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MILITARY SPECIFICATION

WIRE STRAND, STEEL, NONFLEXIBLE (PREFORMED)

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

1. SCOPE

1.1 Scope. This specification covers the preformed type of nonflexible carbon steel wire strand (see section 6) in 1 by 7 and 1 by 19 constructions as specified in Table I.

2. APPLICABLE DOCUMENTS

2.1 Government documents.

* 2.1.1 Specifications and standards. The following specifications and standards form a part of this specification to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DoDISS) and supplement thereto, cited in the solicitation.

SPECIFICATIONS

FEDERAL

QQ-S-781	Strapping, Steel, and Seals.

MILITARY

MIL-B-121	Barrier Material, Greaseproofed, Waterproofed, Flexible.
MIL-B-131	Barrier Material, Watervaporproof, Greaseproof, Flexible.
MIL-C-16173	Corrosion Preventive Compound, Solvent Cutback, Cold-Application.

STANDARDS

MILITARY

MIL-STD-129	Marking for Shipment and Storage.
MIL-STD-794	Parts and Equipment, Procedures for Packaging of.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: the Engineering Division, San Antonio ALC/MMEDO, Kelly AFB, TX 78241 by using the self addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

FSC 4010

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* (Copies of specifications, standards, and other Government documents required by contractors in connection with specific acquisition functions should be obtained from the contracting activity or as directed by the contracting officer.)

* 2.2 Other publications. The following document forms a part of this specification to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DoDISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DoDISS shall be the issue of the non-Government documents which is current on the date of the solicitation.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM A90	Standard Methods of Test for Weight of Coating on Zinc-Coated (Galvanized) Iron or Steel Articles.
* ASTM D 3951	Packaging, Commercial.

(Application for copies of ASTM publications should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, (except for associated detail specifications, specification sheets or MS standards) the text of this specification shall take precedence. Nothing in this specification, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Material. The steel used in the manufacture of wire strand covered by this specification shall be manufactured by the basic-oxygen, acid-open-hearth, basic-open-hearth, or electric-furnace process. Every precaution shall be taken to keep the products of different heats separate and identifiable throughout the manufacturing operations.

3.2 Wire (see section 6). The wires composing the wire strand shall be cylindrical and smooth and of uniformly high quality. They shall be free from splits, cold shuts, and other defects. The wires shall be thoroughly and uniformly coated with commercial zinc.

3.2.1 Preforming. The individual wires composing the wire strand shall be shaped during fabrication to the form or curvature which they assume in the finished wire strand. The finished wire strand shall be such that, if the wire strand is cut or severed, there is no tendency for the normal diameter of the wire strand at the unseized ends to increase more than the amount specified in Table I.

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3.2.2 In a 7-wire strand, 6 wires shall be laid around a center wire with a right-hand lay. In a 19-wire strand, 6 wires shall be laid around a center wire with a left-hand lay for the first operation, and 12 wires shall be laid around this first operation with a right-hand lay as a second operation. The wires shall have a pitch of not more than 11 nor less than 9 times the respective cable diameter (see Section 6).

TABLE I. Construction And Mechanical Test Properties.

Nominal Diameter of Wire Strand (Inch)	Tolerance on Diameter (Plus Only)	Construction	Breaking Strength of wire strand (Minimum)	Weight Per 100 Feet (Approx)	Allowable Increase in Diameter at Unseized End (maximum)
	Inch	Number of Wires	Pounds	Pounds	Inch
1/32	0.003	7	185	0.25	--------
3/64	.006	7	375	.55	--------
1/16	.006	19	500	.85	0.009
5/64	.008	19	800	1.40	.009
3/32	.009	19	1,200	2.00	.010
7/64	.011	19	1,600	2.70	.010
1/8	.013	19	2,100	3.50	.011
5/32	.016	19	3,300	5.50	.017
3/16	.013	19	4,700	7.70	.019
7/32	.015	19	6,300	10.20	.020
1/4	.018	19	8,200	13.50	.021
5/16	.022	19	12,500	21.00	.024

3.2.3 Joints. There shall be no strand joints or strand splices in any length of the completed strand. In a 7-wire strand, joints in individual wires shall be acceptable, provided there is not more than one joint in any 150-foot section of a completed strand. In a 19-wire strand, joints and individual wires shall be well spaced and not less than 20 feet apart. The location of joints in individual wires shall be marked on the strand with paint or other distinguishing mark. Joints in wires composing the strand shall be either brazed-lap type or electric-butt-welded. When the brazed type is used, the length of the lap shall be not less than three times the diameter of the wire. All joints shall be zinc coated after completion.

3.2.3.1 Twist-offs. When a twist-off occurs during the fabrication of the 7-wire inner layer of the 19-wire strand (see 3.2.2), joints in individual wire may be as close as 18 inches.

3.3 Tolerances. The diameter of the wire strand shall be not less than that specified in Table I, but may exceed it by the amount listed.

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3.4 Performance.

3.4.1 Breaking strength. The breaking strength of the wire strand shall be not less than the values listed in Table I.

3.4.1.1 Elongation. The elongation of the strand in a 24 inch length shall not exceed 1.5 percent when measured in accordance with 4.4.6.

3.4.2 Torsion. Wires from the wire strand shall be subjected to the torsion test as specified in 4.3.2 and 4.4.3. The number of complete turns the wire shall withstand without breakage shall be not less than that computed by the following formula:

$$\text{Number of turns (in 8 inch length)} = \frac{2.2}{\text{diameter in inches}}$$

3.4.3 Wrapping. Zinc coated wires taken from the finished wire strand shall not break when wrapped in a close helix for six complete turns about a mandrel and then unwrapped.

3.4.4 Zinc coating. Zinc coating of the wires shall be of the hot-dipped or electroplated process and shall conform to the following requirements:

Wire diameter (inch)	Minimum weight of zinc coating (oz/sq ft)
0.005 to 0.010	0.03
Over 0.010 to 0.015	.05
Over 0.015 to 0.028	.10
Over 0.028 to 0.060	.20
Over 0.060 to 0.090	.30

3.5 Length. Wire strand shall be furnished in minimum lengths of 500 feet, except that shipping reels (see section 6) shall contain not more than two lengths.

3.6 Identification of product. Each manufacturing reel (see section 6) shall be given an identifying number by the manufacturer. When the manufacturing reel is cut into specified lengths for shipping reels, each shipping reel shall be marked with the manufacturing reel number and its location in the manufacturing reel, starting from the head and numbering each subject reel consecutively.

3.7 Workmanship. Workmanship shall be in accordance with high-grade commercial practice covering this class of work. The wire strand shall be securely laid and free from kinks, loose strands, or other defects. The wire shall remain in this condition when unwound from the reel.

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 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

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specified 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.

4.2 Classification of tests. All the tests required herein for the testing of wire strand are classified as quality conformance tests, for which necessary sampling techniques and methods of testing are specified in this section.

4.3 Sampling.

4.3.1 Sample materials. One sample, not less than 15 feet in length, shall be taken for test purposes, after any discard has been removed from the head or starting end of each manufacturing reel. In addition to this sample, one sample shall be taken from each shipping reel.

4.3.2 Torsion samples. One sample wire shall be taken at the beginning of each production run and after each machine adjustment made during the process of manufacture. If the wire fails to withstand the number of turns specified in 3.4.2, an additional two sample units from the same specimen shall be tested. Failure of either of these two sample units shall be cause for rejection.

4.3.3 Elongation sample. One sample shall be taken at the beginning and at the end of each production run and after each machine adjustment made during process of manufacutre.

4.3.4 Zinc coating samples. Three sample wires not less than 12 inches long shall be cut from each size wire used in the wire strand and shall be cut before the wire strand is fabricated.

4.4 Test methods.

4.4.1 Examination of product. All wire strands shall be examined for workmanship and finish. For this purpose, the wire strand shall travel no faster than 100 feet per minute and shall be stopped for closer inspection when deemed necessary. This inspection shall take place at the time the wire strand is wound on shipping reels. Any discard from the head end of the manufacturing reel shall be removed prior to winding on the shipping reels.

4.4.1.1 Exmaination of diameter. The examination of the wire cable or strand diameter shall be made at the free end of the cable strand on the shipping reel. Beginning not less than 5 feet from the end of the cable or strand, the diameter shall be measured at three places not less than 5 feet apart. The average of the measured diameters shall be the diameter of the cable or strand inspection.

4.4.1.2 Examination of pitch. The examination of pitch, of of the lay length, shall be made at the free end of the wire cable or strand on the shipping reel. Beginning not less than 10 feet from the end of the cable, the length of five or more pitches shall be measured. The distance measured shall be divided by the number of pitches, in order to arrive at the length of a single lay.

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4.4.2 Tensile. To determine compliance with 3.4.1 and Table I, the breaking strength of wire strand shall be determined in a tensile testing machine. The distance between the terminals or between the jaws of the testing machine in tension shall be not less than 10 inches.

4.4.2.1 Tensile test methods. The specimens for the breaking strength test may be gripped in the jaws of the machine or held in swaged or socket terminals. In case of break in grips or terminal, the test may be disregarded and a new test conducted.

4.4.3 Torsion. The wire shall be gripped by 2 clamps 8 inches apart, 1 clamp being free to revolve and to move in an axial direction. The free clamp shall be revolved at as high a uniform speed as possible without perceptibly heating the wire. The number of turns to cause failure shall be recorded in order to determine compliance with 3.4.2.

4.4.4 Wrapping. The wire shall be wrapped in any convenient way which does not cause indenting, and it shall be wrapped by the free end around the mandrel of a diameter equal to twice the diameter of the wire so that the coils of the helix are approximately in contact. After a specimen has been wrapped six turns around the mandrel, it shall be unwrapped and inspected to determine compliance with 3.4.3. If the specimen breaks where it has been secured owing to an indentation, the test result shall be discarded and another specimen of the same wire retested.

4.4.5 Zinc coating. The weight of coating on samples of zinc-coated wire shall be determined by the stripping test, ASTM A90.

4.4.6 Elongation. The elongation shall be determined as the percent increase in separation between the jaws of the testing machine from the position after application of an initial load of 1 percent of the minimum breaking strength of the strand shown in Table I, to the position at 60 percent of the minimum breaking strength. Elongation, when measured under this load, shall not exceed 1.5 percent.

4.5 Packaging, packing, and marking. Preparation for delivery shall be examined for conformance with Section 5.

5. PACKAGING

* 5.1 Preservation and Packaging. Preservation and packaging shall be Level A, C, or commercial as specified (see 6.2).

5.1.1 Level A. Wire strand shall be coated with a continuous film of corrosion-preventive compound conforming to grade 2, of MIL-C-16173, prior to winding on the shipping reel. The wire strand shall be wound on reels constructed to the dimension specified in Table II. Before winding the wire strand on the reel, a layer of water vapor proof barrier material conforming to Class 1, of MIL-B-131, and then a layer of greaseproof barrier conforming to grade A, Type II, Class 2 of MIL-B-121 shall be applied to the barrel of the reel and inside of the flanges against which the wire strand will subsequently rest. After the wire strand is wound on the lined reel, a layer of greaseproof barrier conforming to Grade A, Type II, Class 2 of MIL-B-121, and then a layer of water vaporproof barrier conforming to Class 1, of MIL-B-131 shall be applied and fastened by the use of the two metal straps conforming to QQ-S-781.

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TABLE II. Reels for Cable.

Diameter of wire strand	Inches 1/32	Inches 3/64	Inches 1/16	Inches 5/64	Inches 3/32	Inches 7/64	Inches 1/8	Inches 5/32	Inches 3/16	Inches 7/32	Inches 1/4	Inches 5/16
1,000 feet												
Diameter of head	12	12	12	12	12	16	16	16	18	18	18	18
Traverse or distance between heads 1/	4	4	4	4	4	4	4	7	7	7	10	10
Diameter of drum	8	8	8	8	8	10	10	12	12	12	10	10
Diameter of arbor hole	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	2-1/8	2-1/8	2-1/8	2-1/8
3,000 feet												
Diameter of head	12	12	14	16	16	16	16	16	18	18	24	24
Traverse or distance between heads 1/	4	4	4	4	4	7	7	10	10	10	10	10
Diameter of drum	8	8	8	10	10	12	12	8	8	8	10	10
Diameter of arbor hole	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	2-1/8	2-1/8	2-1/8	2-1/8
5,000 feet												
Diameter of head	12	16	16	16	16	16	16	24	24	24	32	32
Traverse or distance between heads 1/	4	4	4	7	7	10	10	10	10	10	18	18
Diameter of drum	8	10	10	12	12	8	8	10	10	10	16	16
Diameter of arbor hole	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	2-1/8	2-1/8	2-1/8	2-1/8
10,000 feet												
Diameter of head	16	16	16	16	16	18	24	24	24	32	36	36
Traverse or distance between heads 1/	4	7	7	10	10	10	10	16	16	20	22	22
Diameter of drum	10	12	12	8	8	8	10	10	10	16	18	18
Diameter of arbor hole	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	1-1/8	2-1/8	2-1/8	3-1/8	3-1/8	3-1/8

1/ Racks made for the above reels should allow a 4-inch greater width than the traverse distance specified above.

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* 5.1.2 Level C. Wire strand shall be preserved and packaged in accordance with the applicable requirements of MIL-STD-794.

* 5.1.3 Commercial. Wire strand shall be preserved and packaged in accordance with the applicable requirements of ASTM D 3951.

* 5.2 Packing. Packing shall be Level A, B, C, or commercial.

5.2.1 Level A. Each packaged reel shall be lagged with a layer of lumber in such a manner that the waterproof barrier will not be exposed to forces which may cause mechanical damage.

5.2.2 Level B. Wire strand, preserved and packaged as specified in 5.1.1, shall require no overpacking.

5.2.3 Level C. Wire strand, preserved and packaged as specified in 5.1, shall be packed in accordance with the applicable requirements of MIL-STD-794.

5.2.4 Commercial. Wire strand, preserved and packaged as specified in 5.1, shall be packed in accordance with the applicable requirements of ASTM D 3951.

5.3 Marking of shipments. Each reel head shall be durably and legibly marked in accordance with MIL-STD-129 or ASTM D-3951 in addition to the following:

WIRE STRAND, STEEL, NONFLEXIBLE (PREFORMED)

Size _____, Length _____, Feet _____ (as applicable)

6. NOTES

6.1 Intended use. Wire strand covered by this specification is intended for application in aircraft where the greater strength is desired and the flexibility of wire strand conforming to MIL-W-83420 is not required.

* 6.2 Ordering data.

* 6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number, and date of this specification.

b. Size and length of wire strand.

c. Levels of packaging and packing required (see 5.1 and 5.2).

6.3 Definitions.

6.3.1 Wire. Each individual cylindrical steel rod or thread is designated as a wire.

6.3.2 Wire strand. A group or a series of concentric groups of wires helically twisted or laid about a center wire is designated as a wire strand.

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6.3.3 Diameter. The diameter of the circumscribed circle is designated as the diameter of the wire strand.

6.3.4 Lay or twist. The helical form taken by the wires in the wire strand is designated as the lay or twist of the wire strand. In a right-hand lay, the wires are the same direction as the thread on a right-hand screw, and for a left-hand lay are in the opposite direction.

6.3.5 Pitch (or length of lay). The distance parallel to the axis of the wire strand in which a wire makes one complete turn about the axis, is designated as the pitch (or length of lay) of the wire strand.

6.3.6 Manufacturing reels. Manufacturing or master reels are the reels on which the strands and the wire cables are wound in one continuous length as they are formed on the cable closing machines.

6.3.7 Shipping reels. Shipping reels are reels on which wire strands or wire cables, cut to the ordered lengths, are wound from the manufacturing reel for shipment.

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

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Air Force - 99

Preparing Activity:
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User Activities:
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STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

(See Instructions – Reverse Side)

1. DOCUMENT NUMBER	2. DOCUMENT TITLE
MIL-W-6940D	Wire Strand, Steel, Nonflexible (Preformed)

3a. NAME OF SUBMITTING ORGANIZATION	4. TYPE OF ORGANIZATION *(Mark one)*
b. ADDRESS *(Street, City, State, ZIP Code)*	☐ VENDOR ☐ USER ☐ MANUFACTURER ☐ OTHER *(Specify)*: _____

5. PROBLEM AREAS

a. Paragraph Number and Wording:

b. Recommended Wording:

c. Reason/Rationale for Recommendation:

6. REMARKS

7a. NAME OF SUBMITTER *(Last, First, MI)* – Optional	b. WORK TELEPHONE NUMBER *(Include Area Code)* – Optional
c. MAILING ADDRESS *(Street, City, State, ZIP Code)* – Optional	8. DATE OF SUBMISSION *(YYMMDD)*

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