

INCH-POUND

MIL-DTL-32231A

13 July 2020

SUPERSEDING

MIL-DTL-32231

15 November 2006

DETAIL SPECIFICATION

CLOTH, POLYESTER/COTTON

This document is approved for use by all Departments and Agencies of the Department of Defense (DoD).

1. SCOPE

1.1 Scope. This specification covers the requirements for a polyester/cotton herringbone cloth treated with durable press and soil release finishes.

1.2 Classification. This specification covers the following types and classes.

1.2.1 Types.

Type I - No stretch

Type II - Stretch

1.2.2 Classes.

Class 1 – White 521 (Army)

Class 2 – Gray 510 (Army)

Class 3 – Blue 1664 (Air Force)

Class 4 – Cadet Grey 563 (West Point)

Comments, suggestions, or questions on this document should be addressed: Attn: DLA Troop Support, 700 Robbins Street, Philadelphia, PA 19111-5096. Since contact information can change, verify the currency of the address information using Acquisition Streamlining and Standardization Information System (ASSIST) online database <https://assist.dla.mil>.

AMSC N/A

FSC 8305

DISTRIBUTION STATEMENT A. Approved for public release. Distribution is unlimited.

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2. APPLICABLE DOCUMENTS

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

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

COMMERCIAL ITEM DESCRIPTIONS

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

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-3064 - Evaluation of Quality of Textile Materials

(Copies of this document are available online at <https://quicksearch.dla.mil>.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation or contract.

FEDERAL TRADE COMMISSION

Rules and Regulations Under the Textile Fiber Products Identification Act

(Copies of this document are available online at <https://www.ftc.gov>.)

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

AMERICAN ASSOCIATION OF TEXTILE CHEMISTS AND COLORISTS (AATCC)

AATCC EP1 - Evaluation Procedure for Gray Scale for Color Change
AATCC EP2 - Evaluation Procedure for Gray Scale for Staining
AATCC EP8 - Evaluation Procedure for AATCC 9-Step Chromatic Transference Scale

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- AATCC EP9 - Evaluation Procedure for Visual Assessment of Color Difference of Textiles
- AATCC TM8 - Test Method for Colorfastness to Crocking: Crockmeter
- AATCC TM15 - Test Method for Colorfastness to Perspiration
- AATCC TM16.3 - Test Method for Colorfastness to Light: Xenon Arc
- AATCC TM20A - Test Method for Fiber Analysis: Quantitative
- AATCC TM61 - Test Method for Colorfastness to Laundering: Accelerated
- AATCC TM81 - Test Method for pH of the Water-Extract from Wet Processed Textiles
- AATCC TM117 - Test Method for Colorfastness to Heat: Dry (Excluding Pressing)
- AATCC TM124 - Test Method for Smoothness Appearance of Fabrics after Repeated Home Laundering
- AATCC TM130 - Test Method for Soil Release: Oily Stain Release Method
- AATCC TM 135 - Test Method for Dimensional Change of Fabrics after Home Laundering
- AATCC TM 197 - Test Method for Vertical Wicking of Textiles

(Copies of these documents are available online at <https://www.aatcc.org>.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

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

(Copies of this document are available online at <https://asq.org>.)

ASTM INTERNATIONAL

- ASTM D1424 - Standard Test Method for Tearing Strength of Fabrics by Falling-Pendulum (Elmendorf-Type) Apparatus
- ASTM D1683/D1683M - Standard Test Method for Failure in Sewn Seams of Woven Fabrics
- ASTM D3107 - Standard Test Method for Stretch Properties of Fabric Woven from Stretch Yarns.
- ASTM D3512/D3512M - Standard Test Method for Pilling Resistance and Other Related Surface Changes of Textile Fabrics: Random Tumble Pilling Tester
- ASTM D3775 - Standard Test Method for End (Warp) and Pick (Filling) Count of Woven Fabrics
- ASTM D3776/D3776M - Standard Test Methods for Mass Per Unit Area (Weight) of Fabric
- ASTM D3990 - Standard Terminology Rating to Fabric Defects.
- ASTM D5034 - Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test)

(Copies of these documents are available online at <https://www.astm.org>.)

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INFORMA HEALTHCARE

Repeat Insult Patch Test - Modified Draize Procedure –
Principles and Methods of Toxicology, A Wallace Hayes (editor)

(Copies of this document are available online at <https://www.crcpress.com>.)

SDL ATLAS (for cloth)

Part Number 402985 – Slub/Knot Replica Set

(Replica set is available for purchase from SDL Atlas Customer Service, 1-803-329-2110)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Unless a specific exemption has been obtained, nothing in this document, supersedes applicable laws and regulations.

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

3.3 Recycled, recovered, environmentally preferable, or biobased materials. Recycled, recovered, environmentally preferable, or biobased 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.

3.4 Figure. Figure 1 is furnished for informational purposes only. To the extent of any inconsistencies between the written document and the figure, the written document shall govern.

3.5 Materials.

3.5.1 Basic material. All yarns shall be a blend of polyester and cotton, drawn and spun into single yarns for both the warp and filling. The finished cloth shall contain 65 (± 5) percent polyester with the remaining percentage of cotton. The cotton shall be carded.

3.5.2 Weave. The weave shall be a 2 x 2 twill drawn on four (4) harnesses with a four (4) pick repeat (see Figure 1). Type I shall have no stretch and Type II shall have mechanical stretch when tested as specified in 4.5.

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3.6 Color. The color of the dyed and finished cloth shall be Army White 521 (Class 1), Army Gray 510 (Class 2), Air Force Blue 1664 (Class 3), and West Point Cadet Grey 563 (Class 4) or as specified in the contract.

3.6.1 Visual shade matching. The color and appearance of the cloth specified in 3.6 shall match the standard sample when tested as specified in 4.6.1.

3.6.2 Colorfastness (all types and classes). The finished cloth shall conform to the colorfastness requirements listed below in Table I when tested as specified in 4.5.

TABLE I. Colorfastness requirements (all types and classes).

| Colors Evaluation | Laundering Color Change and Staining (3 cycles) (min.) | Light (after 40 AFU or 170 kJ/(m ² nm) _{@420 nm}) <u>1/</u> | Perspiration (acid & alkaline) Color Change and Staining) (min.) | Croaking Dry/Wet (min.) <u>2/</u> | Dry Heat (min.) |
|-------------------|--------------------------------------------------------|----------------------------------------------------------------------------------|------------------------------------------------------------------|-----------------------------------|-----------------|
| White 521 | 3-4 | 3-4 | 3-4 | N/A | 3-4 |
| Gray 510 | 3-4 | 3-4 | 3-4 | 3.5 | 3-4 |
| Blue 1664 | 3-4 | 3-4 | 3-4 | 3.5 | 3-4 |
| Cadet Grey 563 | 3-4 | 3-4 | 3-4 | 3.0 | 3-4 |

1/ AFU: AATCC Fading Units.

2/ Croaking (Dry and Wet), shall not apply to White 521.

3.6.3 Labile sulfur. Dyes and compounds containing elementary sulfur capable of oxidation to sulfuric acid shall not be used. The dyed cloth shall be "Free" of labile sulfur when tested as specified in 4.5 and 4.6.3.

3.7 Physical requirements. The finished cloth shall conform to the requirements, listed below, in Table II, when tested as specified in 4.5.

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TABLE II. Physical requirements.

| Characteristic | Type I | Type II | |
|-------------------------------------|-------------------|-------------------|-------------------|
| | All Classes | Classes 1, 2, 4 | Class 3 |
| Weight, oz./sq. yd. | 5.0 (\pm 0.25) | 4.5 (\pm 0.25) | 4.5 (\pm 0.25) |
| Yarns per inch, minimum | | | |
| Warp | 135 | 135 | 126 |
| Filling | 65 | 65 | 68 |
| Breaking strength (pounds), minimum | | | |
| Warp | 100 | 100 | 100 |
| Filling | 50 | 50 | 50 |
| Tearing strength (pounds), minimum | | | |
| Warp | 4.0 | 4.0 | 5.0 |
| Filling | 4.0 | 4.0 | 5.0 |
| Seam efficiency (percent), minimum | | | |
| Warp | 70 | 70 | N/A |
| Filling | 85 | 85 | |
| Seam strength (pounds), minimum | | | |
| Warp | N/A | N/A | 65 |
| Filling | | | 50 |
| Stretch, percent-Type II only | | | |
| Initial (filling only) | N/A | 8-12 | 8-12 |
| Pilling, rating | | | |
| Initial | 3.5 | 3.5 | 3.5 |
| After 5 laundering cycles | N/A | 3.5 | 3.5 |

3.7 Finish. The cloth (Type I and Type II) shall be scoured, bleached (except for Class 3), singed and stabilized to match the finish appearance of the standard sample. The cloth for all types and classes shall be treated with a durable press and soil release finish. In addition for all types, Class 1 shall be treated with an optical brightener and for Class 3, it shall be treated with a moisture wicking finish.

3.7.1 Durable press finish. The durable press treated cloth shall exhibit a fabric appearance rating of not less than SA-3.5 after five (5) laundering cycles when tested as specified in 4.5.

3.7.2 Soil release finish. The soil release treated cloth shall exhibit a rating of not less than a Grade 4 after one (1) laundering cycle for all classes. After five (5) laundering cycles it shall exhibit a rating of Grade 4 for Classes 1 and 2, a rating of 3.5 for Class 3 (Air Force) and a rating of 3.0 for Class 4 when tested as specified in 4.5.

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3.7.3 Optical brightener (Class 1 only). The cloth shall show a rating of pass for optical brightener content when tested as specified in 4.5.

3.7.4 Wicking finish (Class 3 only). The wicking treated cloth shall show a wicking of not less than 2.25-inches in warp direction and 1.75-inches in filling direction in 5 minutes, and 3.75-inches in warp direction and 3-inches in filling direction in 15 minutes, when tested as specified in 4.5.

3.8 Dimensional change. The shrinkage or growth both in the warp and the filling direction of the finished cloth shall be not greater than 2.0 percent after three (3) laundering cycles when tested as specified in 4.5.

3.9 pH. The pH value of the water extract of the finished cloth shall be no less than 5.0 nor more than 8.5 when tested as specified in 4.5.

3.10 Toxicity. The finished polyester/cotton cloth shall not present a health hazard and shall show compatibility with prolonged, direct skin contact when tested as specified in 4.5 and 4.6.3. Chemicals recognized by the Environmental Protection Agency (EPA) as human carcinogens shall not be used.

3.11 Face identification. The warp side shall be identified as the face side by stamping that side with the word "FACE" at each end of the roll.

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

3.13 Length and put-up. For Government procurements only, unless otherwise specified (see 6.2), the cloth shall be finished in continuous lengths, each not less than 40 yards. Each length shall be put-up full width on a roll as specified in 5.1.

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

3.15 Workmanship. The finished cloth shall be uniform in quality and shall conform to the quality of product established on this specification. The occurrence of defects as specified in 4.4 shall not exceed the quality acceptance levels as specified in the contract or purchase order.

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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. A first article, submitted in accordance with 3.1, shall be inspected, examined for appearance, color and finished defects listed in 4.4 and tested for the characteristics as specified in 4.5 and 4.6.

4.3 Conformance inspection. Conformance inspection shall include the visual examination of 4.4 and the tests of 4.5 and 4.6 as applicable. Sampling for inspection shall be performed in accordance with ASQ/ANSI Z1.4 and with acceptance quality limits (AQLs) as specified in the contract and/or order, except where otherwise indicated (see 6.2).

4.3.1 Inspection conditions. Unless otherwise specified in this specification or applicable procurements (see 6.2), all inspections shall be performed in accordance with this specification and all the requirements of referenced documents.

4.4 Visual examination. Each roll in the sample shall be examined yard-by-yard on the face side for defects in accordance with MIL-STD-3064, Type I.

4.4.1 Roll identification and marking examination. During the yard-by-yard examination, each roll in the sample shall be examined for defects as specified in MIL-STD-3064.

4.4.2 Shade variation examination. During the yard-by-yard examination, each roll in the sample shall be examined for shade variation as specified in MIL-STD-3064.

4.4.3 Length examination. For Government procurements only, during the yard-by-yard examination, each roll in the sample shall be examined for length as specified in MIL-STD-3064.

4.5 Material/end item testing. The cloth shall be tested for the characteristics listed in Table III. The methods of testing as specified wherever applicable and as listed in Table III shall be followed. All test reports shall contain the individual values utilized in expressing the final results. The sample unit shall be five (5) continuous yards full width of the finished cloth for all physical and chemical tests. The lot shall be unacceptable if one (1) or more tests fail to meet the 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 up to and including 22,000 | 3 |
| 22,001 and over | 5 |

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TABLE III. Material/end item tests.

| Characteristic | Requirement Reference | Test method |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------|-------------------------------------------------------------------------------------------------|
| Fiber content | 3.5.1 | AATCC 20A 1/ |
| Yarn ply (single) | 3.5.1 | Visual 2/ |
| Weave | 3.5.2 | Visual 2/ |
| Visual shade matching | 3.6.1 | AATCC EP9, Option C and 4.6.1 (see 6.4) |
| Colorfastness: Laundering (after three (3) cycles) Light (after 40 AFU or 170 kJ/(m ² nm)@420 nm) Perspiration (acid and alkaline) Crocking (wet and dry) Dry Heat | Table I Table I Table I Table I Table I | AATCC 61, Option 2A 3/ AATCC 16.3, Option 3 4/ AATCC 15 3/ AATCC 8 5/ AATCC 117, II |
| Labile sulfur | 3.6.3 | 4.6.2 |
| Weight | Table II | ASTM D3776/D3776M |
| Yarns per inch | Table II | ASTM D3775 |
| Breaking strength | Table II | ASTM D5034 |
| Tearing strength | Table II | ASTM D1424 |
| Seam efficiency | Table II | ASTM D1683/D1683M 6/ |
| Seam Strength (Type II, Class 3 only) | Table II | ASTM D1683/D1683M 6/ |
| Stretch (filling only), Type II | Table II | ASTM D3107 |
| Pilling: Initial After five (5) laundering cycles | Table II Table II | ASTM D3512/D3512M AATCC 135, (3),(IV),iii & ASTM D3512/D3512M |
| Durable press finish After five (5) laundering cycles | 3.7.1 | AATCC 124, (3),(IV),iii |
| Soil release After one (1) laundering cycle After five (5) laundering cycles | 3.7.2 3.7.2 | AATCC 130, Option IV 7/ AATCC 130, Option IV 8/ |
| Optical brightener (Class 1 only) | 3.7.3 | AATCC EP9, Option C, 9/, 2/ |
| Wicking finish (Class 3 only) Time – 5 minutes Time – 15 minutes | 3.7.4 | AATCC 197, Option B |
| Dimensional change After three (3) laundering cycles | 3.8 | AATCC 135, (3),(IV),iii |
| pH | 3.9 | AATCC 81 |
| Toxicity | 3.10 | 4.6.3 |

1/ The cotton content shall be calculated as follows:

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

R = Weight of residual fibers

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S = Weight of dry desized specimen

- 2/ One determination shall be made from each sample unit and the result reported as “pass” or “fail”.
- 3/ Rated using the AATCC EP1, Evaluation Procedure for Gray Scale for Color Change and AATCC EP2, Evaluation Procedure for Gray Scale for Staining.
- 4/ Rated using the AATCC EP1, Evaluation Procedure for Gray Scale for Color Change.
- 5/ Rated using the AATCC EP8, Evaluation Procedure for AATCC 9-Step Chromatic Transference Scale.
- 6/ The needle shall measure 0.036 ± 0.001 inch across the blade at the eye. The polyester/cotton wrapped thread shall conform to Type I of A-A-50199. The thread shall be Tex 31-35, 2-ply for the needle and Tex 31-35 for the looper. The seam shall be LSc-2.
- 7/ Launder four (4) specimens. Only two (2) specimens shall be treated with stains.
- 8/ After the first laundering cycle, the two (2) unstained samples shall be laundered an additional four (4) more cycles and then stained. Launder stained samples one (1) more time and then the samples shall be evaluated for stain removal after five (5) laundering cycles.
- 9/ Sample shall be viewed under UV illumination.

4.6 Methods of testing and inspection.

4.6.1 Visual shade matching. The color and appearance of the cloths shall match the standard sample when viewed using the AATCC EP9, Evaluation Procedure for Visual Assessment of Color Difference of Textiles, Option C (see 6.5), with sources simulating artificial daylight D₇₅ illuminant with a color temperature of 7500 (± 200) K illumination of 100 (± 20) foot candles, and shall be a good match to the standard sample under incandescent lamplight at 2856 (± 200)K.

4.6.2 Presence of labile sulfur test. In the determination of presence of labile sulfur in textile materials with lead acetate, two 1.50 (± 0.01) gram samples from each material submitted for evaluation shall be tested. Each of the two (2) samples shall be cut into very small pieces and placed into separate test tubes. The samples shall be submersed in a stannous chloride solution that contains 100 grams of stannous chloride crystals ACS in 100 milliliters of hydrochloric acid ACS (35 percent concentration) and 50 milliliters of distilled water. A filter paper wet out with a 5.0 percent lead acetate solution shall be placed over the top of the test tube. The lead acetate solution contains 5.0 grams of lead acetate CP reagent grade and enough distilled water to make up a 100 milliliter solution; if the solution is not clear add a few drops (one at a time) of glacial acetic acid until the solution is clear. The test tube containing the textile sample, stannous chloride and wet filter paper shall be heated over a low flame until the solution is boiling. The solution should not be heated for more than 15 seconds. A brown to black stain on the filter paper should be evaluated as follows:

- Free - The filter paper shows no discoloration or staining of any kind.
- Slight - The filter paper shows a light tan to light brown discoloration stain.
- Moderate - The filter paper shows a dark brown discoloration stain.

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Severe - The filter paper shows a black color stain.

The rating shall be recorded. The results shall be recorded as “pass” or “fail.”

4.6.3 Toxicity test. When required, (see 6.2) an acute dermal irritation study and a skin sensitization study shall be conducted. When the results of these studies indicate the material is not a sensitizer or irritant, a Repeat Insult Patch Test shall be performed in accordance with the Modified Draize Procedure (see 2.3). If toxicity requirement (see 3.10) can be demonstrated with historical use data, on the finishing treatments used, toxicity testing may not be required (see 6.2).

5. PACKAGING

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

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The Class 1 and Class 2 cloth is intended for use in the manufacturing of shirts worn by Army personnel as part of the Army Service Uniform (ASU), Class 3 by Air Force personnel as part of the Service Dress Uniform, and Class 4 by the Cadets at West Point.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification
- b. Type and class required (see 1.2)
- c. The specific issue of individual documents referenced (see 2.2)
- d. When first article is required (see 3.1, 4.2)
- e. When toxicity testing is required (see 3.10, 4.6.3)
- f. Width of cloth required (see 3.12)
- g. Length required if other than specified (see 3.13)
- h. Conformance inspection acceptance quality limits (AQLs) (see 4.3)
- i. Inspection conditions (see 4.3.1)
- j. Packaging (see 5.1)

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

6.4 Visual shade matching. In 2019, Option A of AATCC EP9, Evaluation Procedure for Visual Assessment of Color Difference of Textiles was changed to Option C. NOTE: In case of confusion, the viewing geometry should be “The specimen plane and illumination source will be parallel to each other and aligned so that the light flux is incident at the center of the specimen plane, which is set at a 35 (\pm 5°) angle relative to the horizontal. The observer will view the specimens at a 90° angle, relative to the plane of the specimens”.

6.5 Cross-reference. Army Cloth, Polyester/Cotton, GL PD 11-05B has been replaced by this document.

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue due to the extent of the changes.

6.7 Subject term (key word) listing.

Durable press

Fabric

Soil release

Stretch

Wicking

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| | | | |
|---|---|---|---|
| | | X | X |
| | X | X | |
| X | X | | |
| X | | | X |

Weave Chain
2X2 Twill

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 4 | | | X | | | X | | | X | | |
| 3 | | X | | | X | | | | | X | |
| 2 | X | | | X | | | X | | | | X |
| 1 | X | | | X | | | | X | | | |

Pattern Draw
Harness #

FIGURE 1. Herringbone pattern.

Custodians:
Army - GL
Navy - NU
Air Force - 11

Preparing activity:
DLA-CT

(Project 8305-2020-016)

Review activities
Army - MD
Navy - CG1, MC

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