

MIL-R-24537(SH)  
18 April 1978

### MILITARY SPECIFICATION

#### ROPE, FIBROUS, PLAITED, CONTINUOUS POLYESTER FILAMENT WITH A STAPLE WRAP

This specification is approved for use by the Naval Sea Systems Command 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 fibrous plaited rope having a continuous polyester filament with a staple wrap.

1.2 Classification. The rope shall be furnished in one type and in the circumference specified (see 6.2.1).

#### 2. APPLICABLE DOCUMENTS

2.1 Issues of documents. The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

#### SPECIFICATIONS

##### FEDERAL

UU-T-81 - Tags, Shipping and Stock.

##### MILITARY

MIL-C-3131 - Cordage: Preparation for Delivery of.

MIL-M-15926 - Marlinespike.

MIL-L-17672 - Lubricating Oil, Hydraulic and Light Turbine, Noncorrosive.

#### STANDARDS

##### FEDERAL

FED-STD-191 - Textile Test Methods.

##### MILITARY

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

(Copies of specifications, standards, drawings, and publications required by contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

#### 3. REQUIREMENTS

3.1 Sample for first article inspection. When specified (see 6.2.1), prior to beginning production, a finished sample shall be submitted to the contracting officer or his designated representative for first article inspection as specified in 4.1.1. A continuous length of 70 feet shall be submitted.

3.2 Materials. Material used in the rope shall be virgin, continuous filament, heat and light resistant polyester filament with a staple wrap.

#### 3.3 Construction.

3.3.1 The rope shall be made of eight strands arranged in four pairs, where one individual strand shall be laid adjacent to the second strand in each pair and shall conform to

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the requirements specified herein. Individual strands shall be made of one size of single yarn and shall have equal numbers of yarns. The yarns shall be made from group filaments conforming to the sizes specified in table I for the respective sizes of rope.

TABLE I. Construction.

Rope size (circumference, inches)	Denier of single yarns
3/4 to 1-1/8	9,000
1-1/4 to 4	18,000
4-1/2	45,000

3.3.2 In the preparation of the constituent rope strands, the pattern "S2S" shall be employed in the twisting of the yarns, and the individual strands of two pairs, while the components of the remaining pairs shall be twisted in the "ZS2" pattern.

3.3.3 The finished rope shall be so constructed that in the interweaving procedure, pairs of strands of the former structure shall be twisted in the "Z" direction, while alternating pairs of the latter structure shall be twisted simultaneously in the "S" direction. Heat setting of the rope or any of its components shall not be permitted. The direction of twist for the yarns, the strands, and the pairs of strands into the rope shall be determined in accordance with 4.2.5.

#### 3.4 Physical requirements.

3.4.1 The finished rope shall conform to the physical properties specified in table II when tested as specified in 4.2.5.

TABLE II. Physical properties.

Circumference at load "P" nominal	Tolerance plus or minus	Load "P"	Approx Dia	Linear density	Hardness min: no max.	Breaking test, minimum
				lbs. per 100 ft. at load "P"		
Inches	Inches	Lbs.	Inches	Pounds	Pounds	Pounds
3/4	1/16	12	1/4	2.10	5	2,080
1	1/16	20	5/16	3.15	5	2,980
1-1/8	1/16	30	3/8	4.35	5	3,970
1-1/4	1/16	40	7/16	5.65	5	5,050
1-1/2	1/16	50	1/2	7.35	5	6,400
1-3/4	1/16	70	9/16	9.55	5	8,100
2	1/8	90	5/8	12.2	5	9,900
2-1/4	1/8	110	3/4	15.2	5	12,200
2-1/2	1/8	140	13/16	18.4	5	14,500
2-3/4	1/8	170	7/8	21.5	5	16,700
3	3/16	200	1	25.2	20	19,000
3-1/4	3/16	240	1-1/16	29.6	20	22,000
3-1/2	3/16	270	1-1/8	33.6	20	25,000
3-3/4	3/16	310	1-1/4	37.8	20	27,500
4	3/16	350	1-5/16	42.5	20	30,700
4-1/2	1/4	450	1-1/2	63.0	20	37,000

3.4.2 Elongation. The elongation of the rope shall not exceed 25 percent at 75 percent of the minimum breaking test in table II. The load elongation curve, drawn autographically, shall not exhibit evidence of changes in load applications greater than 5 percent of the load weighed at the instant of change. Changes due to splice slippage shall not be considered in this determination.

3.4.3 Hardness. The finished rope shall meet the minimum hardness specified in table II when tested "as received".

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3.5 Finish. No extraneous material shall be added for the purpose of weighting the rope. The extractable matter of the finished rope shall not exceed 4.0 percent when tested as specified in 4.2.5.

3.6 Moisture content. The moisture content of the rope "as received" shall not exceed 5.0 percent when tested as specified in 4.2.5.

3.7 Spliceability. The finished ropes shall be spliceable and shall not develop yarn displacement or strand cockles in the splicing test specified in 4.2.5.

3.8 Identification marker. The manufacturer shall identify his product by inserting a kraft paper or water-repellent cotton marker within one strand in all ropes 2 inches in circumference and larger. The marker shall be completely enveloped by the cover yarns in the strand in which inclosed. Unless otherwise specified (see 6.2.1), the manufacturer's name, year of manufacture, and type of fiber (polyester) shall be clearly printed on the marker. Italic or script type shall not be used. The printing shall not be affected upon exposure to water or mineral oil, when tested as specified in 4.2.5. The marker shall extend the entire length of the rope.

3.9 Identification ticket. In addition to marker requirements specified (see 3.8), each package unit shall have a ticket (identification tag) attached to it for identification purposes. The ticket shall conform to the requirements for type B, class 1, size 4 or 5 of UU-T-81. The ticket shall be made of not less than 15 points paper stock and shall have a minimum tearing resistance of both directions (total) of 850 g. The ticket shall be legibly printed, stamped or typed with water insoluble ink. The ticket shall contain the following information:

- (a) Stock number.
- (b) Nomenclature.
- (c) Specification number.
- (d) Length.
- (e) Contract number and date.
- (f) Date of manufacture (month and year).
- (g) Contractor's name.

3.10 Put-up. Unless otherwise specified (see 6.2.1), the rope shall be furnished without knots or splices on non-returnable reels (spools) not larger than 6 feet in diameter in the lengths specified in table III. The ends of all rope shall be cut off squarely and be securely whipped, taped or heat-sealed to prevent fraying and untwisting. The reels (spools) shall be wound so that each turn and layer is free from entanglement.

TABLE III. Put-up.

Circumference (inches)	Minimum length (feet)	Approx. wt. <sup>1/</sup> (pounds)
3/4	2250	50
1	2250	75
1-1/8	1620	75
1-1/4	1200	72
1-1/2	1200	93
1-3/4	1200	121
2	1200	155
2-1/4	1200	193
2-1/2	1200	234
2-3/4	1200	272
3	1200	320
3-1/2	1200	427
3-3/4	600	240
4	600	270
4-1/2	600	401

<sup>1/</sup>Not a requirement; for information only.

#### 4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified

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herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 First article inspection. When specified (see 6.2.1), the first article sample submitted in accordance with 3.1 shall be visually inspected in accordance with table IV. The sample shall then be tested for physical and chemical requirements in accordance with 4.2.5.

4.1.1.1 First article inspection report. The contractor shall prepare a first article inspection report in accordance with the data ordering document included in the contract (see 6.2.2).

TABLE IV. Visual examination of defects.

Examine	Defect	Classification	
		Major	Minor
Appearance and workmanship	Cut, chafed or damaged, affecting serviceability	X	
	Kinks, darting yarns <sup>1/</sup> , broken or loose ends, bulged strands, strand knots	X	
	Other than 8 strands (four pairs)	X	
	Ends not securely whipped, taped or heat sealed to prevent fraying or untwisting		X
Identification marker (ropes 2" in circumference and larger)	Omitted, incorrect illegible	X	
	Italic or script type used	X	
	Not completely covered by cover yarns	X	
	Not as specified	X	
Identification ticket	Omitted, incorrect, illegible, insecurely attached	X	
	Not as specified		X
Cleanness	Spot or stain, clearly visible <sup>2/</sup>		X
	Objectionable odor		X

<sup>1/</sup>Darting yarns are internal yarns which project through the cover yarns of the strand at intervals along the rope.

<sup>2/</sup>At normal inspection distance (approximately 3 feet).

4.2 Inspection. Sampling and inspection shall be performed in accordance with 4.2.5, unless otherwise indicated.

4.2.1 Material and component inspection. Testing shall be conducted on components in accordance with all requirements of this specification (see table V).

4.2.1.1 Certificate of compliance. The contractor shall prepare a certificate of compliance in accordance with the data ordering document included in the contract (see 6.2.2). The certificate shall contain actual test, examination, or other verifiable quality data.

4.2.2 Examination of the end item for visual defects. The defects listed in table IV shall be counted regardless of the 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 unit of product for this examination shall be the reel or spool, as applicable. Ten percent of the gross length contained on each unit of product, but not less than 100 feet shall be subjected to the visual examination. The acceptable quality level (AQL) shall be 1.5 major defects and 4.0 total defects (major and minor combined) per 100 units. The inspection level shall be level S-1 of MIL-STD-105.

4.2.3 Examination for length and winding. The sample unit for this examination shall be one reel or spool. The inspection level shall be level S-3 of MIL-STD-105 with an (AQL) of 4.0. For lots consisting of 500 or fewer units, the sample size shall be 10 and the acceptance number 1. The lot size shall be the number of units in the inspection lot. Defects shall be determined in accordance with 4.2.3.1 and 4.2.3.2.

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4.2.3.1 Defects with regard to length shall be considered to exist if any of the following are determined during inspection:

- (a) Length of unit less than specified (see 3.10).
- (b) Length of unit less than marked on ticket.
- (c) Any piece less than 600 feet in length for sizes up to and including ropes of 4-1/2 inch circumference.

4.2.3.2 Defects with regard to winding shall be considered to exist if any of the following are determined during inspection:

- (a) Improperly or not firmly wound resulting in kinks, knots entangling or slippage during unwinding or otherwise affecting free unhampered unwinding of rope.
- (b) Knot, splice, or otherwise joining of ends to make a continuous length.

4.2.4 Examination of preparation for delivery requirements. Examination shall be made to determine that the packaging, packing and marking requirements of section 5 of this specification are complied with. The examination shall be in accordance with MIL-C-3131, except that the inspection level shall be S-2 and the AQL 2.5 defects per 100 units.

4.2.5 Test methods. Methods of testing shall be as specified in FED-STD-191, wherever applicable, and as listed in table V. The physical and chemical values required in section 3 of this specification apply to the average of the determinations made on a sample unit for test purposes as specified in the applicable test methods. Sample size, acceptance and rejection numbers shall be in accordance with table VI. The sample unit for testing shall be 85 feet of rope. Lot size shall be expressed in units of reels or spools.

TABLE V. Test methods.<sup>1/</sup>

Characteristics	Requirements	Test method	No. of deter. per indiv. units of product	Results reported as
Material	3.2	<sup>2/</sup>		
Direction of rope twist	3.3	4050	1	Pass or fail
Direction of twist (plied yarn)	3.3	Visual		Pass or fail
Direction of twist (strand)	3.3	Visual		Pass or fail
Denier (singles yarn)	Table I	<sup>2/</sup>		Pass or fail
Circumference	3.4.1	4.2.5.1	3	Aver. of 3 deter. to nearest 1/16"
Linear density	3.4.1	4.2.5.2	1	Reported to nearest 0.1 ft. for ropes 4-1/2" or less in cir. and to the nearest 0.01 ft. for ropes over 4-1/2" in cir.
Breaking strength, ropes	3.4.1	6015	3	Aver. of 3 deter. to nearest 10 lbs.
Elongation	3.4.2	4.2.5.4	1	Report to nearest 0.1 percent
Hardness	3.4.3	4.2.5.5	3	Aver. of 3 deter. to nearest 1.0 lb.
Extractable matter	3.5	2611.1	*1	Aver. of 2 deter. to nearest 0.1 percent
Moisture content	3.6	2600	1	Reported to nearest 0.1 percent
Spliceability	3.7	4.2.5.6	1	Pass or fail
Identification marker material	3.8	<sup>2/</sup>		
Fastness to oil and water	3.8	4.2.5.7	1	Pass or fail
Identification ticket material	3.9	5671	1	Pass or fail

See footnotes at top of next page.

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1/ Tests to determine compliance with specification requirements including quantity of delivery may be made under prevailing atmospheric conditions except in settlement of dispute in which case the tests shall be made upon material which has reached equilibrium under standard conditions as defined in FED-STD-191.

2/ See 4.2.1.1.

TABLE VI. Sampling for tests.

Number of reels, spools or coils in lot	Number of samples	Acceptance No. for each test characteristic	Rejection number for each test characteristic
1 to 2	1	0	1
3 to 15	2	0	1
16 to 40	3	0	1
41 to 110	5	0	1
111 to 300	7	0	1
301 to 500	10	0	1
501 and over	15	1	2

4.2.5.1 Determination of circumference. The circumference shall be measured at the beginning of the breaking strength test with the specimen under the load "P" specified in table II. A hard fiber shall be passed snugly around the rope and cut where it overlaps. The cut length shall be straightened and measured to the nearest 1/16 inch. This determination shall be repeated at least three times in different positions not less than two turns of rope apart. The average of these determinations shall be the circumference of the rope.

4.2.5.2 Determination of length per pound. A minimum of 20 feet of rope shall be measured to the nearest 1/4 inch and weighed to within + 0.5 percent of its total weight. The feet per pound shall be calculated using the following equation:

$$\text{Feet per pound} = \frac{L \times (1 + e/100)}{W}$$

Where:

L = Measured length of specimen (feet).  
W = Measured weight of specimen (pounds).  
e = Percent elongation of load P (see Table II, determined as specified in 4.2.5.4).

#### 4.2.5.3 Determination of breaking strength.

4.2.5.3.1 Initial. The breaking strength shall be determined in accordance with method 6015 of FED-STD-191, except as modified herein. Lengths for the breaking strength shall be taken from each sample and spliced at each end with five full tucks. The inside length of each eye, measured with the sides of the eye in contact, shall be not less than 12 inches. The length between the inner ends of the splices shall be between 3 and 5 feet. Clamps or capstan arrangements may be used in lieu of splices but in case of dispute, spliced specimens shall be used.

4.2.5.4 Determination of elongation. A 20-inch gage, minimum, shall be marked off on the tensile specimen in the spliced relaxed condition. The specimen shall be tensioned to the load "P" specified in table II for the respective size rope. The elongation under this tension shall be measured for each breaking strength specimen averaged to the nearest 0.1 percent and recorded as the value "e" for use in determining length per pound (see 4.2.5.2). The elongation at the breaking point shall be determined and calculated to percent as specified in method 6015 of FED-STD-191.

#### 4.2.5.5 Hardness.

4.2.5.5.1 Initial. The length of rope previously used in the weight determination shall be taped off at each end. The tip of a 14-inch marlinespike, conforming to MIL-S-15926, shall be started through the center of the rope so that two pairs of strands shall be visible on each side thereof. With the spike inserted, the rope shall be placed in a compression type testing machine in such a manner that the force necessary to push the spike through the rope will be measured with the rope in a relaxed state without tension, completely free to absorb the force of the penetrating spike. The rate of loading shall be 6-inches per minute. Care shall be taken to assure that the spike shall not be inserted less than 5 feet

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from a cut nor less than 5 feet from an area which has been subjected to a previous hardness test. The load necessary to force the spike to the 1/2 inch diameter mark shall be measured on ropes up to and including 2-3/4-inch circumference and to the 1-inch diameter mark for larger size ropes. The 1/2-inch and the 1-inch diameter marks shall be considered to be reached when the respective mark just disappears behind two pairs of strands.

4.2.5.6 Determination of spliceability. A breaking strength specimen shall be prepared and spliced at each end with five full tucks. The specimen shall then be allowed to rest for 24 hours. Three of the tucks shall then be backed out of the rope. The portion of the rope from which the tucks have been removed shall be examined for yarn displacement and strand cockles.

4.2.5.7 Determination of fastness of printed matter of the identification marker to salt water and mineral oil. Three lengths of the marker approximately 1-1/2 feet each, one of which will be retained as a control, will be employed in this determination. Immerse one length for two hours in synthetic sea water composed of 3.0 percent sodium chloride and 0.5 percent anhydrous magnesium chloride. Soak the remaining length for 2 hours in mineral oil conforming to Military Symbol 2075-FH of MIL-L-17672. The fastness of the printed matter shall be considered satisfactory when no perceptible change in color or in legibility is noted during a visual comparison of the exposed specimens with the control specimen following removal from the respective environments.

4.2.5.8 Extractable matter. An extraction procedure, employing the Soxhlet apparatus with chloroform or other suitable solvent, shall be used in this determination. The procedure outlined in method 2611 of FED-STD-191 shall be followed.

## 5. PREPARATION FOR DELIVERY

(The preparation for delivery requirements specified herein apply only for direct Government procurements.)

5.1 Packaging, packing and marking. Rope in the quantity and on reels as specified (see 3.10), shall be packaged level A or C, packed level A, B or C as specified (see 6.2.1) and marked in accordance with MIL-C-3131.

## 6. NOTES

6.1 Intended use. The rope covered by this specification is intended for use as messengers and in-haul and out-haul lines for transfer at sea of personnel, light freight, and other applications where relative freedom from torque is required in addition to high strength, high elongation and maximum gripping surface.

### 6.2 Ordering data.

6.2.1 Procurement requirements. Procurement documents should specify:

- (a) Title, number, and date of this specification.
- (b) Circumference (size) required (see 1.2 and table II).
- (c) When first article sample is required (see 3.1 and 4.1.1).
- (d) When information on identification marker is other than specified (see 3.8).
- (e) Put-up and length, if other than specified (see 3.10).
- (f) Selection of applicable levels of packaging and packing (see 5.1).
- (g) That rope shall be purchased on a price-per-pound basis (net weight).
- (h) That purchaser will accept at original weight, any unit which has been shortened or cut for test specimens, if in complete compliance with this specification.

6.2.2 Data requirements. When this specification is used in a procurement which invokes the provision of the "Requirements for Data" of the Armed Services Procurement Regulations (ASPR), the data identified below, which are required to be developed by the contractor, as specified on an approved Data Item Description (DD Form 1664), and which are required to be delivered to the Government, should be selected and specified on the approved Contract Data Requirement List (DD Form 1423) and incorporated in the contract. When the provisions of the "Requirements for Data" of the ASPR are not invoked in a procurement, the data required to be developed by the contractor and required to be delivered to the Government should be selected from the list below and specified in the contract.

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<u>Paragraph</u>	<u>Data requirements</u>	<u>Applicable DID</u>	<u>Option</u>
4.1.1.1	First article inspection report	UDI-T-23450	
4.2.1.1	Certificate of compliance	DI-E-2121	

(Copies of data item descriptions required by the contractors in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply.)

6.2.2.1 The data requirements of 6.2.2 and any task in section 3, 4, or 5 of the specification required to be performed to meet a data requirement may be waived by the procuring/purchasing activity upon certification by the offeror that identical data were submitted by the offeror and accepted by the Government under a previous contract for identical item procured to this specification. This does not apply to specific data which may be required for each procurement regardless of whether an identical item has been supplied previously (for example, test reports).

6.3 Adjustment for high moisture content. Material furnished containing an excess of moisture will be accepted by an adjustment in weight to the 5 percent moisture basis.

6.4 First article inspection.

6.4.1 Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection as to those bidders offering a product which has been previously procured or tested by the Government, and that bidders offering such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending procurement.

Preparing activity:  
Navy - SH  
(Project 4020-N012)



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