled or ticketed in accordance with the Rules and Regulations Under the Textile Fiber Products Identification Act.

4.2.3 End item testing. The cloth shall be tested for the characteristics listed in table VIII. The methods of testing specified in FED-STD-191 wherever applicable and as listed in table VIII shall be followed. The physical and chemical values specified in section 3 apply to the average results of the determinations made on a sample unit for test purposes as specified in the applicable test methods. All test reports shall contain the individual values

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used in expressing the final results. The sample unit shall be 2 continuous yards full width of the finished cloth. The lot shall be unacceptable if one or more sample units fail to meet any requirement specified. 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 to 22,000 inclusive	3
22,001 and over	5

TABLE VIII. End item tests

<u>Characteristic</u>	<u>Requirement paragraph</u>	<u>Test method</u>
Nylon identification	3.1	1530 or 2530 <u>1/</u>
Polyester identification	3.1	1600 or 2535 <u>1/</u>
Acrylic identification	3.1	1600 <u>1/</u>
Rayon identification	3.1	1500 <u>1/</u>
Cotton identification	3.1	1200 <u>1/</u>
Wool identification	3.1	1100 <u>1/</u>
Weave (types I and II)	3.1.2	Visual <u>2/</u>
Knit (types III and IV)	3.1.2	Visual <u>2/</u>
Adhesive	3.1.3	<u>1/</u>
Color	3.3	Visual
Labile sulfur (cotton and cotton blends)	3.3.1	2020 <u>1/</u>
Colorfastness to:		
Dry cleaning (After 1 cycle)	3.3.2	5620
Laundering (after 1 cycle)	3.3.2	5610
Dry heat	3.3.2	5642 <u>3/</u>
Weight	3.4	5041
Yarns per inch (types I and II)	3.4	5050
* Warp Yarn count (type II, style B)	3.4	4021 <u>1/</u>
Inserts per inch (type III)	3.4	5050 <u>4/</u>
Knit stitches per inch (type IV)	3.4	5070
Breaking strength (type I, II, V, VI, VII and VIII)	3.4	5100
Bursting strength (type III and IV)	3.4	5120
Fiber content	3.4	<u>1/</u>
Bonding strength:		
Initial	3.4.1	4.3.1
After dry cleaning (3 cycles) (Class 1)	3.4.1	4.3.1
After laundering (3 cycles) (Classes 2, 3, and 4)	3.4.1	4.3.1

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TABLE VIII. End item tests (cont'd)

Characteristic	Requirement paragraph	Test method
Dimensional stability:		
After drycleaning (class 1)	3.5	4.3.2
After laundering (classes 2, 3, and 4)	3.5	4.3.2

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

2/ One determination per sample unit and the results reported as "pass" or "fail".

3/ The test shall be conducted at 300°F.

4/ Filling only.

4.2.4 Packaging inspection. The inspection shall be in accordance with the applicable quality assurance provisions of PPP-P-1132, PPP-P-1133, or PPP-P-1134 as applicable.

4.3 Methods of inspection.

4.3.1 Bonding strength test.

\* 4.3.1.1 Bonding strength procedure (initial and after laundering/dry cleaning). Cut a 12-inch warp by 11-inch filling sample from a blended polyester/cotton (any percentage) plain weave sheeting material that weighs a minimum of 3.5 ounces per square yard. If the fusible cloth is to be supplied for fusing to a known outershell material, the known outershell shall be used if possible (see 6.5). Match the adhesive side of the fusible material (warp machine or wale direction) to the backside (warp direction) of the outershell material leaving a 1-inch starter strip along the full filling width. The starter strip may be formed by either placing a thin 1-inch non-adhesive strip between the fusible and outershell, or by folding the fusible 1/2 inch into itself along the full width. Fuse a single layer (fusible cloth to outershell material) in accordance with the producer's own standards for time, temperature, and pressure. Fusing shall be accomplished on a dry electrically heated fusing press capable of controlling time, temperature, and pressure for a minimum of 8 hours. When cool to the touch (see 6.4), cut the sample in half along the warp direction, and cut one of the halves along the warp direction to obtain three 1-inch by 12-inch strips. Pinking sheers shall not be used for cutting specimens. Determine the bonding strength on a constant rate of extension (CRE), constant rate of traverse (CRT), or calibrated spring scale tensile tester (see 6.5).

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Clamp the open end of the outershell material into the top jaws of the tensile equipment and the fusible starter strip into the bottom jaws. If a spring scale is used, gently pull the fusible starter strip in an even downward motion with the outershell material either hooked or clamped onto the spring scale. Each of the three determinations on the sample unit must meet the initial bonding strength requirements of 3.4.1. The remaining half of the fused swatch shall be commercially dry cleaned three times using perchlorethylene solvent (for class 1 fusible) or laundered three times in accordance with 4.3.2.2 (classes 2, 3, and 4). Samples shall be bottom steam pressed after laundering or dry cleaning for twenty seconds in a non-locked position and vacumed for 10 seconds. Any evidence of bubbling, delamination, or strike through after pressing shall be considered a failure for the sample unit. Acceptable sample units shall be cut and tested for bonding strength in accordance with the initial bonding strength procedure above. Any sample on which the bond strength does not meet the after laundering/dry cleaning requirements of 3.4.1 shall fail this test.

#### 4.3.2 Dimensional stability test.

4.3.2.1 Preparation of specimens. A 22-inch by 22-inch square specimen shall be cut parallel to the warp (wale or machine) and filling (course or cross machine) directions to within 3 inches of the selvage from the fusible cloth sample. Types II, III, and IV fusible material shall be fused to the outershell material in accordance with the procedure in 4.3.1.1. As an option, the remaining types can also be fused. An 18-inch square shall be marked as a minimum at each corner within the 22-inch specimen with indelible ink or stitch marks with the side of the square parallel to the yarns of the fusible material. No marks shall be closer to the edge of the specimen than 1 inch. Class 1 fusibles shall be commercially dry cleaned once, using the procedure stated in 4.3.1.1, and classes 2, 3, and 4 shall be laundered once, using the procedure stated in 4.3.2.2.

4.3.2.2 Laundering. Place the 22-inch by 22-inch specimen in the washing machine with sufficient dummy pieces to have a 4 +/- 1/4 pound wash load. Lightweight fusible types V through VIII should be placed into mesh laundry bags to prevent excessive degradation. The washer shall be filled with water having a temperature of 120° +/- 5° F. The rinse temperature shall be 80° +/- 5° F. Washing shall be accomplished with a 12 minute cycle on the permanent press setting, and the machine allowed to proceed through the final spin cycle. Upon completion, remove the load, dry it in a dryer on the permanent press setting, and finish with a 10-minute cool down cycle. Remove immediately upon completion and condition the sample to equilibrium under standard conditions in accordance with FED-STD-191. Any dimensional change as determined by the procedure in 4.3.2.3 that exceeds the maximum specified in 3.5 (except for type IX) shall constitute failure of this test.

4.3.2.3 Dimensional stability calculation. Each of the three 22 by 22 inch specimens shall be laid out without tension on a flat surface. Care should be taken that the specimens are free from wrinkles and creases. The previously measured distances marked on the specimens (initial measurement, 18 inches) in

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the warp direction shall be remeasured to the nearest 1/16-inch, recorded, averaged and calculated for dimensional change. The same procedure shall be repeated for the filling direction. The dimensional change of the sample unit (3 specimens) shall be calculated to the nearest 0.10 percent using the following formula:

$$\text{Dimensional change, percent} = \frac{A-B}{A} \times 100$$

Where A = Average of initial measurements (18 inches)

B = Average measurements after laundering or drycleaning

## 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 requirements of PPP-P-1132, PPP-B-1133 or PPP-P-1134, as applicable.

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-1132, PPP-P-1133, or PPP-P-1134.

5.3 Marking. In addition to any special marking required by the contract or purchase order, shipments shall be marked in accordance with PPP-P-1132, PPP-P-1133, or PPP-P-1134, as applicable.

## 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 the fusible type clothing for the Department of Defense. Fused end item properties are dependent upon selection of fusible substrate type, fiber content, adhesive class, fusing press conditions, and end item care-label instructions. All these variables must be considered to assure proper end item performance.

### 6.1.1 Substrate type:

a. Woven substrates offer excellent strength and stability with type I providing a relatively thin and stiff composite. Type II provides more bias-stretch and loft.

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b. Knit substrates offer stretch, type III provides softness and drape, and type IV, being a self-lining, offers minimum stiffness.

c. Non-wovens generally offer lower strength compared to other types; but can provide excellent softness, drape, and hand with lowest possible weight and bulk. The type VIII comes with either aperture holes or non-apertured or solid flannel.

d. Open net-web type IX has no substrate carrier and serves as a two-sided fusible to bond dissimilar fabrics. Increased web weight increases bonded stiffness. Also, specify polyamide web for dry cleanable end item use and polyester for launderable use.

#### 6.1.2 Adhesive class:

a. Class 1, polyamide - Chemists term for nylon 6, 6,6, 11, 12 or blends thereof. Excellent dry cleaning/good laundering resistance, strong bond without excessive heat or pressure. Adhesive is regenerative in nature.

b. Class 2, polyester - Excellent laundering/good dry cleaning resistance. Adhesive has higher melt viscosity than polyamide, thus possess less show through.

c. Class 3, polyethylene - High density type possess excellent laundering/fair dry cleaning resistance. May require slightly higher fusing press temperature to activate and is relatively stiff when fused.

d. Class 4, polyvinyl chloride/polyvinyl acetate (PVC/PVA) - Excellent laundering/good dry cleaning resistance. Uses higher fusing press temperature to activate and provides excellent bond on water-repellent treated outershell materials. PVA is blended to the PVC to provide good flexibility and resiliency.

\* e. Class 5, polyvinyl acetate co-polymer - Absolutely no laundering resistance offered. Used only as a fabrication aide interlining essentially for folding, shaping, and stitching shirt collars together.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Type, class, and style required (see 1.2 and 3.4).
- c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1).
- d. When face napping is required (see 3.1.2.1, 3.1.2.2, and 3.1.2.3).
- e. Adhesive application if other than specified (see 3.2).
- f. Color if other than natural (see 3.3).
- g. Width of cloth required (see 3.6).

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- h. Length if other than specified (see 3.7).
- i. Levels of put-up, preservation, and packing (see 5.1 and 5.2).

6.3 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

6.4 Cool to the touch. Experience has shown that a minimum of 2 hours after fusing provides the maximum bonding strength.

6.5 Bonding strength dispute procedure. In case of dispute, the government shall utilize the actual outershell material designated in the end-item requirement. Also, bonding strength shall be determined using the average of the first 3 inches of the five highest and five lowest bonding strength peaks from a chart recording on a CRE Tensile Tester running at 12 inches per minute. If splitting is observed on a nonwoven fusible, then just the highest peak shall be regarded as the bonding strength.

6.6 Subject term (key word) listing.

Adhesive  
 Clothing  
 Interlining  
 Substrate

- \* 6.7 Changes from previous issue. The margins of this specification are marked with asterisks to indicate where changes (additions, modifications, corrections, deletions) from the previous issue were made. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations and relationship to the last previous issue.

## Custodians:

Army - GL  
 Navy - NU  
 Air Force - 11

## Preparing activity:

Army - GL  
 (Project 8305-0352)

## Review activities:

Army - MD  
 Navy - MC, CG  
 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
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<b>1 RECOMMEND A CHANGE:</b>	1. DOCUMENT NUMBER MIL-C-44296A	2. DOCUMENT DATE (YYMMDD) 1990 September 6
3. DOCUMENT TITLE CLOTH, FUSIBLES		
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)	7. DATE SUBMITTED (YYMMDD)
	(1) Commercial (2) AUTOVON (if applicable)	
8. PREPARING ACTIVITY		
a. NAME	b. TELEPHONE (include Area Code)	(2) AUTOVON
S Army Natick RD&E Center	(1) Commercial 508-651-5221	256-5221
c. ADDRESS (include Zip Code)	IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT	
Commander, U S Army Natick RD&E Center ATTN STRNC-ES Natick, MA 01760-5014	Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	