

INCH-POUND

MIL-T-83193B
21 November 1989
 SUPERSEDING
 MIL-T-83193A
 6 September 1979

MILITARY SPECIFICATION

THREAD, ARAMID, SPUN STAPLE

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

1. SCOPE

1.1 Scope. This specification covers spun staple, high temperature, aramid thread used for machine sewing.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

PPP-P-50	Packaging and Packing of Thread for Domestic and Overseas Shipment
L-P-1183	Plastic Molding Material, Acrylonitrile-Butadiene-Styrene (ABS), Rigid

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: U.S. Army Natick Research, Development, and Engineering Center, Natick, MA 01760-5014 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 8310

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STANDARDS

FEDERAL

FED-STD-191 Textile Test Methods

MILITARY

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

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Naval Publications and Forms Center, (ATTN: NPODS), 5801 Tabor Avenue, Philadelphia, PA 19120-5099.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DoD adopted are those listed in the issue of the DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

THE COLOR ASSOCIATION OF THE UNITED STATES

Standard Color Card of America

Department of Defense Standard Color Card for Sewing Threads

(Color cards may be available from the Color Association of the United States, 343 Lexington Avenue, New York, NY 10016-0927. If color cards are not available from the Color Association, individual color samples may be obtained from the contracting activity or as directed by the contracting activity.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D 4101 - Propylene Plastic Injection and Extrusion Materials

D 861 - Use of the Tex System to Designate Linear Density of Fibers,
Yarn Intermediates, Yarns, and Other Textile Materials

(Application for copies should be addressed to American Society for Testing and Materials (ASTM), 1916 Race St., Philadelphia, PA 19103-1187.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

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2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Government and contractor purchases. The requirements specified in 3.4.4, 3.5, 3.6, and the related provisions of section 4, and all of section 5 apply only to thread purchased directly by the Government. All other requirements apply both to thread purchased by a contractor as a component for an end item and to thread purchased directly by the Government.

3.2 Standard sample. When a standard sample is available, the thread shall match the standard sample for shade and shall be equal to or better than the standard sample with respect to all characteristics for which the standard sample is referenced (see 4.3.2.2 and 6.3).

3.3 Materials.

3.3.1 Fiber. The fiber used in the manufacture of the thread shall be aramid of 1.5 to 2.0 denier per filament. The fiber shall not carbonize at a temperature below 675°F when tested as specified in 4.2.2.

3.4 Physical requirements. The finished thread shall conform to the applicable requirements of table I when tested as specified in 4.2.2.

3.4.1 Twist. Unless otherwise specified, the direction of final twist shall be "Z" for all thread. Each of the individual plies shall be initially twisted with no less than the number of turns per inch to be used in the final twist and in opposite direction to the final twist (see 4.2.2).

TABLE I. Physical requirements

Nominal Tex Size	Plies, Final	Length per Pound, Yards		Breaking Strength (pounds, minimum) original	Elongation percent maximum
		Minimum	Maximum		
21	2	20,600 - 23,700		1.2	25
24	2	18,000 - 19,700		1.5	25
27	2	16,200 - 18,400		1.5	25
35	2 or 3	12,000 - 14,200		2.0	30
40	2 or 3	11,000 - 13,000		2.4	30
45	2 or 3	9,200 - 11,100		2.7	30
50	2 or 3	8,200 - 10,200		3.0	30
60	3 or 4	7,000 - 8,600		3.6	35
70	3 or 4	6,200 - 7,100		4.3	35

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TABLE I. Physical requirements (cont'd)

Nominal Tex Size	Plies, Final	Length per Pound, Yards		Breaking Strength (pounds, minimum) original	Elongation percent maximum
		Minimum	Maximum		
80	3 or 4	5,500 -	6,200	4.9	35
90	3 or 4	4,700 -	5,600	5.5	35
100	3 or 4	4,700 -	5,200	6.3	35
105	3 or 4	4,000 -	4,800	6.5	35

3.4.2 Color. The color (shade) shall be as specified in the applicable end item specification or in the contract or purchase order (see 6.2). Shade designations by letter (e.g. Olive Drab S-1) and related cable numbers (e.g. C.A. 66022) refer to the DOD Standard Shades for Sewing Threads or the standard sample (see 3.2).

3.4.2.1 Visual color matching. The shade of the end item thread, after removal of finish, when applicable (see 6.3.1), shall match the specified applicable approved shade standard (see 6.3) when tested as specified in 4.2.2.

3.4.2.2 Colorfastness. The dyed and finished thread shall show fastness to laundering (after 3 cycles) equal to or better than the standard sample or equal to or better than a rating of "good" when tested as specified in 4.2.2.

3.4.3 Heat aging resistance. The finished thread shall retain a minimum of 85 percent of the applicable original breaking strength specified in table I after heat aging when tested as specified in 4.2.2.

3.4.4 Knots. Tex size 45 and finer shall average not more than one knot per 4 ounces in singles.

3.4.5 Finish. The thread shall have a soft finish and shall contain only the minimum amount of lubricant to facilitate sewing.

3.4.5.1 Sewing finishes. Only non-staining and non-flame propogating finishes commonly used shall be permitted as sewing finishes unless prior approval is obtained from the Contracting Officer. The finish shall have no deleterious effect on the thread including effects of prolonged storage. No finish or treatment shall be applied for the purpose of increasing breaking strength.

3.5 Put-up. Unless otherwise specified (see 6.2), the thread shall be put up on a weight basis, 8, 16, or 32 ounces per holder, on commercial tubes or cones. Plastic tubes, when used, shall conform to 3.5.1 or 3.5.2. A plus or minus tolerance of 10 percent thread weight will be permitted on any one holder.

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The thread shall be put up in one continuous length per holder and shall be so wound that each turn and layer is free from entanglement when examined as specified in 4.2.1.2.

3.5.1 Acrylonitrile. The tubes shall be acrylonitrile-butadiene-styrene (ABS) rigid plastic (see 6.6) meeting the requirements of type I of L-P-1183 with the following values substituted in the table of property values (see 4.2.2).

Property values

Impact strength (Izod), min., ft. -lb. per inch of notch at $23^{\circ} \pm 2^{\circ}\text{C}$ (1/8 inch sample)	1.5
Tensile yield stress, min., psi	66,000
Deflection temperature under load, min. (264 psi fiber stress):	88 degrees C
Modulus of elasticity in tension, min., psi	39,000
Rockwell hardness (R scale), min.	105
Specific gravity, $23^{\circ}/23^{\circ}\text{C}$, max.	1.2
Chemical resistance, 40-hr. immersion in heptane at $23^{\circ} \pm 2^{\circ}\text{C}$. weight change, max., percent	5.0

3.5.2 Polypropylene. The tubes shall be molded from a virgin propylene homopolymer plastic (see 6.7) meeting the requirements of PP 123 under ASTM D 4101 (see 4.2.2).

3.6 Identification marking. Except when acceptance of commercial identification markings are specified in the invitation to bid, each holder shall have a label attached in such a manner as to remain in place and be clearly legible until all thread has been removed. The label shall be printed with the information as specified below.

Nomenclature
 National stock number
 Weight (net)
 Direction of twist
 Tex size and ply
 Yards per pound
 Color
 Contract or purchase order number

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Name of contractor

Date manufactured (month and year)

3.7 Workmanship. The finished thread shall conform to the quality of product established by this specification.

4. QUALITY ASSURANCE PROVISIONS

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

4.1.1 Responsibility for compliance. All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

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

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

4.2.1 End item examination.

4.2.1.1 Thread on holder examination. The thread on holders shall be examined for the defects specified in table II. All defects shall be counted regardless of their proximity to each other except where two or more defects represent a single local condition, in which case only the more serious defect shall be counted. The lot size shall be expressed in units of holders (tubes or cones). The sample unit shall be one holder (tube or cone). The inspection level shall be S-3 (see 6.5).

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TABLE II. Thread on holder defects

Examine	Defects	Major	Minor
Identification	Missing, insecurely attached, incorrect, or incomplete		201
Holder	Cut, torn, chafed, or otherwise damaged holder, affecting the free unhampered unwinding of thread, or the secure holding of thread winds or layers of winds on the holder. Holder other than specified.	101	
Color	Other than specified. Uneven, apparent or successive layers of end to end.	102	
Spots or stains	Clearly visible on individual strands of thread.		202
Finish	Other than specified. Uneven, lumpy, bare or thin spots.		203

4.2.1.2. Thread as unwound examination. The thread while being unwound shall be examined for the defects listed in table III. All defects shall be counted regardless of their proximity to each other except where two or more defects represent a single local condition, in which case only the more serious defect shall be counted. The lot size shall be expressed in units of holders (tubes or cones). The sample unit shall be one holder (tube or cone). The inspection level shall be S-3 (see 6.5).

TABLE III. Thread as unwound defects

Examine	Defect	Major	Minor
Construction Workmanship	Unevenly spun, twisted or plied	101	
Continuous length	Not in continuous length		201

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TABLE III. Thread as unwound defects (Cont'd)

Examine	Defect	Major	Minor
Winding	Improperly or not firmly wound resulting in knots, kinks, entangling, or slippage during unwinding or otherwise affecting free unhampered unwinding of thread	102	
Number of plies	Other than specified	103	

4.2.1.3 Net weight per holder examination. The sample examined in accordance with 4.2.1.2 shall be examined for conformance to the weight per holder requirements in 3.5. The net weight of the thread shall be determined by subtracting the weight of the holder from the combined weight of the thread and holder. The lot shall be rejected if the net weight on any one holder exceeds the tolerances of 3.5, or if the average net weight (to the nearest 0.1 ounce) is less than the target net weight specified in 3.5.

4.2.2 End item testing. The thread shall be tested for the characteristics listed in table V. The methods of testing specified in FED-STD-191 wherever applicable and as listed in table V shall be followed. The sample unit shall be one holder (cone or tube). The lot shall be rejected if one or more sample units fail to meet any requirement specified. The sample size shall be as specified in table IV.

TABLE IV. Sample size for testing

Lot size (holders)	Sample size (sample units)
50 or less	2
51 to 150	3
151 to 1000	5
1001 and over	5 per thousand

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TABLE V. End item test methods

Characteristic	Requirement paragraph	FED-STD-191 Test Method
Fiber identification	3.3.1	<u>1</u> /
Number of plies	3.4	Visual <u>2</u> /
Length per pound	3.4	4010
Elongation	3.4	4100 <u>3</u> /
Breaking strength: Initial	3.4	4100 <u>4</u> / <u>5</u> /
Direction of twist	3.4.1	4050
Twist, turns per inch		
Singles	3.4.1	4052 <u>6</u> /
Plied	3.4.1	4054 <u>6</u> /
Color (shade) match	3.4.2 and 3.4.2.1	4.3.2
Colorfastness	3.4.2.2	5614 <u>7</u> / <u>8</u> /
Heat aging resistance	3.4.3	4.3.1 and 4100 <u>5</u> /
Finish	3.4.5	<u>1</u> /
Composition of plastic tubes	3.5.1 and 3.5.2	<u>1</u> /

- 1/ Unless otherwise specified, a certificate of compliance shall be submitted and will be acceptable for the stated requirement.
- 2/ One determination per sample unit shall be made and the result reported as "pass" or "fail".
- 3/ To be determined simultaneously with breaking strength.
- 4/ Thread clamps embodying the flat anvil and drum principle with side closing cam, known as Callaway or U.S. Rubber Clamps, shall be used. The gage length shall be 10 inches measured from the bite between the drum and flat jaw in the bottom clamp.

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- 5/ Except that five determinations shall be made per sample unit.
- 6/ The test for turns per inch (tpi) in the individual plies shall be made in conjunction with that for the final (plied) twist. After recording the final twist, and while the individual plies are straight between the jaws, all plies but one shall be cut and removed. The clamp shall then be opened, the slack drawn through, and the remaining single ply shall be reclamped under the specified tension. The counter shall be reset to zero. The jaw shall then be rotated until all twist has been removed as determined by the separation of filaments by a needle.
- 7/ The specimens must be dried after each of the three laundering cycles.
- 8/ On the color transfer cloth evaluation, only the stain on the nylon fiber of the color transfer cloth shall be evaluated.

4.2.3 Packaging inspection. The inspection shall be in accordance with the quality assurance provisions of PPP-P-50.

4.3 Methods of inspection.

4.3.1 Heat aging resistance test. Five specimens each of every applicable size shall be used for the heat aging test. Five specimen skeins of 15 yards each shall be exposed in a hot air convection (circulating air) oven at a temperature of $500^{\circ}\text{F} \pm 10^{\circ}\text{F}$ for a period of 4 hours. Upon removal, the specimens shall be conditioned at standard atmospheric conditions for 4 hours and then tested for breaking strength as specified in table V. The heat aging resistance shall be the average of the breaking strength obtained from the specimens tested, and shall be reported to the nearest 1.0 percent of the original breaking strength.

4.3.2 Shade match evaluation.

4.3.2.1 Removal of finish. If a sample contains finish, before evaluation for shade matching, the sample of thread shall be wet drycleaned in accordance with Method 5622 of FED-STD-191 (disregarding references to the standard sample). Excess solvent shall be removed by centrifuging or wringing. The sample shall then be rinsed in distilled water at 120°F to 160°F , and dried at a temperature not exceeding 180°F . The dried sample shall then be conditioned for a minimum of 4 hours prior to evaluation for shade match (see 6.3.1).

4.3.2.2 Shade matching procedure. The sample shall be wound or prepared for examination in a manner similar to that for the standard shade sample. The color of the sample shall match the standard sample when viewed under filtered tungsten lamps that approximate artificial daylight and that have a correlated color temperature of 7500 ± 200 K. with illumination of 100 ± 20 foot candles, and shall be a good match to the standard sample under incandescent lamplight at 2300 ± 200 K.

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5. PACKAGING

5.1 Preservation. Preservation shall be level A or Commercial, as specified (see 6.2).

5.1.1 Levels A and Commercial. The thread shall be preserved in accordance with the applicable requirements of PPP-P-50.

5.2 Packing. Packing shall be level A, B, or Commercial, as specified (see 6.2).

5.2.1 Levels A, B, and Commercial. The thread, preserved as specified in 5.1 shall be packed in accordance with PPP-P-50.

5.3 Marking. In addition to any special markings specified in the contract, or purchase order, unit packs and shipping containers shall be marked in accordance with applicable provisions of PPP-P-50.

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 thread is intended for use in machine sewing of protective combat apparel and flight safety equipment.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification.
- b. Direction of twist, if other than specified (see 3.4.1).
- c. Color (shade) required (see 3.4.2).
- d. Tex size required (see table I.)
- e. Put-up required (see 3.5).
- f. Selection of applicable levels of preservation and packing (see 5.1 and 5.2).
- g. Acceptance criteria required (see 6.5).

6.3 Standard sample. For military shades, the standards for shade reference are those contained in the Standard Color Card of the Official Standardized Shades for Sewing Threads or the standard sample (see 3.2). For other shades, address the contracting activity issuing the invitation for bids or request for proposal. Standard samples frequently used by the military (directly or for components of end items) have been made available to normal contractors as basic reference for the establishment of the contractor's secondary standards conforming to the characteristics of the official standards. The basic shade standards are those appearing in the DOD Color Card. Prime thread manufacturers who inadvertently have not been furnished standards for establishment of their colorfastness standards in accordance with this document may obtain samples for

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this purpose from the U.S. Army Natick Research, Development, and Engineering Center, Natick, MA 01760-5014, (ATTN: STRNC-ITC).

6.3.1 Shade matching evaluation. In cases where it is not considered feasible to remove the finish prior to shade matching, the thread may be evaluated on an "as is" basis upon approval of the contracting officer.

6.4 Subject term (key word) listing.

High temperature resistant
Machine sewing

6.5 Acceptance criteria. The acceptance criteria below are recommended for use. The acceptance criteria as specified in the contract or purchase order shall be binding. Unless otherwise specified, the following acceptance criteria are in accordance with MIL-STD-105.

6.5.1 For thread on holder examination. An acceptable quality level (AQL), expressed in terms of defects per hundred units, of 1.0 for major defects and 2.5 for total (major and minor combined) defects is recommended.

6.5.2 For thread as unwound examination. An AQL, expressed in terms of defects per hundred units, of 4.0 is recommended.

6.6 Material for acrylonitrile tubes. "ABS" material known as "Kralastic MM" has been used satisfactorily to make injection-mold tubes to meet the requirements specified in 3.5.1. Kralastic MM is made by the Naugatuck Chemical Division of the U.S. Rubber Company, Naugatuck, CT.

6.7 Material for polypropylene tubes. "EL Rexene PP 11-S-5" material has been used satisfactorily to make injection molded tubes meeting the requirements specified in 3.5.2. Resin is made by Dart Industries, Inc., P.O. Box 37, West 115 Century Road, Paramus NJ 07652.

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

Custodians:

Army - GL
Air Force - 11
Navy - NU

Preparing activity:

Army - GL

(Project 8310-0172)

Review activities:

Army - MD
Air Force - 82, 99
DLA - CT

User activity:

Navy - AS

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