

INCH-POUND

GL/PD 07-14A

10 June 2009

SUPERSEDING

GL/PD 07-14

6 April 2007

PURCHASE DESCRIPTION

TROUSERS, ARMY COMBAT UNIFORM

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

1. SCOPE

1.1 Scope. This specification covers the requirements for universal camouflage pattern trousers to be worn by the Army.

1.2 Classification. The trouser shall be of the following types, classes and sizes, as specified (see 6.2).

1.2.1 Type I - 50/50 Nylon/Cotton Ripstop

Type II - 65/25/10 Rayon/Para-Aramid/Nylon Ripstop Flame Resistant

Class1 - Untreated

Class 2 - Permethrin treated

1.2.2 Size. The trouser sizes shall be as follows:

SCHEDULE OF SIZES

<u>X-Small</u>	<u>Small</u>	<u>Medium</u>	<u>Large</u>	<u>X-Large</u>	<u>XX-Large</u>
X-Short	X-Short	X-Short	X-Short	X-Short	X-Short
Short	Short	Short	Short	Short	Short
Regular	Regular	Regular	Regular	Regular	Regular
Long	Long	Long	Long	Long	Long
X-Long	X-Long	X-Long	X-Long	X-Long	X-Long
XX-Long	XX-Long	XX-Long	XX-Long	XX-Long	XX-Long

Comments, suggestions, or questions on this document should be addressed to: US Army Natick Research, Development and Engineering Center, Attn: RDNS-WPW-C, Kansas Street, Natick, MA 01760-5019.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 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 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, 4, or 5 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 SPECIFICATIONS

V-B-871 Button, Sewing, Hole and Button Staple (plastic)

FEDERAL STANDARDS

FED-STD-4B Glossary of Fabric Imperfections

COMMERCIAL ITEM DESCRIPTIONS

A-A-50195	Thread, Aramid
A-A-50198	Thread, Gimp, Cotton, Buttonhole
A-A-50199	Thread, Polyester Core, Cotton or Polyester Covered
A-A-55126	Fastener Tape, Hook and Loop, Synthetic
A-A-55195	Thread, Para-Aramid, Spun, Intermediate Modulus
A-A-55217	Thread, Aramid, Spun, Staple
A-A-59826	Thread, Nylon

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-DTL-32075	Label: For Clothing, Equipage, and Tentage (General Use)
MIL-DTL-44411	Insect Repellent, Permethrin
MIL-DTL-44436	Cloth, Camouflage Pattern, Wind Resistant Poplin, Nylon/Cotton Blend
MIL-PRF-5038	Tape, Textile and Webbing, Textile, Reinforcing Nylon

(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.)

PURCHASE DESCRIPTION

GL/PD 07-12 Cloth, Flame Resistant

(Copies of this document are available through the contracting activity.)

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 specified in the solicitation or contract.

DRAWINGS

U.S. ARMY RESEARCH, DEVELOPMENT AND ENGINEERING COMMAND

2-1-2519	Universal Camouflage Pattern
2-1-2519-1	ARPAT Camouflage Pattern Desert Sand 500
2-1-2519-2	ARPAT Camouflage Pattern Urban Gray 501
2-1-2519-3	ARPAT Camouflage Pattern Foliage Green 502

(Copies of drawings are available from the U.S. Army Natick Research Development and Engineering Center, Natick Soldier Center, ATTN: RDNS-WPW-C, Natick, MA 01760.)

ENVIRONMENTAL PROTECTION AGENCY (EPA)

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
(40 CFR Part 162) State Registration of Pesticide Products

Federal Insecticide, Fungicide and Rodenticide Act (FIFRA)
FIFRA as amended by the Food Quality Protection Act of 1996 and the
Pesticide Registration Improvement Act of 2003

EPA Product Performance Test Guidelines
OPPTS 810.370 Insect Repellents for Human Skin and Outdoor Premises

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

FEDERAL ACQUISITION REGULATIONS (FAR)

52.209-4 – First Article Approval – Government Testing

(Copies are available online at <http://acquisition.gov/far/index.html> or by contacting the Superintendent of Documents at 202-512-1800.)

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 specified in the solicitation or contract. (See 6.2).

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC Evaluation Procedure 9, Option A, Visual Assessment of Color Difference of Textiles
AATCC Test Method 81 - pH of the Water-Extract from Wet Processed Textiles
AATCC Test Method 135- Dimensional Changes of Fabrics After Home Laundering

(Copies 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 QUALITY (ASQ)

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

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

ASTM INTERNATIONAL (ASTM)

ASTM D 1776	Standard Practice for Conditioning and Testing Textiles
ASTM D 1907	Standard Test Method for Linear Density of Yarn (Yarn Number) by the Skein Method
ASTM D 3773	Standard Test Method for Length of Woven Fabrics
ASTM D 3774	Standard Test Method for Width of Textile Fabrics
ASTM D 3775	Standard Test Method for Warp End Count and Filling Pick Count of Woven Fabrics
ASTM D 3776	Standard Test Method for Mass Per Unit Area (Weight) of Fabric
ASTM D 5034	Breaking Strength and Elongation of Textile Fabrics
ASTM D 6413	Standard Test Method for Flame Resistance of Textiles (Vertical Test)
ASTM D 6193	Standard Practice for Stitches and Seams

(Copies are available online at www.astm.org or from the ASTM INTERNATIONAL, 100 Barr Harbor Drive, West Conshohocken, PA 19426-2959.)

PARACHUTE INDUSTRY ASSOCIATION (PIA)

PIA-TEST METHOD-4108 Strength and Elongation Breaking; Textile Webbing, Tape and braided material

(Copies are available online through the PIA website at: www.pia.com.)

OTHER PUBLICATIONS

Repeat Insult Patch Test – Modified Draze Procedure
Principles and Methods of Toxicology, (fourth edition) A Wallace Hayes (editor), pp 1057 - 1060, 2001

(Copies are available online at <http://www.taylorandfrancis.co.uk/> or from Taylor and Francis, 325 Chestnut Street, Philadelphia, PA 19106.)

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 in accordance with 4.2.

3.2 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 Materials.

3.3.1 Basic material (Type I). The basic material for the Type I trousers shall be a 50/50% nylon/cotton ripstop blend, wind resistant poplin cloth in a universal camouflage pattern conforming to Class 8 of MIL-DTL-44436.

3.3.1.1 Basic material (Type II) The basic material for the Type II trouser shall be a 65/25/10 flame resistant rayon/para-aramid/nylon blend, cloth in universal camouflage pattern conforming to GL/PD 07-12.

3.3.2 Cloth, side and hip hanging pockets, and waistband lining (Type I and Type II). The cloth for waistband lining, side and hip pockets, shall be basic material or ground shade cloth or printed UCP seconds. For printed material, prior to overprinting of the Universal Camouflage Pattern (UCP), the ground shade cloth for Type I shall be dyed conforming to class 6 of MIL-DTL 44436 and for Type II shall be Desert Sand 500 in accordance with GL-PD 07-12. The ground shade (Type I and II) shall meet the respective finished fabric physical, mechanical, and dimensional requirements. Seconds shall be cloth which has been rejected only for defects pertaining to color, infrared reflectance, or camouflage printed pattern as specified in MIL-DTL-44436 (Type I) or GL-PD 07-12 (Type II) as applicable.

3.3.2.1. Alternate side and hip hanging pockets (Type I only). As an alternate for Type I trouser only, a 5.04 oz/sq. yd. minimum, plain weave, 75% polyester 25% cotton, material or equal may be used for side and hip hanging pockets only. The color for the material shall be Desert Sand 500, Urban Grey 501, or Foliage Green 502. (See 6.4)

3.3.2.2 Alternate Flame Resistant (FR) side and hip hanging pockets (Type II only). As an alternate for Type II trouser, the following material type may be used for side and hip hanging pockets only, 7.0 to 8.0 oz/sq. yd., 2x1 left hand twill, with 91 x 47 warp/filling ends per inch (minimum), 80% cotton/20% meta aramid fiber blend. The material shall have the following flame resistance characteristics: After Flame of 2.0 seconds (minimum); After Glow of 25.0 seconds (maximum) and Char Length of 4.5 inches (maximum) initially and after 25 laundering cycles. The color for the material shall be Desert Sand 500, Urban Grey 501, or Foliage Green 502. (See 6.4.) Testing shall be as specified in 4.4.2. (See 6.4.1)

3.4 Insect bite protection. The Class 2 trouser shall be treated for insect bite protection. The finished trouser with bite protection treatment shall be strictly limited to the level specified in 3.4.1 and provide the minimum insect bite protection specified in 3.4.2.

3.4.1 Permethrin treatment (Class 2 only). Permethrin treatment process and garments will comply with Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) as amended (see 2.2.2). Permethrin concentration in Class 2 trousers shall comply with EPA Toxological Category IV. The Class 2 trouser shall have an EPA registered (See 6.5) permethrin insect protection treatment which shall use permethrin in accordance with Type II specified in MIL-DTL-44411 except that the application for Type II specified in paragraph 3.5 (Labels and labeling) of MIL-DTL-44411 shall also be applicable to finished garment. The trouser shall be labeled in accordance with 3.8.2.1.1 and 3.8.2.1.2. The permethrin finish shall be uniformly applied across the fabric or garment and strictly controlled to fall within the initial minimum to maximum permethrin levels specified below. The treatment level shall provide the percent (%) bite protection specified in 3.4.2. The permethrin treatment shall be durable to repeated laundering. The permethrin level testing shall be as specified 4.4.2. The finished permethrin treatment shall not degrade any performance characteristics of the garment or present any latent defects to the cloth or garment.

	<u>Min: mg/cm²</u>	<u>Max: mg/cm²</u>
Initial	0.087	0.130
After 20 launderings	0.025	0.130

3.4.2 Percent (%) Bite Protection (Class 2 only). Type II finished permethrin treated garments shall provide bite protection specified below when assessed by the biting protection testing specified in 4.4.2. Government notification and approval is required initially, and any time there is a change in the permethrin treatment formulation or processing conditions (see 3.13.1).

<u>Condition</u>	<u>% Bite Protection</u>
Initial	>= 90%
After 20 launderings	>= 90%
After 50 launderings	>= 70 - 90%

3.4.3 pH (Class 2). The pH value of the water extract of all the finished cloth and garments shall be no lower than 5.0 or higher than 8.5 when tested as specified in 4.4.2.

3.5 Components.

3.5.1 Tape and cord

3.5.1.1 Barrel lock and hem tape (drawstring). The tape for the barrel lock and leg bottom hem shall conform to MIL-PRF-5038, Type III, 3/8 inch wide. The tape for attaching the barrel lock shall be cut approximately 2 inches in length so that when folded it finishes 3/4 ($\pm 1/8$) inch in length. The drawstring tape for the leg bottom hem shall be 32 (± 1) inches in length. The tape ends shall be heat cut to prevent raveling and the ends of the bottom hem drawstring tape shall be finished with knotted ends. The color shall match Foliage Green 504.

3.5.1.2 Tape, FR identification marker (Type II trouser only). The tape for the FR identification marker shall be 1-inch wide conforming to Type III of MIL-PRF-5038. The tape ends shall be heat cut to prevent raveling. The color shall match Foliage Green 504.

3.5.1.3 Cord, elastic (drawcord). The elastic cord for the cargo pockets shall have a 1/8 ($+1/32$, -0) inch diameter. The elastic cord properties shall be as follows: weight 0.20 oz./linear yard, elongation 120 (± 10) percent, 55 picks/inch minimum, 16 carriers, 3 ends/carrier, 12 elastic strands minimum and polyester cover yarn (see 6.4). The cord length shall be 14 ($\pm 3/4$) inches and shall be heat cut and have knotted ends. The color shall match Foliage Green 504. Testing shall be as specified in 4.4.2. (See 6.6.)

3.5.2 Braid, flat tubular (drawstring). The flat tubular braided drawstring for the internal waistband shall conform to the following requirements: 1000 denier textured nylon cover yarn, basket weave braid construction, 11 picks/inch minimum, 44 carriers, 1-end per/carrier, 3/8 ($\pm 1/32$) inch in width, and a 400 pounds break strength. The finished cut lengths shall have a tolerance of (± 1 inch) as follows: 50 inches for X-Small and Small; 52 inches for Medium and Large; and 54 inches for X-Large and XX-Large. The lengths shall be heat cut to prevent raveling and have knotted ends. The color shall be Foliage Green 504. Testing shall be as specified in 4.4.2

3.5.3 Barrel lock. The barrel locks shall maintain a 3-pound minimum holding strength on elastic cord (see 3.5.3.3) when tested in accordance with 4.4.2. The barrel lock shall be 1/2-inch x 3/8-inch elliptical or 3/8-inch round shape, push-button size to easily operate with gloves. The color shall match Foliage Green 504. Barrel lock shall be set for customer use before packaging. (See 6.7.)

3.5.4 Fastener tape, hook and loop. The hook fastener tape shall conform to Type II, Class 1 or Type III, Class 4 and the loop fastener tape shall conform to Class 1 or Class 4 of A-A-55126. Hook and loop with slit, split edges or any splicing of fastener tape is not permitted. The widths shall be as specified for each application throughout this specification. The tolerance for all widths specified shall be ($\pm 1/32$) inch so as to prevent stitching runoffs or improper fit into

automatic sewing equipment. The color shall match Foliage Green 504. The fastener tape hook and loop Type and Class shall be consistent (same manufacturer/lot) within a garment. (See 6.8.)

3.5.5 Thread (Type I trouser). The thread for all seaming and stitching for the Type I trouser shall conform to Table I. The color shall match Foliage Green 504. Colorfastness requirements in each Commercial Item Description (CID) shall apply.

TABLE I. Thread requirements, Type I trouser only.

Component area	Thread specification	Needle thread (Tex size)	Bobbin/Looper thread (Tex size)
All seaming, stitching and bartacking	A-A-50199, Type II	36-45	36-45
Buttons	A-A-50199, Type II	71-105 (30/3)	N/A
Seat Patch	A-A-50199, Type II	46-60	46-60
Alternate Inseam, safety stitch(5 thread)	A-A-50199, Type II	46-60	46-60
Alternate Inseam, top stitching	A-A-50199, Type II	36-45	36-45
Overedge stitching (raw edges)	A-A-50199, Type II	31-35	31-35
Crotch	A-A-59826, Type I	45-46	45-46

3.5.5.1 Thread (Type II trouser). The thread for all seaming and stitching shall be as specified in Table II. The color shall match Foliage Green 504. Colorfastness requirements in each respective Commercial Item Description (CID) shall apply.

TABLE II. Thread requirements, Type II trouser only.

Component area	Thread specification	Needle thread (Tex size)	Bobbin/Looper thread (Tex size)
All seaming except small parts	A-A-50195 (Soft or Bonded)	60	40
	A-A-55195, Type I	78	59
	A-A-55195, Type II	59	39
	A-A-55217, Type I	70-80	50-60
Safety stitch with top stitch, bartacks, and small parts, (hook and loop, pockets, flaps, top stitching, tabs, hems and eyelets), identification marker, labels and zipper	A-A-50195 (Soft or Bonded)	40	40
	A-A-55195, Type I	59	39
	A-A-55195, Type II	20	20
	A-A-55217, Type I	50-60	50-60

TABLE II. Thread requirements, Type II trouser only - Continued.

Component area	Thread specification	Needle thread (Tex size)	Bobbin/Looper thread (Tex size)
Overedge/Serge/ for portions of safety stitch operation for raw edge cover	A-A-50195 (Soft or Bonded)	40	40
	A-A-55195, Type I	39	39
	A-A-55195, Type II	16	16
	A-A-55217, Type I	24-27	24-27
Crotch seam and seat patch	A-A-50195 (Soft or Bonded)	60	60
	A-A-55195, Type I	78	78
	A-A-55195, Type II	59	59
	A-A-55217, Type I	70-80	70-80
Button attachment	A-A-50195 (Soft or Bonded)	60	60
	A-A-55195, Type I	59	59
	A-A-55195, Type II	39	39
	A-A-55217, Type I	50-60	50-60

3.5.5.2 Gimp. The cotton gimp for reinforcing buttonholes shall conform to A-A-50198, soft or glazed finish, Tex Size 180 or 210. The color shall match Foliage Green 504.

3.5.6 Buttons. Buttons shall be dull finish, 4 holes, 30 ligne conforming to V-B-871, Type II, Class D, Style 26. The color shall match Foliage Green 504. When attached to the trouser, the button and thread shall withstand 40 lbs (minimum) when tested as specified in 4.4.2.

3.6 Design. The trousers shall have a waistband with clean finished ends with seven (7) belt loops, a drawstring and button/buttonhole closure. The trousers shall have a covered fly with three (3) buttons and buttonhole closure. The trousers shall have two (2) side hanging pockets, two (2) back single welt hip pockets with two (2) button closure flaps, two (2) front side pleated cargo pockets with hook and loop closure flaps and two (2) lower leg pockets with hook and loop closure flaps. The front side cargo pockets shall have an elastic drawcord with barrel locks at the top hem. Both front side cargo pockets and lower leg pocket shall have sewn-in eyelets at the bottom of the bellows. The trousers shall have a double needle seat patch, and a knee patch on each leg with hook and loop closure at bottom and a drawstring at each leg bottom (see 3.5.1.1).

3.7 Construction. All material edges shall be clean finished, either, turned-in, turned-under or serged unless otherwise indicated.

3.7.1 Fastener tape, (hook and loop). All widths of hook and loop tape shall be sewn 1/8 - 3/16 inch from bound selvage (for fastener tape with selvage) or from tape edge (for fastener tape without selvage) to prevent needle cutting along edges, stitching runoffs or improper fit into automatic sewing equipment. To prevent raveling on fastener tape with selvage, do not sew directly on the selvage. The use of fastener tape that is slit, has split edges, or any splicing of fastener tape is not permitted. Under no circumstances shall any fastener tape be re-stitched for repair purposes. New tape shall be used for repairs to prevent needle cutting, thus offering maximum field life. All fastener tape may be sewn through all layers on trouser as indicated on the figures (see patterns for placement). Tolerance for all lengths of fastener tape shall be $\pm 1/8$ inch.

3.7.2 Waistband. The finished waistband shall measure 1-3/4 ($\pm 1/8$) inches wide with clean finished ends and a button/buttonhole closure. The width of the waistband shall be consistent so that the right and left sides match each other in width at the front within 3/16 inch. The waistband also has a flat tubular braided drawstring inserted through 1/2 inch straight cut vertical buttonholes or 3/8 inch sewn eyelets, with knotted ends for waist adjustment. The drawstring buttonholes or sewn eyelets shall be centered 3 ($\pm 1/2$) inches from finished edge on each side of waistband, and shall be of sufficient size and form as to allow the drawstring to move smoothly and evenly through the holes. The waistband shall also have a button and horizontal buttonhole closure that shall align vertically with the fly button and buttonhole closure (see figure 6).

3.7.3 Belt loops. The trouser shall have seven (7) belt loops measuring 3/8 - 1/2 inch in width and finish 2 - 2-1/4 inches between bartacks in the length. The belt loop placement shall be as follows: one (1) loop on each side seam, one (1) on back seam, and one (1) on each front centered between side seam and waistband end, and one (1) on each back side centered between side seam and back seam. Belt loops may be positioned immediately adjacent to felled seams to reduce bulk in sewing.

3.7.4 Fly. The trouser fly shall be a covered fly with three (3) buttons and buttonhole closure. The buttonholes shall be horizontal and placed as indicated on the pattern. The fly shall have "J" stitching 2-inches from fly edge. The top fly shall be edge stitched 1/16 - 1/8 inch. See figure 6.

3.7.5 Seat patch. The trouser shall have a double-needle seat patch (see pattern for placement). See figure 2.

3.7.6 Knee patches. The trouser shall have a knee patch on each leg, for foam inserts, with an opening on the bottom with hook and loop closure. The top of the knee patch shall be double-needle stitched. The opening shall be a minimum of 6 inches wide between bartacks and the channels shall be a minimum of 6 inches wide. The hook and loop tape for the closure shall be 5/8 inch wide by 6-1/2 inches long. Openings on each side of the knee patch hook and loop closure shall be topstitched closed prior to bartacking. The hook fastener shall be sewn on the underside of patch and the loop fastener on the trouser leg front. The hook and loop fastener tape shall be sewn on prior to finishing the knee patch assembly.

3.7.7 Pockets and flaps.

3.7.7.1 Front side pockets. The trouser shall have two (2) front side hanging pockets with pocket openings measuring not less than 6 inches and not more than 7-1/4 inches between bartacks. Pocket openings shall match each other within 1/4 inch.

3.7.7.2 Hip pockets. The trousers shall have back left and right single welt hip pockets with a two (2) button/buttonhole closure per pocket. The welt shall measure 3/16 – 1/2 inch. The buttons shall be sewn onto the outside of the pocket and the buttonholes shall be sewn into the underside of the flap as indicated on patterns.

3.7.7.3 Cargo pockets and flaps. The trouser shall have two (2) pleated bellows cargo pockets with flaps (see pattern for placement). The pockets shall have a sewn-in eyelet at the bottom of bellow, as indicated on the pattern (see 3.7.10). The pockets shall have an elastic drawcord (see 3.5.1.3) inserted through eyelets at the top of pocket hem with a barrel lock (see 3.5.3) for adjustment. The barrel lock shall be attached to the side of the cargo pocket with a piece of folded tape (see 3.5.1.1). The elastic cord shall be firmly clasped in the barrel lock when closed and shall pull smoothly through barrel lock when open. The pocket flaps shall be set 1/2 inch from the folded edge of pocket top (see pattern for placement). The cargo pockets and flaps shall close with a three (3) button (2) buttonhole closure per pocket. The buttons shall be sewn onto the outside of the pocket and the buttonholes shall be sewn onto the underside of the flap as indicated on patterns.

3.7.7.4 Lower leg pockets and flaps. The trouser shall have two (2) lower leg bellows pockets with flaps (see pattern for placement). The pockets shall have a sew-in eyelet at the bottom of the bellow, as indicated on pattern (see 3.7.10). The pocket flaps shall be set 1/2 inch from the folded edge of pocket top (see pattern for placement). The pockets shall close with one (1) piece of loop fastener tape measuring 1-inch wide by 3-1/2 inches long sewn to the underside of pocket flap and two (2) pieces of hook fastener tape measuring 1-inch wide by 1-inch long sewn to the outer side of pocket hem as indicated on pattern.

3.7.8 Leg bottom and hem. The trouser leg bottoms shall be hemmed and shall have a drawstring inserted through two (2) sewn-in eyelets or two (2) 1/2 inch horizontal straight cut buttonholes with reinforcement piece as indicated on patterns (see 3.7.9 and 3.11.1). The drawstring tape see (3.5.1.1) shall overlap (cross) between holes when threaded through the hem casing. The drawstring shall be knotted at each end. The finished hem shall measure 7/8 (\pm 1/8) inch wide.

3.7.9 Buttonholes. The buttonholes shall be eyelet-end tapered bar type worked over gimp for the fly, back hip welt pocket flaps, cargo pocket flaps and waistband with not less than four (4) tacking stitches at bar end catching the gimp ends (not counting the crossover stitch). The purling shall be on the outside surface. The cut lengths shall be 3/4 to 7/8 inch. The buttonholes shall be clean cut with the stitching securely caught in fabric, possessing 52-56 stitches per inch, including tack. When buttonholes are used in lieu of sewn-in eyelets for the waistband and leg bottom hem drawstrings they shall be 1/2 inch vertical straight cut for the waistband and 1/2 inch horizontal straight cut for the leg bottom hem.

3.7.10 Eyelets. The sewn-in eyelets for the bellows pockets shall have a minimum of 16 stitches each with a 3/16 to 1/4 inch diameter finished opening. The width of the bight of stitching shall be not less than 1/16 inch. The eyelet stitching shall have at least four overlapping stitches with the purling on the outside (301 or 401 stitch type). When sewn-in eyelets are used for the waistband and leg bottom they shall measure $3/8 \pm 1/8$ inch in diameter.

3.7.11 Identification FR marker (Type II trouser only). The Type II trouser shall have a tape marker as specified in 3.5.1.2 on the left cargo pocket flap as worn (see pattern for placement). The tape marker shall finish 1-inch ($\pm 1/8$) in length. The finished tape identification marker shall be box stitched as specified in Table V using 10 - 14 stitches per inch. The thread shall be in accordance with the requirements for the Type II trouser (see 3.5.5.1).

3.8 Labels. Each trouser shall have a size label and a combination identification/care label. The color of the labels shall be white or approximate the ground shade of the basic fabric, and the printing shall be black. The inscription shall have a minimum font size of 8 points for identification/care label only. The font for the size label shall be 10 points. The inscription legibility, label, and label attachment shall last the expected life of the trouser.

3.8.1 Size label. The size label shall conform to Type VI, Class 2 of MIL-DTL-32075 and shall be sewn and caught in the bottom of the inside waistband seam. The stitching shall not cover the printing. The size label shall include the information in Table III for the applicable size:


TABLE III. Size label.

X-Small – X-Short Inseam: Up to 26-1/2 in. Waist: Up to 27 in. NSN No. NATO Size: 6067/5869	X-Small – Short Inseam: 26-1/2 to 29-1/2 in. Waist: Up to 27 in. NSN No. NATO Size: 6775/5869	X-Small – Regular Inseam: 29-1/2 to 32-1/2 in. Waist: Up to 27 in. NSN No. NATO Size: 7583/5869
X-Small – Long Inseam: 32-1/2 to 35-1/2 in. Waist: Up to 27 in. NSN No. NATO Size: 8390/5869	X-Small – X-Long Inseam: 35-1/2 to 38-1/2 in. Waist: Up to 27 in. NSN No. NATO Size: 9098/5869	X-Small – XX-Long Inseam: Over 38-1/2 in. Waist: Up to 27 in. NSN No. NATO Size: 9805/5869
Size: Small – X-Short Inseam: Up to 26-1/2 in. Waist: 27 to 31 in. NSN No. NATO Size: 6067/6979	Small – Short Inseam: 26-1/2 to 29-1/2 in. Waist: 27 to 31 in. NSN No. NATO Size: 6775/6979	Small – Regular Inseam: 29-1/2 to 32-1/2 in. Waist: 27 to 31 in. NSN No. NATO Size: 7583/6979
Small – Long Inseam: 32-1/2 to 35-1/2 in. Waist: 27 to 31 in. NSN No. NATO Size: 8390/6979	Small – X-Long Inseam: 35-1/2 to 38-1/2 in. Waist: 27 to 31 in. NSN No. NATO Size: 9098/6979	Small – XX-Long Inseam: Over 38-1/2 in. Waist: 27 to 31 in. NSN No. NATO Size: 9805/6979

TABLE II. Size label – Continued.


Medium – X-Short Inseam: Up to 26-1/2 in. Waist: 31 to 35 in. NSN No. NATO Size: 6067/7989	Medium – Short Inseam: 26-1/2 to 29-1/2 in. Waist: 31 to 35 in. NSN No. NATO Size: 6775/7989	Medium – Regular Inseam: 29-1/2 to 32-1/2 in. Waist: 31 to 35 in. NSN No. NATO Size: 7583/7989
Medium – Long Inseam: 32-1/2 to 35-1/2 in. Waist: 31 to 35 in. NSN No. NATO Size: 8390/7989	Medium - X-Long Inseam: 35-1/2 to 38-1/2 in. Waist: 31 to 35 in. NSN No. NATO Size: 9098/7989	Medium - XX-Long Inseam: Over 38-1/2 in. Waist: 31 to 35 in. NSN No. NATO Size: 9805/7989
Large - X-Short Inseam: Up to 26-1/2 in. Waist: 35 to 39 in. NSN No. NATO Size: 6067/8999	Large – Short Inseam: 26-1/2 to 29-1/2 in. Waist: 35 to 39 in. NSN No. NATO Size: 6775/8999	Large - Regular Inseam: 29-1/2 to 32-1/2 in. Waist: 35 to 39 in. NSN No. NATO Size: 7583/8999
Large – Long Inseam: 32-1/2 to 35-1/2 in. Waist: 35 to 39 in. NSN No. NATO Size: 8390/8999	Large - X-Long Inseam: 35-1/2 to 38-1/2 in. Waist: 35 to 39 in. NSN No. NATO Size: 9098/8999	Large - XX-Long Inseam: Over 38-1/2 in. Waist: 35 to 39 in. NSN No. NATO Size: 9805/8999
X-Large - X-Short Inseam: Up to 26-1/2 in. Waist: 39 to 43 in. NSN No. NATO Size: 6067/9909	X-Large - Short Inseam: 26-1/2 to 29-1/2 in. Waist: 39 to 43 in. NSN No. NATO Size: 6775/9909	X-Large - Regular Inseam: 29-1/2 to 32-1/2 in. Waist: 39 to 43 in. NSN No. NATO Size: 7583/9909
X-Large - Long Inseam: 32-1/2 to 35-1/2 in. Waist: 39 to 43 in. NSN No. NATO Size: 8390/9909	X-Large - X-Long Inseam: 35-1/2 to 38-1/2 in. Waist: 39 to 43 in. NSN No. NATO Size: 9098/9909	X-Large - XX-Long Inseam: Over 38-1/2 in. Waist: 39 to 43 in. NSN No. NATO Size: 9805/9909
XX-Large - X-Short Inseam: Up to 26-1/2 in. Waist: 43 to 47 in. NSN No. NATO Size: 6067/0919	XX-Large – Short Inseam: 26-1/2 to 29-1/2 in. Waist: 43 to 47 in. NSN No. NATO Size: 6775/0919	XX-Large - Regular Inseam: 29-1/2 to 32-1/2 in. Waist: 43 to 47 in. NSN No. NATO Size: 7583/0919
XX-Large - Long Inseam: 32-1/2 to 35-1/2 in. Waist: 43 to 47 in. NSN No. NATO Size: 8390/0919	XX-Large - X-Long Inseam: 35-1/2 to 38-1/2 in. Waist: 43 to 47 in. NSN No. NATO Size: 9098/0919	XX-Large - XX-Long Inseam: Over 38-1/2 in. Waist: 43 to 47 in. NSN No. NATO Size: 9805/0919

3.8.2 Identification and care label, Type I trouser. The combination identification/care label shall conform to Type VI, Class 15 of MIL-DTL-32075 and shall be placed on the inside of the right hip pocket as worn, so that on the finished trouser the label shall face the wearer. The label shall be sewn on all four sides and the stitching shall not cover the printing or penetrate the trouser front. The label shall include the following information:

	<p>This product meets the manufacturing and performance testing requirements as authorized by the Program Executive Office - Soldier</p>	<p>Trouser, Army Combat Uniform Contract Number: Fiber Content: Contractor Name: Lot Number: <u>1</u>/</p>
<p style="text-align: center;">Use and Care Label</p> <ol style="list-style-type: none"> 1. Adjust waist size with internal waistband tie. 2. Before washing, remove all items from pockets. Close all hook and loop fasteners to prevent snagging. Knot waistband tie. Turn the trousers inside out. 3. <u>Washing and Drying:</u> Machine wash in cold water, using Permanent Press cycle, Rinse cold Machine tumble dry on low to medium setting between 140° – 160° F. or Hand wash using a mild detergent only without bleach. Rinse completely. DO NOT WRING OR TWIST, hang dry. <p style="text-align: center;">CAUTION</p> <p>DO NOT USE CHLORINE BLEACH, BLEACH ALTERNATIVES, FABRIC SOFTENER OR STARCH Dry cleaning or commercially hot pressing the ACU will permanently damage the trousers.</p> <p>Applying heat or an iron to any hook and loop fastener area will permanently damage the fasteners. Lightly brushing the hook and loop fasteners will remove accumulated debris</p> <p>DO NOT REMOVE THIS LABEL</p>		

1/ Lot number shall be stamped with indelible black ink prior to shipment.

3.8.2.1 Identification and care label, Type II flame resistant trouser. The combination identification/care label shall conform to Type VI, Class 15 of MIL-DTL-32075 and shall be placed in the inside of the right hip pocket as worn, so that on the finished trouser the label shall face the wearer. The label shall be sewn on all four sides and the stitching shall not cover the printing or penetrate the trouser front. The label shall include the following information:

	<p>This product meets the manufacturing and performance testing requirements as authorized by the Program Executive Office - Soldier</p>	<p>Trouser, Army Combat Uniform FLAME RESISTANT Contract Number: Fiber Content: Contractor Name: Lot Number: <u>1/</u></p>
<p style="text-align: center;">Use and Care Label</p> <ol style="list-style-type: none"> 1. Adjust waist size with internal waistband tie. 2. Before washing, remove all items from pockets. Close all hook and loop fasteners to prevent snagging. Knot waistband tie. Turn the trousers inside out. 3. <u>Washing and Drying</u>: Machine wash in cold water, using Permanent Press cycle, Rinse cold Machine tumble dry on low to medium setting between 140° – 160° F. or Hand wash using a mild detergent only without bleach. Rinse completely. DO NOT WRING OR TWIST, hang dry. <p style="text-align: center;">CAUTION</p> <p>DO NOT USE CHLORINE BLEACH, BLEACH ALTERNATIVES, FABRIC SOFTENER OR STARCH Dry cleaning or commercially hot pressing the ACU will permanently damage the trousers.</p> <p>Applying heat or an iron to any hook and loop fastener area will permanently damage the fasteners. Lightly brushing the hook and loop fasteners will remove accumulated debris</p> <p style="text-align: center;">DO NOT REMOVE THIS LABEL THIS GARMENT IS FLAME RESISTANT</p>		

1/ Lot number shall be stamped with indelible black ink prior to shipment.

3.8.2.1.1 Combination insect protection/identification/care label Class 2 trouser. The combination insect protection/identification/care label shall conform to Type VI, Class 15 of MIL-DTL-32075 and shall be placed in the inside of the left hip pocket as worn, so that on the finished trouser the label shall face the wearer. The label shall include both permanent insect protection and brand labeling information; and shall comply with the approved EPA registration (see 6.5). The label shall be sewn on all four sides. Label stitching shall not cover the printing and shall be completely covered from the outside by the pocket (stitching shall not be visible from the front of the trouser). The label shall include the following information:

**Insect Repellent Brand Name:
INSECT REPELLENT APPAREL**

Refer to hangtag for more information

Trouser, Army Combat Uniform, **Flame Resistant**

Contract Number:

Contractor Name:

(Brand Name) INSECT REPELLENT APPAREL

EPA REG. NO.:

EPA EST. NO.:

Lot Number 1/

-Do Not Dry Clean

Dry Cleaning removes active ingredient

-Wash separate from other clothing

-Do Not Re-treat with a permethrin product

-May be laundered with other clothing when in field or combat situations

-Dispose of garment in trash

Repels mosquitoes, ticks, ants, flies, chiggers and midges

Repellency remains effective for 25 washings

ACTIVE INGREDIENTS	%W/W
Permethrin.....	0.52%
OTHER INGREDIENTS: (Garment).....	99.48%
TOTAL.....	100.00%

It is a violation of Federal Law to use this product
In a manner inconsistent with its labeling

Retain hangtag for future reference on proper handling
of this garment

DO NOT REMOVE THIS LABEL

1/ Lot number shall be stamped with indelible black ink prior to shipment.

3.8.2.1.2 Hang tag, insect protection Class 2 trouser. Each trouser shall have an individual paper tag attached to the garment conforming to Type VIII, Class 15 of MIL-DTL-32075. The tag shall provide additional insect protection information as required by EPA registration. The hang tag shall contain the following information:

<p align="center">Insect Repellent Brand Name: INSECT REPELLENT APPAREL Trouser, Army Combat Uniform, Flame Resistant Contract Number: Contractor Name: (Product Brand Name) INSECT REPELLENT APPAREL EPA REG. NO.: EPA EST. NO.:</p>									
<ul style="list-style-type: none"> * Do Not Dry Clean Dry Cleaning removes active ingredient * Wash separate from other clothing * May be laundered with other clothing when in field or combat situations * Do Not Re-treat with other permethrin products * Dispose of garment in trash. Do not contaminate water, food or feed by storage or disposal. Do not reuse clothing/fabric for purposes other than originally intended. * For protection of exposed skin, use in conjunction with an insecticide registered for direct application to the skin. 	<p>Repels mosquitoes, ticks, ants, flies, chiggers and midges Repellency remains effective for 25 washings</p> <table> <tr> <td>ACTIVE INGREDIENTS</td> <td align="right">%W/W</td> </tr> <tr> <td>Permethrin.....</td> <td align="right">0.52%</td> </tr> <tr> <td>OTHER INGREDIENTS: (Garment).....</td> <td align="right">99.48%</td> </tr> <tr> <td>TOTAL.....</td> <td align="right">100.00%</td> </tr> </table> <p>It is a violation of Federal Law to use this product in a manner inconsistent with its labeling.</p> <p>Retain hangtag for future reference on proper handling of this garment. This tag not to be removed except by customer.</p>	ACTIVE INGREDIENTS	%W/W	Permethrin.....	0.52%	OTHER INGREDIENTS: (Garment).....	99.48%	TOTAL.....	100.00%
ACTIVE INGREDIENTS	%W/W								
Permethrin.....	0.52%								
OTHER INGREDIENTS: (Garment).....	99.48%								
TOTAL.....	100.00%								

3.8.3 Barcode label. Each trouser shall have a barcode label conforming to Type VIII, Class 17 of MIL-DTL-32075. The bar coding element shall be a 13 digit national stock number (NSN). There shall be a 12 digit UPC number assigned for all NSNs by the contracting activity. The initials "UPC" must appear beneath the code. The bar code for NSN and UPC type shall be a medium to high density and shall be located so that it is completely visible on the trouser when it is folded and/or packaged as specified and so it causes no damage to the trouser.

3.9 Figures. The figures in this specification are furnished for informational purposes only. To the extent of any inconsistencies between the written document and the figure, the written document shall govern.

3.10 List of pattern parts. The Government shall furnish patterns, which show directional line markings for proper cutting and assembly, and are to be used as a guide for cutting contractor's working patterns. The Government patterns, provide a seam allowance of 1/2 inch for outseams, seat seams, and crotch seams, 1/4 inch allowance for hip pocket flaps and 3/8 inch allowance for all other seams, except where otherwise specified, will be provided by the Government. Pockets, pocket flaps, knee patches, hook and loop fastener tape, buttons, buttonholes, and bartacks shall be located in accordance with marks on patterns and table references. Minor modifications are permitted where necessary to accommodate manufacture's processes and use of automatic equipment. These modifications shall not alter the design, serviceability, appearance or finished measurements. **NOTE:** When the 5-thread safety stitch is used for the inseam, contractor must adjust patterns for 3/8-inch gauge in lieu of 1/2 inch double needle seams. The pattern list in Table IV is provided to insure that the pattern set provided is complete.

TABLE IV. List of pattern parts.

Pattern Abbreviation	Nomenclature	Cut Parts
BACK	Back	2
SD_HG_PK_BR	Side Hanging Pocket Bearer	2
SD_HG_PK_FC	Side Hanging Pocket Facing	2
SEAT_PATCH	Seat Patch	2
KNEE_PATCH	Knee Patch	2
SD_HANG_PKT	Side Hanging Pocket	2
WAISTBND_LN	Waistband Lining	1
CG_PKT_FLP	Cargo Pocket Flap	2
CG_PKT_FLPIN	Cargo Pocket Flap Inner	2
LOW_LEG_FLP	Lower Leg Flap	2
LOLEG_PKT	Lower Leg Pocket	2
LEG_EYELET	Leg Eyelet	2
CARGO_PKT	Cargo Pocket	2
HIP_PCKT_BR	Hip Pocket Bearer	2
HIP_PKT_FAC	Hip Pocket Facing	2
HIP_PKT_FLP	Hip Pocket Flap	2
HIP_POCKET	Hip Pocket	2
HP_PK_FL_TB	Hip Pocket Flap Tab	2
CRG_PKT_FAC	Cargo Pocket Facing	2
WST_EYELET	Waistband Eyelet	2
FRONT	Front	2
LEFT_FLY	Left Fly	3
RGT_FLY_LIN	Right Fly Lining	1
FRONT RT	Right Front	2

TABLE IV. List of pattern parts – Continued.

Pattern Abbreviation	Nomenclature	Cut Parts
Alternate Sewn on Waistband <u>1/</u>		
RGT_FLY_LN_ALT	Right Fly Lining Alternate	1
LEFT_FLY_ALT	Left Fly Alternate	3
FRONT_RGT_ALT	Right Front Alternate	2
HP_PKFLTB_AL	Hip Pocket Flap Alternate	2
BACK_ALT	Back Alternate	2
FRONT_ALT	Front Alternate	2
HIP_PCKT_ALT	Hip Pocket Alternate	2
S_H_P_B_ALT	Side Hanging Pocket Bearer Alternate	2
S_H_P_F_ALT	Side Hanging Pocket Facing Alternate	2
SD_HG_PK_ALT	Side Hanging Pocket Alternate	2

1/ A waistband pattern will be prepared by contractor in accordance with requirements indicated in section 3.7.2.

3.11 Configuration. Each trouser shall conform to appearance (see figures 1-6), the finished measurements in Table VI and the construction methods specified in 3.11.1 through 3.11.2 and Tables IV and V in order to maintain configuration compliance.

3.11.1 Seams and stitching. All seams shall be consistent and exhibit a uniform appearance and conform to the ASTM D 6193 seam and stitch types listed in Table V. The backside of seams (inside garment) shall be flat with no protruding seam allowance to create irritation or discomfort. All material edges shall be clean finished, either, turned-in, turned-under or serged. All pocket flaps shall be serged prior to setting. Needle and bobbin thread tension shall be balanced such that neither is too tight nor too loose relative to each other. The seams for all outside visible stitching shall be sewn with 10-14 stitches per inch. Overedge or pre-hemming shall be 6-10 stitches per inch. As an alternate, the inseam may be safety stitched (5-thread) with 9 stitches per inch (min.) and top stitched with 10 – 14 stitches per inch. Hook and loop tape shall be sewn with 8-12 stitches per inch. Buttons shall be attached with 16 stitches per button. The sewn eyelets for the bellows pockets shall have a minimum of 16 stitches.

3.11.1.1 Crotch intersection seaming and stitching. To reduce bulk when using a felled stitch seam at the crotch intersection, turn back the angled section of the seat patch (see pattern) and stitch down to the right side of the trouser back. See Table VI for bartack placement.

3.11.1.2 Fly seaming and stitching. The fly construction stitching of front center crotch seam shall end 3/8 - 1/2 inch above J-stitch. There shall be a horizontal bartack superimposed on the bottom point of the J-stitch (see figure 6).

Table V. Seam and stitching types.

Seam Placement	Seam type	Gage	Stitch type
Side seams, backseam and inseam OR	LSc-2	3/16 to 9/32 inch gauge (double lap seam)	301 or 401
Alternate inseam safety stitch/top stitch	Ssa-2	3/8 to 1/2 inch gauge	401 516, 519
Top stitch inseam	LSq-3	2 rows 3/16 – 1/4 inch gauge apart	301 or 401
Top stitching of pocket flaps and side pockets	OSf-1	3/16 to 1/4 inch from edge	301
Attachment of pockets	LSd-1	1/16 to 1/8 inch from edge and 1/4 inch gauge	301
Raw edges of pocket flaps, pocket bagging, bearer or facings	Ssa-2	1/4 - 3/8 inch gauge	516, 519
FR identification marker to left cargo pocket flap (Type II trouser only)	LSbj-1	Box stitch 7/8-inch by 7/8-inch	301
Attachment of knee patches	LSd-2	Two rows 3/16 to 1/4 inch apart	301
Bottom hemming	Efb-1	1 inch wide hem	301
Waistband attachment options:			
- Grown-on lining attachment	LSct-2	1/16 to 1/8 inch from top and bottom edge of waistband lining	301, 401
- Top stitch	LSct-3	Along top edge	301, 401
OR			
- Sewn-on 1-piece	Bso-2/	1/16 to 1/8 inch from top and bottom edge of waistband	301, 401
-Top stitch	Bso-3	Along top edge	301, 401
OR			
- Sewn-on 2-piece	LSbc-2	1/16 to 1/8 inch from top and bottom edge of waistband	301, 401

Table V. Seam and stitching types – Continued.

Seam Placement	Seam type	Gage	Stitch type
Hook and loop	LSbj-1	1/8 to 3/16 inch from the bound selvage	301
Cargo and lower Leg Pocket bellows, inside pleat	OSf-1	1/16 to 1/8 inch from edge	301
Seat patch	LSd-2	Two rows 3/16 to 1-4 inch apart. First row of stitching shall be 1/16 to 1/8 inch from folded edge	301
Buttonhole fly – join pieces along front edge; turned in edge	SSe-2 or SSc-1	1/16 to 1/8 inch from turned in edge	301
Join left front and left fly lining along front edge; turned in edge	SSe-2 or SSc-1	1/16 to 1/8 inch from turned in edge	301
Overedge back edges of left fly lining and buttonhole fly	EFd-1	3/16 to 1/4 inch gauge	502, 503 or 504
J-stitch	LSbj-1		301
Join right front and right fly lining along front edge	SSe-2 or SSc-1	1/16 to 1/8 inch from turned in edge	301
Overedge right fly raw edges	FFd-1	3/16 to 1/4 inch gauge	502, 503 or 504
Crotch seam	LSb-2	Two rows 3/16 – 1/4 inch apart. Stitching shall penetrate both crotch pattern pieces. Stitching shall end 2-3/4 – 3 inches from inseam.	301

3.11.2. Bartacking. To maintain durability and functionality, bartacks on the tops of front hanging pockets, cargo pockets, knee patches, fly and top, centerback of drawstring, and top & bottom of belt loops shall be 5/8 inches in length with approximately 36 stitches per bartack. Bartacks on knee patch bottom opening and top corner (anchoring barrel lock webbing) of upper cargo pocket shall be 3/4 inches in length with approximately 48 stitches per bartack. Bartacks shall be placed as specified in Table VI.

TABLE VI. Bartack placement.

Bartack Placement	Size of Tack	Stitches per Tack	# of Bartacks per Side Of Piece
All pocket flaps at top on ends of topstitching (horizontal)	5/8	36	2
Top and bottom of all belt loops (set 1/8-inch from edge)	3/8	28	2
Fly front (one: horizontal superimposed on bottom point of J-stitch of fly outside; one vertical with lower end 1/4 inch from base of right fly and 1/2 inch from front edge of right fly)	5/8	42	2
Horizontal on buttonhole fly to left front lining between the second and third buttonholes and third and fourth buttonholes	5/8	36	2
Bottom of knee patch at hook/loop opening superimposed on top stitching (3/4 inch)	3/4	48	2
Center back of drawstring (on waistband lining)	5/8	36	1
Top and bottom of opening on front hanging pockets @ right angles to front edge (top 1/4-3/8 inch from stitch line of waistband)	5/8	36	2
Cargo pocket top, one: front side; one: back side catching webbing (3/4"); one: at lower back corner (all vertical)	3/4	48	3
End of elastic cording 1/4 inch apart (vertical)	5/8	36	2
Cargo pocket pleats below facing stitching (horizontal)	5/8	42	2
Lower Leg Pocket top, left and right; one at lower corner (opposite side of bellows), (vertical)	5/8	36	3
Back hip pocket at welt ends	5/8	36	2
Center back of leg bottom hem or line tack (vertical), securing lace	5/8	36	1
Crotch junction centered on seam	5/8	36	1
Crotch centered between crotch junction and J-stitch (vertical)	5/8	36	1

3.12 Finished measurements. The trousers shall conform to the finished measurements specified in Table VII.

Table VII. Finished measurements (inches).

Size	X-Small	Small	Medium	Large	X-Large	XX-Large
1/2 Waist, $\pm 1/2$ 1/	13-3/4	15-3/4	17-3/4	19-3/4	21-3/4	23-3/4
Inseam, $\pm 3/4$ 2/						
X-Short	28-3/8	28-3/8	28-3/8	28-3/8	28-3/8	28-3/8
Short	30-3/8	30-3/8	30-3/8	30-3/8	30-3/8	30-3/8
Regular	32-3/8	32-3/8	32-3/8	32-3/8	32-3/8	32-3/8
Long	34-3/8	34-3/8	34-3/8	34-3/8	34-3/8	34-3/8
X-Long	36-3/8	36-3/8	36-3/8	36-3/8	36-3/8	36-3/8
XX-Long	38-3/8	38-3/8	38-3/8	38-3/8	38-3/8	38-3/8
Outseam, $\pm 3/4$ 3/						
X-Short	37-3/8	37-7/8	38-3/8	38-7/8	39-3/8	39-7/8
Short	39-7/8	40-3/8	40-7/8	41-3/8	41-7/8	42-3/8
Regular	42-3/8	42-7/8	43-3/8	43-7/8	44-3/8	44-7/8
Long	44-7/8	45-3/8	45-7/8	46-3/8	46-7/8	47-3/8
X-Long	47-3/8	47-7/8	48-3/8	48-7/8	49-3/8	49-7/8
XX-Long	49-7/8	50-3/8	50-7/8	51-3/8	51-7/8	52-3/8
Bottom, $\pm 1/2$ 4/						
X-Short	17	17	17-3/4	17-3/4	18-1/2	18-1/2
Short	17	17	17-3/4	17-3/4	18-1/2	18-1/2
Regular	17	17	17-3/4	17-3/4	18-1/2	18-1/2
Long	17	17	17-3/4	17-3/4	18-1/2	18-1/2
X-Long	17	17	17-3/4	17-3/4	18-1/2	18-1/2
XX-Long	17	17	17-3/4	17-3/4	18-1/2	18-1/2

- 1/ With waistband and fly buttoned, place trousers on a flat surface and measure along center of waistband from folded edge to folded edge.
- 2/ Measure inseam of trousers from crotch seam to bottom edge of trousers.
- 3/ Measure from top edge of waistband to bottom of leg along outseam.
- 4/ Measure across bottom of leg and multiply by two.

3.13 Toxicity. The finished trouser shall not present a health hazard and shall show compatibility with prolonged, direct skin contact when tested as specified in 4.5.5. Chemicals recognized by the Environmental Protection Agency (EPA) as human carcinogens shall not be used.

3.13.1 Toxicity documents. Finishes/chemicals used in the process of this garment shall be identified and accompanied by the appropriate material Safety Data Sheet (MSDS) information.

3.14 Workmanship. After completion of the final assembly, the trouser shall be thoroughly cleaned and all thread scraps, lint and foreign matter shall be removed. The trouser shall be uniform in quality and shall be free from irregularities or defects which could adversely affect fit, performance, reliability or durability. The trouser shall conform to the quality established by this specification.

4. VERIFICATION

4.1 Classification of inspection. 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. First article, submitted in accordance with 3.1 shall be inspected for design, configuration in Tables V and VI and overall workmanship. The first article shall also include the finished measurements in Table VII, examination for defects in Table VIII, and testing in Table IX. The presence of excessive defects, as defined in the contract (see 6.2) or failure of any testing shall be cause for rejection of the first article.

4.3 Conformance inspection. Conformance inspection shall include shade and appearance of all components, finished measurements in Table VII and examination for defects in Table VIII and testing in Table IX. Sampling for inspection shall be performed in accordance with ANSI/ASQ Z1.4, as defined by contract, except where otherwise indicated.

4.4 Component and end item inspections. In accordance with 4.3, components and end items shall be tested in accordance with all the requirements of referenced documents unless otherwise excluded, amended, modified or qualified in this document or applicable procurement documents. The government reserves the right to inspect and test all components and end items to determine conformance to requirements.

4.4.1 End item visual examination. Each trouser shall be subjected to visual examination. All fabric and garment defects shall be scored in accordance with Table VIII, which are clearly noticeable at normal viewing distance (3 feet) and affect serviceability and appearance of the garment. Material defects are defined in Section I of FED-STD-4. If needed, closer inspection will be performed to verify compliance to specification requirements.

Table VIII. Trouser visual examination.

Examination	Defect	Classification	
		Major	Minor
Material	Incorrect, not as specified (see 3.3.1 and 3.3.1.1)	101	
	Hole, cut, tear, smash, burn, needle chew, exposed drill hole, run, thin place, dye streak, color not as specified, misweave, visible mend	102	
	Knots greater than Sears Scale Level C (See 6.7)		201
	Slubs greater than Sears Scale Level D (See 6.7)		202
Component Part	Component part of trouser omitted, not as specified, distorted, full, tight, or twisted; any part of trouser caught in unrelated stitching, the edge of any component part required to be forced out having folds of more than 1/8 inch	103	
	Fullness creating unwanted permanent fold, pleat, or crease in fabric or garment		203
Stitching and Seams	Trouser seam: open stitching, puckered, distorted, pleated, wavy, twisted, irregular, or loose or tight stitch tension, broken or missing thread or stitch, needle chew, edge or raise stitching sewn too close the edge resulting in damage to cloth, seam allowance not as specified, no visible raw edge (inside raw edge greater than 1 inch)	104	
	Stitching not as specified	105	
	Double needle intersecting seams staggered by more than 1/4 inch		204
	Run off of more than 1/2 inch for edge or raised stitching		205
	Ends of stitching when not caught in other stitching back-tacked less than 1/4" or ends of a continuous line of stitching overlapped less than 1/2", except label stitching		206
	Thread color not as specified		207
Evenness	Waistband uneven by more than 1/4 inch when buttoned		208
	Inseam and/or outseam lengths vary by more than 1/2 inch	106	
	Bottom openings vary by more than 1/2 inch in half width		209
	Seat patch not aligned at top more than 1/4 inch.		210
Hook & Loop	Side pocket openings varying in length more than 1/4 inch		211
	Misplaced, damaged or omitted, twist or distortion when closed, out of alignment causing bulge	107	
	Joining pieces out of alignment with each other by more than 1/4 inch	108	
	Color or type not as specified	109	
	Not stitched as specified	110	
	Stitching on tape selvage rather than hook or pile	111	
	Tape piece not securely stitched down on cloth	112	

Table VIII. Trouser visual examination – Continued.

Examination	Defect	Classification	
		Major	Minor
Hook & Loop Continued	Tape stitched more than 3/16 inch from edge, or leaving sharp or ragged edges	113	212
	Yarns at selvage or cut edges of tape raveling or not secured		
	Tape piece not cut straight (at approximately 90 degrees)	114	
	Tape pieces spliced and not properly aligned to each other	115	
Hems	Trouser leg bottom less than 3/4 inch or more than 1-inch		213
	Hem twisted, wavy omitted, or not as specified		214
Buttons and buttonholes	Buttons not specified type, color not as specified, damaged, loose thread or misplaced	116	215
	Buttonholes not as specified, misplaced, ragged, not specified size, purling on wrong side, not clean cut or securely caught in fabric		
	Trouser fly buttons/buttonholes, hip pockets and flaps and trouser waistband, out of alignment causing bulge, twist or distortion when buttoned.	117	
Pocket and Flaps	Pocket companions not uniform in size or shape		216
	Pocket twisted, curled or puckered, not stitched as specified or not well formed	118	217
	Pocket flaps not completely covering pocket opening, not positioned as specified		
	Pocket construction not as specified	119	218
	Pockets out of alignment 1/4 inch or more		
	Pocket flaps or openings not as specified	120	
Eyelets	Omitted, misplaced, improper size or caught in stitching, stitch type not as specified		219
Cargo pocket assembly (cording and barrel lock)	Incorrect placement, not functional, component not as specified	121	
Shade	Shade variation within part or between parts	122	
Belt loops	Belt loops omitted, insecure, not specified size, opening not as specified or incorrect placement	123	
Knee/Seat Patches	Seat or knee patches omitted, not attached as specified, not type specified, opening not as specified	124	
Cleanness	Spot stain, less than 1/4 inch, excessive thread (more than 3) over 1/4 inch not trimmed or removed, odor, affecting appearance or serviceability	125	

Table VIII. Trouser visual examination – Continued.

Examination	Defect	Classification	
		Major	Minor
Bartacks	Omitted, misplaced, loose stitching, not specified size, incorrect number of stitches, not serving intended purpose.	126	
Labels	Omitted, incorrect, illegible, not attached where specified Bar code/UPC code omitted, not readable by scanner; human readable interpretation (HRI) omitted or illegible Bar code/UPC code not visible on folded, packaged item, bar code attachment causes damage to the item	127 128	220
Packaging	Any trouser not packaged in accordance with contract or purchase order	129	

4.4.2 End item testing. The trouser and components shall be tested and meet the requirements specified in Table IX under standard testing conditions per ASTM D 1776.

Table IX. End item tests.

Characteristic	Requirement paragraph	Test method
Flame resistance:		
Initial	3.3.2.2	ASTM D 6413
After 25 launderings	3.3.2.2	AATCC 135 <u>1</u> / and ASTM D 6413
Permethrin content (Class 2 only)		
Initial	3.4.1	4.5.1
After 20 launderings	3.4.1	4.5.1 <u>2</u> /
% Bite protection (Class 2 only)		
Initial	3.4.2	4.5.2
After 20 launderings	3.4.2	4.5.2 <u>2</u> /
After 50 launderings	3.4.2	4.5.2 <u>2</u> /
pH (Class 2 only)	3.4.3	AATCC 81
Cord, elastic:		
Width/diameter	3.5.1.3	Visual/micrometer
Weight (oz/lin. yd.)	3.5.1.3	ASTM D 3776
Elongation	3.5.1.3	4.5.3
Picks/inch	3.5.1.3	ASTM D 3775
# of carriers	3.5.1.3	Visual
Ends/per carrier	3.5.1.3	Visual
# of strands	3.5.1.3	Visual
Color shade matching	3.5.1.3	AATCC Evaluation Procedure 9, Option A

Table IX. End item tests – Continued.

Characteristic	Requirement paragraph	Test method
Braid, flat tubular:		
Yarn denier	3.5.2	ASTM D 1907
Weave	3.5.2	Visual
Picks/inch	3.5.2	ASTM D 3775
# of carriers	3.5.2	Visual
Ends/carrier	3.5.2	Visual
Width	3.5.2	ASTM D 3774
Break strength (lbs.)	3.5.2	PIA TM 4108
Length	3.5.2	ASTM D 3773
Color shade matching	3.5.2	AATCC Evaluation Procedure 9, Option A
Barrel lock	3.5.3	4.5.4
Button pull/break	3.5.6	ASTM D 5034
Toxicity	3.13	4.5.5

1/ Launder in accordance with AATCC 135, I, 3, V, Aiii.

2/ After 20 launderings as per AATCC 135, I, 3, V, Aiii, except laundering cycles 5, 10, 15, 19 and 20 shall be performed without adding any detergent to minimize detergent accumulation in specimens. After 50 launderings as per AATCC 135, 3, Viii, except laundering cycles 5, 10, 15, 19, 20, 25, 30, 35, 40, 45, 49 and 50 shall be performed without any detergent.

4.5 Methods of Inspection.

4.5.1 Permethrin content analysis (Class 2). The permethrin content of treated fabric shall be determined by gas chromatographic procedure and directly compared to an external standard containing a known permethrin content. Testing shall be conducted according to the following test method. Alternate method(s) of extraction and analysis, and specimen size are subject to government approval and laboratory cross correlation prior to implementation.

Evaluation of Permethrin Treated Fabric Materials: Extraction and Analysis by Gas Chromatography-Mass Spectrometry

Note: The conditions described in this method are optimum for the gas chromatograph employed. These conditions may vary based on the gas chromatograph used. The carrier gas flow rate shall be adjusted so the elution of the first permethrin isomer is greater than 5 minutes. Alternate methods of extraction and analysis are subject to government approval and laboratory cross correlation prior to implementation.

A. Apparatus.

A.1 Analytical Balance. 0.0001g sensitivity, Mettler Toledo, or equal

A.2 Analytical Balance. 0.000001g sensitivity, Mettler Toledo, or equal

A.3 Glassware.

- a. 10-100mL volumetric flasks
- b. Funnel
- c. Pipettes

A.4 Automatic Die Cutter. Freeman Atom, or equal

A.4.1 Three Inch Cutting Die. 3 inch diameter circular steel die cutter

A.5 Extraction Apparatus.

A.5.1 Accelerated Solvent Extractor (ASE) Dionex Corporation or equal

- a. Liquid Nitrogen Cylinder to Deliver High Pressure Gas, 230psi
- b. Complete Extraction Cells, 22mL
- c. Cellulose filters, 1.98cm
- d. 40mL Amber Glass Collection Vials
- e. Solvent Resistant Teflon-Silicone Coated Septa
- f. 3mm-4mm borosilicate glass beads

A.5.2 Soxhlet.

- a. Electric heater with variable control
- b. Heat resistant glass flask when using Soxhlet extractor. The flask shall be a 250mL, flat or round bottom, and single neck.
- c. Extractor condenser
- d. Boiling condenser
- e. Cellulose extraction thimbles

A.6 Agilent 6890N (G1530N) Series Gas Chromatograph. Gas Chromatograph equipped with ChemStation software, or equal

- a. Carrier Gas Cylinder, Appropriate Regulator Set at 80psi
- b. Hewlett-Packard Capillary Column, 5% Phenyl Methyl Siloxane/30.0m x 250µm x 0.25µm nominal, 325°C Max, or equal.
- c. Split Inlet Liner, Packed with Silanized Glass Wool/5mm
- d. Injector Microliter Syringe, Capable of Delivering 1µL
- e. GC Amber Injection Vials and Rinse Vials

A.7 Agilent Series 5973N (G2579A) Mass Spectrometer, or equal.

- a. Performance Turbo Pump MSD (EI Mode), or equal

A.8 Ultrasonic Cleaner. Branson, or equal

A.9 High Temperature Convection Oven. 500°C Max

A.10 Refrigerator Storage. 4°C

B. Reagents.

B.1 Permethrin Analytical Standard. Permethrin standard shall be $\geq 97\%$, mixture of Cis/Trans Isomers. Permethrin standards are available from FMC Agricultural Products; Princeton, New Jersey 08543; FMC reference #33297; 97% purity/specified technical, or equal

B.2 Solvent Mixture. Solvent mixture shall be 80% Acetonitrile/Analytical Grade and 20% Methanol/Analytical Grade

B.3 High Purity Helium Carrier Gas. Carrier gas shall be $\geq 99.999\%$

B.4 Cleaning Solutions. Cleaning solutions shall be as follows:

- a. Micro-90 Ultra Cleaning Solution, or equal
- b. Reversed Osmosis Water, 98% Rejection Rate

C. Calibration of Apparatus.

C.1 Analytical Balance.

C.1.1 Pre-Weighing Procedures. Prior to weighing, initiate the internal weight calibration function or use an external certified weight set to verify that the balance is operating properly.

C.1.2 Manufacturer Calibrations. Obtain manufacturer certifications within 12 months prior to taking measurement.

C.2 Gas Chromatography equipped with Mass Selective Detector (See A.6, A.7)

- a. Perform the manufacturer's recommended calibration procedures prior to analyses.
- b. Before samples or required blanks can be analyzed, the instrument must meet the initial calibration acceptance criteria (see G).

C.3 Cleaning Techniques. Establish cleaning techniques to ensure that no permethrin carries over from experiment to experiment. The techniques listed below have been determined to be suitable:

- a. Evaporate excess solvent from extraction glassware and wash using conventional methods. (see B.4)

b. Bake off residual organic substances from glassware in high temperature convection oven, 500°C, for three to six hours. (see A.9)

c. Sonicate A.S.E. Cells in the solvent that was used for the extraction. (see A.8)

D. Sampling and Test Specimens.

D.1 Sample size. The sample size (Class 2 trouser) to be tested shall be selected in accordance with ANSI/ASQ Z1.4, Special Inspection Levels S-1 and AQL of 1.5.

D.2 Test specimens.

a. From each sample garment being evaluated (unlaundered, after 20 and after 50 launderings), select three 3 inch diameter specimens (use a 3 inch circular cutting die having surface area of 45.6037cm²) for each test condition. Cut specimens from single ply areas so that no two specimens shall contain the same warp and filling yarns (for example, for the blouse areas-front left, front right, back, right sleeve, left sleeve; and for the trouser areas-front left leg, back left leg, right front leg, back front leg, and front left or right fly). Specimens for the measurement of permethrin content after laundering shall be cut after the finished garment has been laundered according to AATCC 135, 3, V, III to the specified number of cycles. Laundered specimens shall be cut from different ply areas across the garment.

b. Weigh each specimen to the nearest milligram (see A.1).

E. Standard Preparation.

a. Prepare six concentrations of permethrin standards which are 20, 50, 75, 100, 150, and 200ng/μL, [1ng/μL is equal to 1 part-per-million (ppm)]

b. Using the balance specified in A.2, weigh 10mg ± 1mg of permethrin crystals and place into a 50mL volumetric flask and fill with 80% acetonitrile/20% methanol solvent to obtain the standard of 200ng/μL. Make all appropriate dilutions from this flask to obtain the additional standards.

c. Calculate the actual concentrations of the standards based on the weight of the permethrin.

F. Extraction Procedure (see A.5)

F.1 ASE

F.1.1 Preparing Specimens. Roll each specimen and place into an ASE cell fitted with a cellulose filter. Fill the void with glass beads to conserve solvent. Place all cells onto ASE cell tray.

F.1.2 Quality Control. Extract a specimen blank for every run to detect if any carry over of permethrin is significant.

F.1.3 Accelerated Solvent Extraction Procedures.

F.1.3.1 Parameters.

Cell Size	22mL
Collection vials	60mL, light blocking/amber
Solvent	80% Acetonitrile, 20% Methanol

Approximate Gas Pressures:

System	50 psi
System Solvent	10 psi
Oven Compression	130 psi

Parameters:

Preheat	0 min
Heat	5 min @ 100°C
Static w/Solvent	10 min @ 1500 psi
Flush Volume	90%
Purge	90 sec
Cycles	2

F.1.3.2 Preparation for analyses. Dilute or concentrate each vial to 40mL and prepare a 1mL aliquot from every specimen extraction for GC analysis. Permethrin recovery must be 95% or greater (see F.4).

F.2 Soxhlet. Place each specimen into cellulose Soxhlet extraction thimble. Add 160mL of the acetonitrile/methanol mixture and boiling chips into a 250mL flask. Assemble the Soxhlet apparatus and extract the permethrin treated specimens for 6 hours or until an extraction recovery of 95% or greater has been achieved (see F.4). Concentrate the extract by rotoevaporation, or equal, at 35°C to a final volume of 40mL.

F.3 Storage. After the specimens are extracted, store in light blocking amber vials in refrigerator until ready to inject (see A.10). Specimen extractions shall be stored in a refrigerator for no longer than three months. When ready to analyze, allow the temperature of the GC vials to equilibrate in the area of evaluation before injection into GC.

F.4 Extraction Efficiency.

a. Select three random specimens from any permethrin treated fabric sample and perform three consecutive extractions.

b. Quantify the level of permethrin recovered from each specimen for each consecutive extraction, through GC/MS analysis.

c. Verify that the percent recovery of permethrin for any specimen size and composition, is 95% or greater by comparing the recovery level from the first extraction, to that of subsequent extractions. Combine the permethrin levels obtained from each of the three extractions, if the initial extraction yields permethrin levels 95% or greater than the total percent of permethrin extracted three sequential times, then the extraction efficiency is 95% or greater. Note - To ensure that the extraction efficiency is being accurately calculated, the permethrin levels in the second and third extraction should be minimal, and the permethrin level by the third extraction should be trace or zero.

Note: Initial verification of extraction efficiency of this test method must be performed. Once an extraction efficiency of 95% or greater is established, no further demonstration of the extraction efficiency is needed.

G. Analytical Procedure.

G.1 Quality Control. Laboratory blanks that contain no analyte are used to ensure specimens are free of contaminants or to ensure there is no cross contamination during a run. Inject a blank containing 80% acetonitrile/20% methanol before every set of standards and before and after every ten specimens. If any blank, after multiplying concentration by five, is greater than any specimen result, the specimen data points are invalid and a system check must be run to identify the source of the carry over. After system maintenance has been performed, repeat injections of the standards for the calibration curve, new blanks, and new aliquots of the specimens affected by the previous carryover.

G.2 Standard Injection.

a. All six permethrin standards will be injected at the beginning and at the end of each series of specimens to "bracket" the specimen injections. Check linearity of the standards for each set of injections by plotting the responses (area counts) on the x-axis vs. the calculated standard concentrations on the y-axis. A 3rd order polynomial regression line with R-squared value of 0.99 or greater is acceptable. Derive the equation of the 3rd order polynomial for sample calculations.

G.3 Specimen Injection. Run specimen injections in duplicate. Sample extracts, standards, and blanks must be analyzed within an analytical sequence such as listed below:

- a. Initial calibration (Standards)
- b. Instrument blank at the end of the initial calibration
- c. Specimen Series 1 (extracts 1-10, 1st quantitation)
- d. Instrument blank
- e. Standard Series 1
- f. Instrument blank

- g. Specimens Series 2 (extracts 1-10, 2nd quantitation)
- h. Instrument blank
- i. Standard Series 2
- j. Instrument blank
- k.-r. Subsequent specimen series,(ex. 11-20, including blanks, and standard series)
- s. Final calibration (Standards)

Note: After the initial calibration, the analytical sequence may continue as long as acceptable instrument blanks and the standards are analyzed at the required frequency. If any specimen count does not fall on the standard calibration curve, the evaluator may dilute that specimen by 1:10 and re-run; calculations of the permethrin level must be adjusted using the factor of 10.

G.4 Gas Chromatograph/Mass Spectrometer Parameters. (see A.6)

G.4.1 Injection procedures.

- a. Place all GC vials into auto sampler tray. To avoid vapor pressure differences, all vials must be at room temperature and containing identical volumes.
- b. Inject 1 μ L into the Gas Chromatograph equipped with Mass Spectrometer. Use high purity helium carrier gas (see B.3) and appropriate column.
- c. Ensure that rinse vials in the injector port contain 80% acetonitrile/20%methanol above the minimum solvent line.

G.4.2 Instrument Settings. The following parameters will be used in the analysis:

Oven Temperature	250 °C
Injector Temperature	275 °C
Detector Temperature	280 °C
Injection volume	1 μ L
Carrier Gas Flow Rate	1.3 mL/min
GC Run Time	10 min
Split Ratio	3:1
MS Single Ion Monitoring	
Scan Parameters	EM Voltage Gain Factor of 1
Real Time Plot	10 min
Resolution	Low
Solvent Delay	4 min
Start Time	4 min, 4.26 Cycles/sec
Ions Monitored	183 (quantitation), Dwell 100
	163 (confirmatory), Dwell 100

G.4.3 Evaluation Procedures.

a. Quantify the permethrin content detected by the mass spectrometer by extracting ion chromatograms 183 (quantitation ion) and 163 (confirmatory ion).

b. Integrate permethrin peaks manually from baseline to baseline using the software, or generation of report.

H. Calculations.

H.1 Permethrin Concentration. The permethrin concentration will be calculated from the area counts of the chromatographic curve and expressed in terms of mass permethrin per surface area (mg/cm^2), with the option of expressing in terms of weight permethrin per weight of specimen (W/W%):

H.1.1 Concentration. The concentration of permethrin in milligrams per square centimeter shall be calculated as follows:

$$\text{Concentration (mg/cm}^2\text{)} =$$

$$40\text{mL} \times (ax^3 + bx^2 + cx + d) \times (1,000 \mu\text{L}/1\text{mL}) \times 1\text{mg}/1,000,000\text{ng} \times (1/45.6037\text{cm}^2)$$

Where:

40mL = Final Volume

a, b, c and d = numbers derived from 3rd degree polynomial equation from standard series following specimen series

x = area count of the specimen curve

45.6037 cm^2 = area of specimen

H.1.2 Conversion to Permethrin Weight Percent Content (W/W%).

Concentration (W/W%) = [Concentration (mg/cm^2) multiplied by (surface area) cm^2 divided by (weight of specimen) mg] multiplied by 100.

I. Report. Report the individual concentration for each specimen in milligrams per square centimeter permethrin to the nearest 0.001mg, (no individual specimen results shall fall outside of the minimum to maximum range of the permethrin levels as specified in paragraph 3.4.1). A single retest shall be allowed; when a single specimen fails, a new sample with complete set of specimens shall be sampled and tested. The retest shall be used to rate pass or fail.

4.5.2 Percent (%) Biting Protection Assay. Percent (%) bite protection shall be measured on a finished permethrin treated garment, Class 2, under three test conditions and using a control specimen (non-permethrin treated, garment, Class 1) against the two selected insect species specified in 4.5.2.3. The three test conditions shall be one unlaundered, two: after 20 launderings and three: after 50 launderings from garments produced in the same lot. Corresponding

permethrin content for each of these conditions will be measured as specified in 4.5.1 to correlate biological toxicity with the particular garment treatment used to meet requirements specified in 3.4.1.

4.5.2.1 Number of determinations. Three determinations will be run for each of the 2 insect species (see 4.5.2.3.3). Each determination for each insect is conducted with 3 volunteers using 3 different fabric conditions; unlaundered, after 20 launderings and after 50 launderings and compared to non-permethrin treated control. A single untreated unlaundered control sleeve can be used for the 3 determinations for each volunteer provided that the control is run against the same insect population, on the same day the specimens being tested, and tested on an arm that has not been used for testing a treated sleeve (see 4.5.2.3.6). The total number of specimens for the 3 determinations is outlined below. It is estimated that one coat yields 3 specimens and one trouser yields 3 specimens consisting of largely a single ply fabric area (see 4.5.2.2). See 6.10.

<u>Number of Insect tests X</u>	<u>Number of Determinations X</u>	<u>Number of Fabric conditions</u>	<u>=</u>	<u>Total Specimens per garment type</u>
Mosquitos <u>1/</u>	3 x	3 x	=	9 <u>2/</u>
Control <u>2/</u>	1 x	1 x	=	1 <u>2/</u>

1/ One set of treated specimens will be used twice to test each mosquito species

2/ Total garments estimated, required to conduct 3 determinations are;
3 treated trousers and 1 untreated trouser

4.5.2.2 Specimen size. Specimens will be cut to the shape and dimensions illustrated in Figure 7. Specimens shall be cut from single fabric ply areas. To minimize the number of garments needed for each determination, multiple ply areas such as seam areas or hems may occur limitedly in the perimeter areas provided multiple plies of fabric in these areas shall not create a gap between subject's arm and fabric (see 4.5.2.3.5). Specimens will be cut with gloved hand and placed in a plastic bag and the glove disposed of to avoid residual contamination of controls. When failure point is being quantified, the laundered samples may be used to accomplish the additional launderings needed.

4.5.2.3 Procedure. The procedure to conduct biting protection assay is derived from the "EPA Product Performance Test Guidelines, OPPTS 810.3700, Insect Repellents For Human Skin and Outdoor Premises, December 1999 (see 2.2.2), and is described in part below, noting any exceptions to this procedure.

4.5.2.3.1 Applicable Protocol. Within OPPTS 810.3700, Section 3 addresses treated fabric material and section (3)(iii) specifies that laboratory studies are conducted as described in (d)(1) of the OPPTS 810.3700 guideline.

4.5.2.3.2 Fastening Test Specimen. Section (3)(iii) recommends "fastening a strip of the impregnated material to the test subject's forearm". This will be accomplished by utilizing specimen size specified in 4.5.2.2 (see Figure 7) and ensure it covers the entire forearm of the test subject without gaps for insect access. With the arm in the pronated position, the fastening seam

that closes the specimen on the volunteer's arm shall be located on the top of the forearm. Attachment of the treated specimen will be done with gloved hand, which will be disposed of prior to attaching the control to alternate arm.

4.5.2.3.3 Test Insects. OPPTS 810.3700 section (d) (1) addresses laboratory tests conducted with mosquitoes and stable except this test shall utilize two species of mosquito. The results of this evaluation for the mosquitos is a contractual requirement. Insect genus, species and subspecies, colony origin and approximate age shall be used as specified below and in 4.5.2.3.3.

Mosquitoes:

Aedes (Stegomyia) aegypti

Anopheles albimanus,

4.5.2.3.3.1 Insect Characteristics. Mosquito ages employed for these studies shall be 5-11 days old after emergence from the pupal stage. Mosquitoes shall be laboratory-reared and disease free, and have been kept in stock cages containing both males and females. The mosquitoes will be maintained on 10% sugar water and have not been provided a blood meal. Methods should be used to preselect females for the studies. Use either a hand draw box or suitable aspirating device to collect host-seeking mosquitoes for the required cage density (see 4.5.2.3.3.3).

4.5.2.3.3.2 Insect Rearing. Insects for these studies shall be reared under optimal conditions for larvae, as described in OPPTS 810.3700, section (d)(1)(iii).

4.5.2.3.3.3 Cage Conditions. A cage density of 200 ± 25 female insects per cage is required to meet the biting pressure density of at least one female mosquito per 300 cm^3 cage volume. (Cages shall be $60,000 \pm 6,000 \text{ cm}^3$, with a sleeved opening for the arm of the volunteer to be inserted.) Cages shall be constructed of a lightweight clear plastic on 3 sides, or an aluminum bottom panel with light weight clear plastic on 2 sides. The top of the cage and side opposite the cloth sleeve should consist of screen rather than plastic. Tests shall be conducted with fluorescent lights on and under room conditions ($22\text{-}27^\circ\text{C}$, and $30\text{-}80\%$ RH). Tests should not be conducted if the temperature or humidity is outside of the specified range.

4.5.2.3.4 Subjects. A minimum of 3 test volunteers shall be used in each study for each insect species at each test facility. The same 3 subjects can be used to evaluate different insect species done at the same facility. Due to the replication, the number of volunteers is now decreased from the 5 or more recommended in OPPTS 810.3700, section (c)(3)(i). Collection of data from both females and males are preferred for the study. Cosmetics and alcohol shall be avoided 12 hr prior and during the test. Volunteers shall read and sign the appropriate Institutional Review Board (IRB)-Human Use protocol forms, required for their consent, prior to being used in the test. IRB protocols shall be approved through the appropriate agencies' IRB mechanisms.

4.5.2.3.5 Volunteer's Test Area. The test area shall consist of the region from the wrist to approximately 1/2 inch before the elbow. Fabric material shall be secured around the forearm to eliminate gaps between the arm and material and with the fastened seam positioned on the top of the forearm as specified in 4.5.2.3.2. The ends of the garment, near the wrist and elbow shall be

sealed with protective tape of adequate thickness to prevent insects from biting through the tape. The hand shall be gloved with a glove of appropriate thickness to prevent biting through to the hand.

4.5.2.3.6 Controls. For each set of specimens, a control shall be conducted. The control shall consist of the same fabric as the specimens, will not be laundered and will not contain the insect protection treatment. It will be identical in size to the test swatch (see 4.5.2.2). Controls will be cut in clean area and stored in separate plastic bags to avoid residual permethrin contamination. The controls will be tested on the arm opposite the treated specimens, or on the same arm used for experiments provided that the control is tested prior to testing treated specimens.

4.5.2.3.7 Biting Exposure. Arms containing the controls and treated specimens shall be exposed to a cage of insects for 15 min. The order of testing specimens on the arm will be sequential and in order of the most laundered to least laundered. Therefore, if the same arm will be used to test the control and specimens, the order of testing shall be control, followed by the specimens laundered 50 cycles, followed by the specimens laundered 20 cycles, and then conclude with testing the unlaundered treated specimens. Tests should be conducted with as little elapsed time as possible in between testing of a volunteer's arms.

4.5.2.3.8 Raw Data. Raw data shall consist of the insect information as described in 4.5.2.3.3, the number of insects used per cage, and method of selection of these insects. The number of male and female insects shall be counted and only the number of females used for purposes of identifying insects that bite compared to non-biting mosquitoes. The number of bites received for each sample (treatment or control) shall be counted and recorded.

4.5.2.4 Report. Calculation of the reduction in bites for the treatment, compared to the control, shall be expressed as a percentage that represents the percentage bite protection as shown below. Individual subject results for each trial (3 for each treatment type or control), shall be averaged with all trials for the other volunteer subjects in the study. An overall average % bite protection shall be calculated by Abbott's equation below and reported in this manner for each insect and for all volunteer tested. For initial and 20 wash conditions, a single average within each species trial may fall below the 90% minimum provide it is greater than or equal to 90% and the overall average of all 3 (or more) volunteer's samples results in bite protection which is greater than or equal to 90%. For the 50 wash condition, single average within each species trial may fall below the 70% minimum provide it is greater than or equal to 70% and the overall average of all 3 (or more) volunteer's samples results in bite protection which is greater than or equal to 70%.

$$\% \text{ Bite Protection} = \frac{(B_{NC}/F_C) - (B_T/F_C)}{(B_{NC}/F_C)}$$

where:

B_{NC} = bites recorded on the arm covered by the negative control fabric

F_C = female insects in the cage that are capable of biting at the start of the 15-min period

B_T = bites recorded on the arm that was covered by the treated fabric.

4.5.3 Elastic cord elongation. Cut a 14-inch specimen from a representative sample cord and make two marks on the cord so that a distance of 10 inches is between the gage marks. Suspend the cord from a clamp in such a manner as to allow a 2-pound weight to be hung on the lower end of the cord. Gradually lower the weight until the entire load is carried by the cord. After 2 minutes, take a measurement between the two marks and calculate the increase in length as follows:

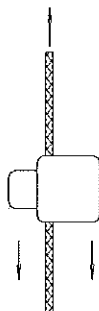
$$\text{Elongation (\%)} = \frac{B-A}{A} \times 100$$

Where:

A = Initial measurement

B = Measurement of elongation at 2 pounds

4.5.4 Barrel lock test. The barrel lock holding strength shall be tested as follows:



Barrel lock holding strength: Using tensile testing machine (in accordance with ASTM D 5034) at 2 inches/minute, either pull-up cord on stationary engaged cord-lock or vice-versa (see above illustration.).

4.5.5 Toxicity test. If the toxicity requirement (see 3.11) can be demonstrated with historical data, toxicity testing may not be required (see 6.2). When required, (see 6.2), an acute dermal irritation study and a skin sensitization study shall be conducted on laboratory animals. When the results of these studies indicate the (item) is not a sensitizer or irritant, a Repeat Insult Patch Test shall be performed in accordance with the Modified Draize Procedure. (See 2.3)

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of material is to be performed by DoD or in-house personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system command. 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.

5.2 Permethrin packaging (Class 2). Every box containing permethrin treated uniforms must be labeled according to EPA requirements as stated in Federal Insecticide, Fungicide And Rodenticide Act (FIFRA). (See 2.2.2).

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 trouser is for wear by military personnel in the United States Army as a combat uniform in garrison and combat missions.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number and date of this document.
- b. Type, class and sizes required (see 1.2).
- c. The specific issue of individual documents referenced (see 2.2).
- d. When first article sample is required (see 3.1, 4.2, 6.3).
- e. Conformance inspection quality acceptance limits (see 4.3).
- f. Inspection conditions (see 4.4).
- g. Toxicity requirements (see 4.5.5)
- h. Packaging requirements (see 5.1).

6.3 First article. When a first article is required, it shall be inspected and approved under the appropriate provisions of FAR 52.209-4. The first article should be a pre-production sample. The contracting officer should specify the appropriate type of first article and the number of units to be furnished. The contracting officer should include specific instructions in all acquisitions documents regarding arrangements for selection, inspection and approval of the first article.

6.4 Alternate pocket material. Alternate material for pocketing found to meet the requirements in this specification is available from:

QST, 525 W. Monroe, Suite 1400, Chicago, IL 60661, (312) 930-9400

6.4.1 Alternate FR pocket material. Alternate FR material for pocketing found to meet the requirements in this specification is available from:

Mount Vernon Mills, Inc., 503 S. Main Street, Mauldin, SC 29662, (864) 688-7100

6.5 Approved EPA Permethrin Registrations. Permethrin treatment operation for the subject uniforms shall be EPA registered. Samples of approved permethrin registrations and labels are shown at the EPA web site: <http://oaspub.epa.gov/pestlabl/ppls.home>

NOTE: EPA registration does not certify that the permethrin treatment meets the specification requirements.

6.6 Elastic cord. Elastic cord that has been found to meet the requirements in this specification is available from:

RI Textile Company, 211 Columbus Avenue, Pawtucket, RI 02861, part number DLB 48, (401) 722-3700

Hope Global, 50 Martin Street, Cumberland, RI 02864, part number 2831, (401) 333-8990

6.7. Barrel lock. Barrel locks that have been found to meet the requirements in this specification are available from:

ITW Nexus part no. 350-3000

ITW Nexus 195 Algonquin Avenue, Des Plaines, IL 60016

Military Sales (401) 454-4817 or (847) 375-6709

YKK part no. LC055F/H or equal

YKK Corporation of America, Atlanta, GA

6.8 Fastener tape (Hook & Loop). Fastener tape hook and loop that has been found to meet the requirements in this specification is available from the following sources:

Velcro USA, Inc., 406 Brown Avenue, Manchester, NH 03103

YKK (U.S.A.) Inc., 1306 Cobb Industrial Drive, Marietta, GA 30066

Aplix Inc., 12300 Steele Creek Road, P.O. Box 7505, Charlotte, NC 28241

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

6.10 Percent Bite Protection. The following facilities are known to perform percent bite protection testing in conformance with 4.5.2.

Aedes aegypti and Anopheles albimanus:

United States Department of Agriculture-Agriculture Research Service
Center for Medical, Agricultural and Veterinary Entomology
Agricultural Research Service
1600 SW 23rd Dr
Gainesville, FL 32608
POC: Dr. Ulrich R. Bernier/Research Chemist Mosquito and Fly Research Unit
Ph: (352) 374-5917
E-mail: uli.bernier@ars.usda.gov

6.11 Subject term (key word) listing.

Clothing
Clothing, Flame Retardant
Insect protection
Permethrin
Uniform
Universal Camouflage
Uniform

CUSTODIAN:

Army – GL

PREPARING ACTIVITY:

DLA – CT

Project No.

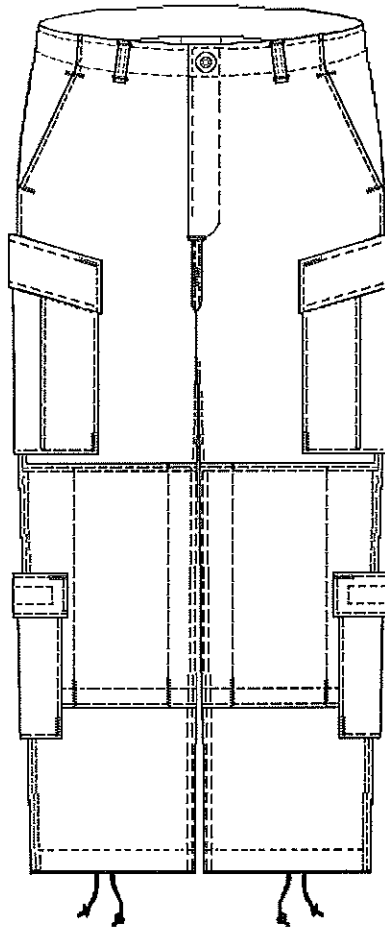


Figure 1. Trousers Front, Army Combat Uniform

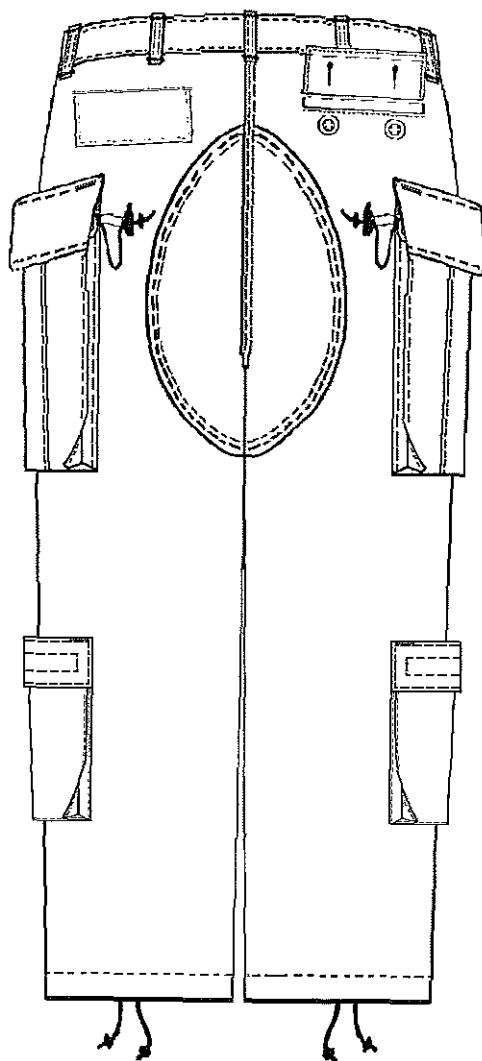


Figure 2. Trouser Back, Army Combat Uniform

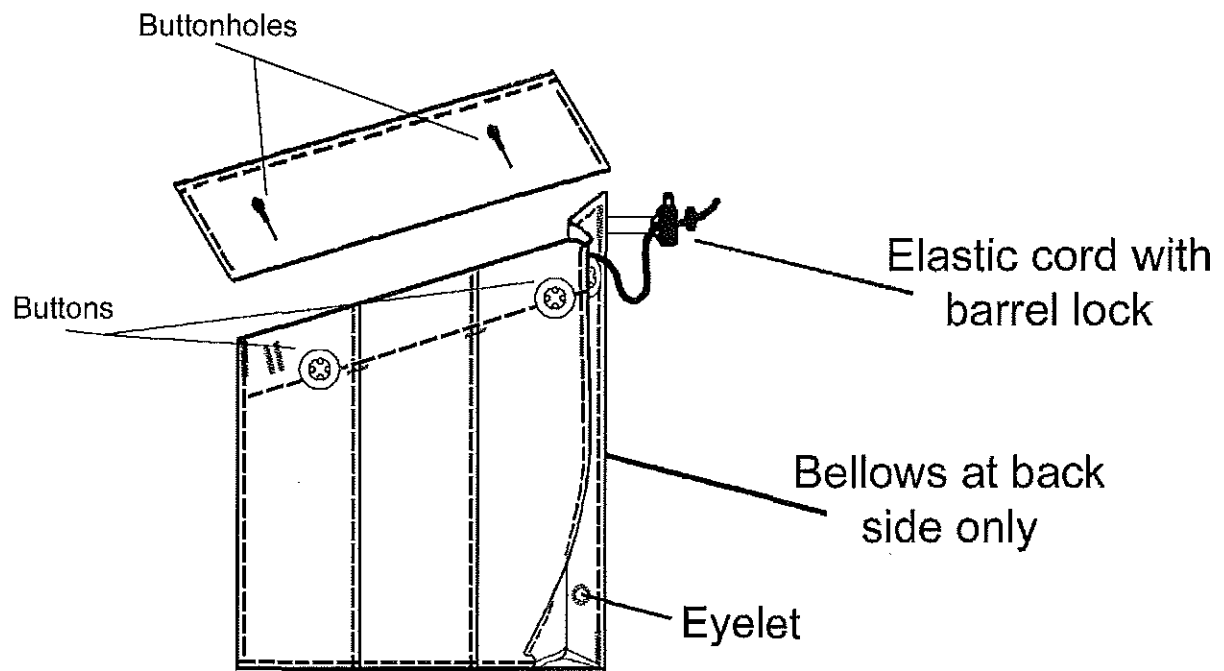


Figure 3. Trousers Cargo Pocket, Army Combat Uniform

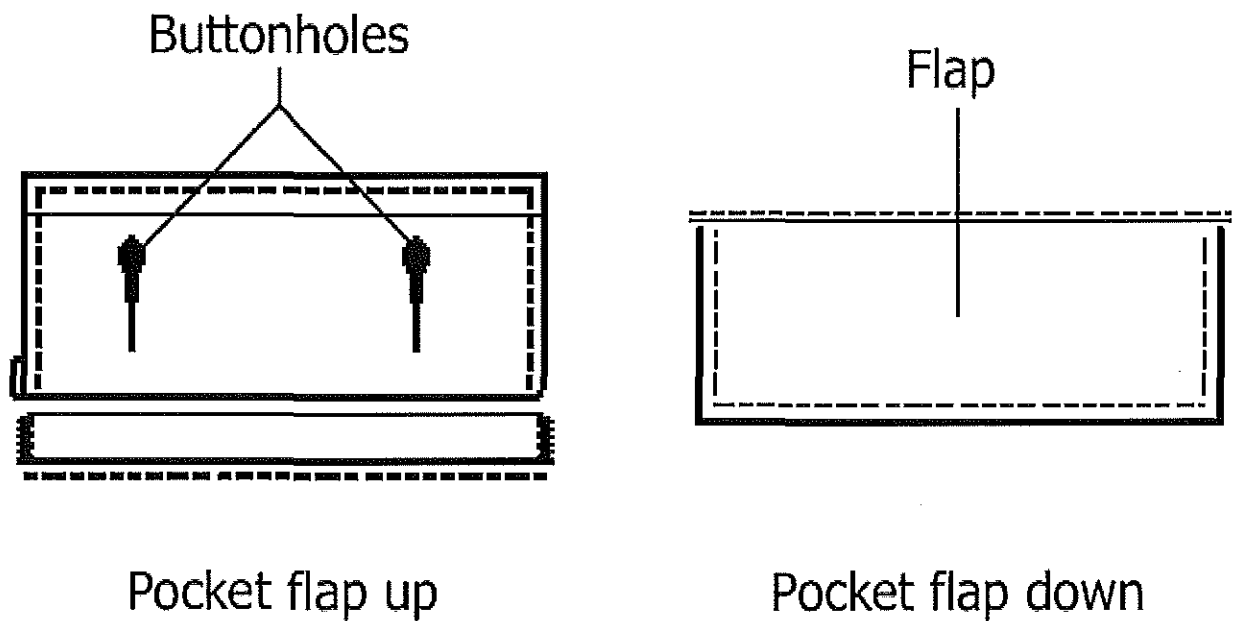


Figure 4. Trousers Back Hip Pocket, Army Combat Uniform

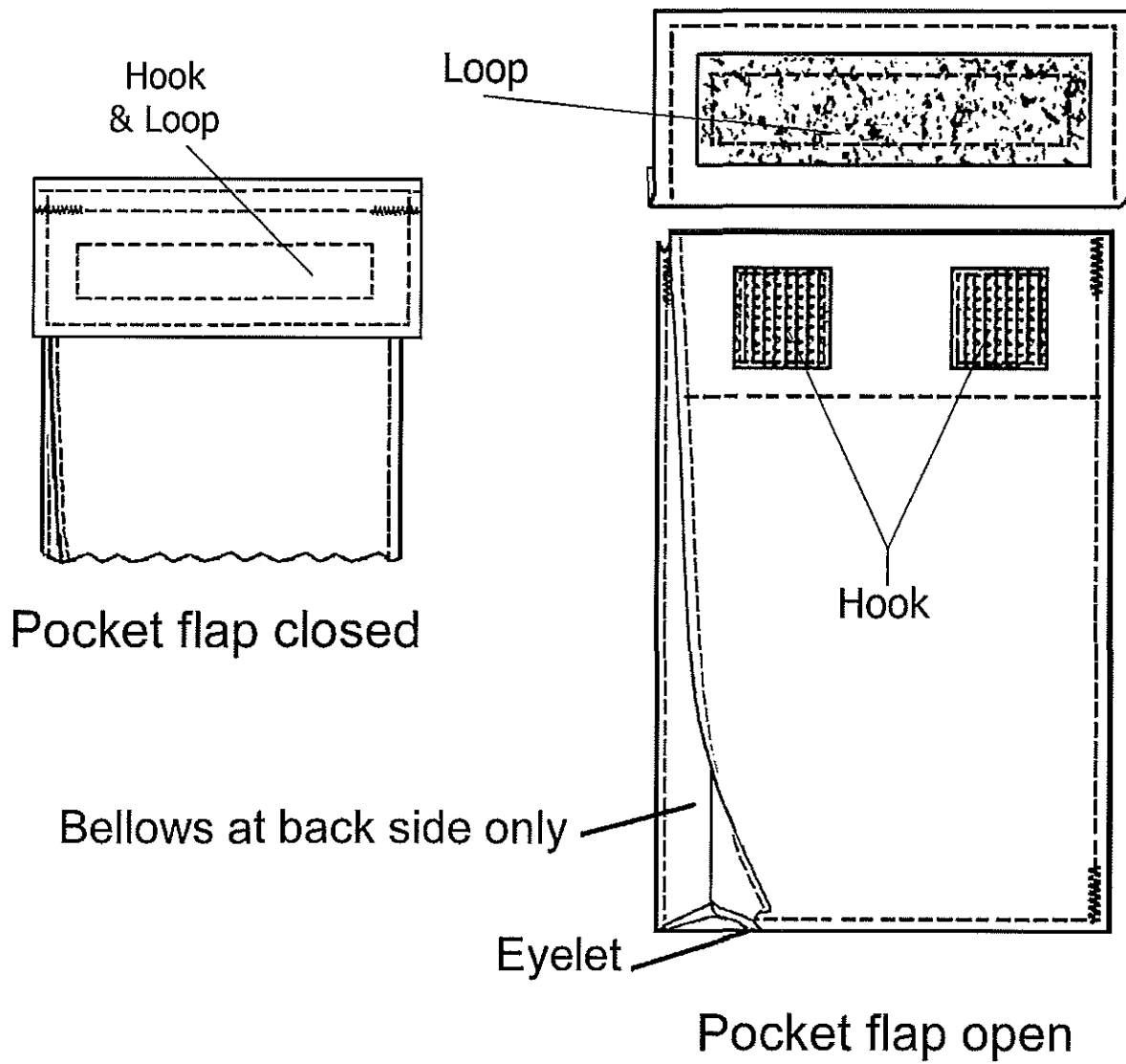


Figure 5. Trousers Lower Pocket, Army Combat Uniform

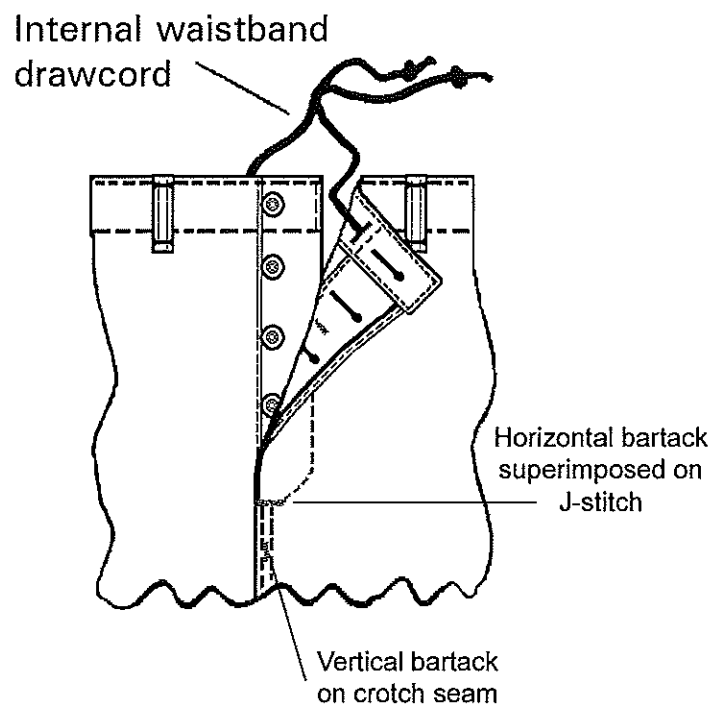


Figure 6. Trousers Fly Construction, Army Combat Uniform

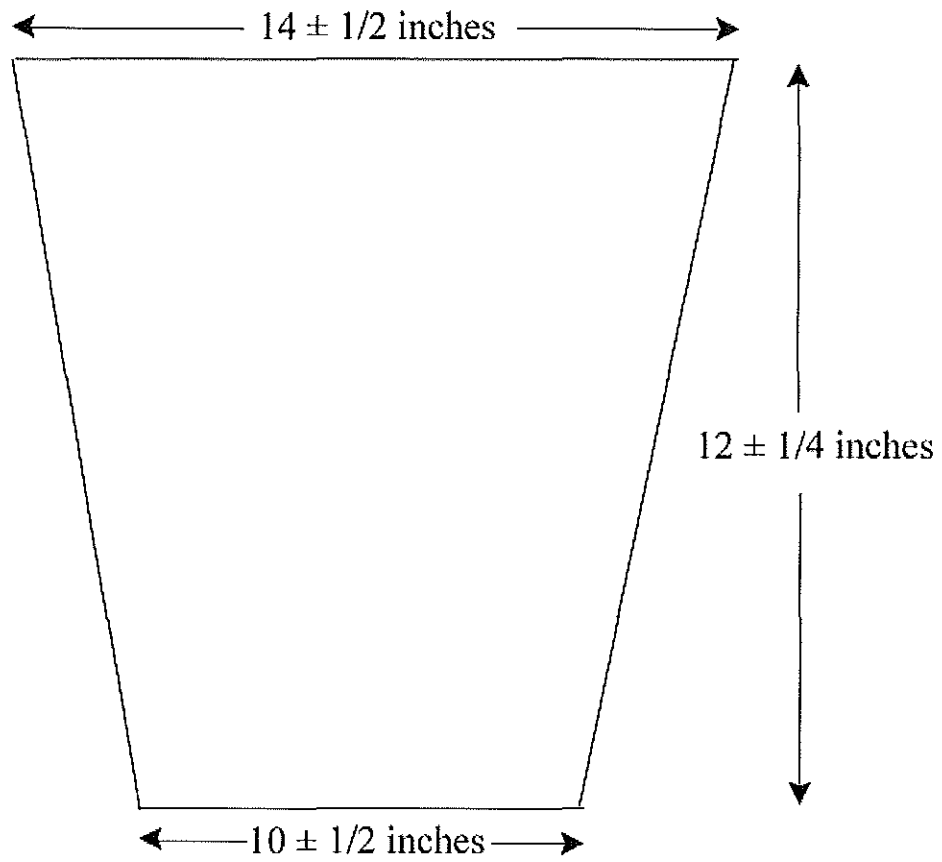


FIGURE 7. Test Specimen, % Bite Protection Test