MIL-W-81044B
31 December 1973
SUPERSEDING
MIL-W-81044A(AS)
22 December 1967

MILITARY SPECIFICATION

* WIRE, ELECTRIC, CROSSLINKED POLYALKENE, CROSSLINKED ALKANE-IMIDE POLYMER, OR POLYARYLENE INSULATED, COPPER OR COPPER ALLOY

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

1. SCOPE

* 1.1 Scope - This specification covers single conductor electric wires made as specified in the applicable specification sheet with tin-coated, silver-coated, or nickel-coated copper or copper alloy conductors insulated with crosslinked polyalkene, crosslinked alkane-imide polymer, or polyarylene. The crosslinked polyalkene, crosslinked alkane-imide polymer, or polyarylene may be used alone or in combination with other insulation materials as specified in the specification sheet.

1.2 Classification - The wires shall be as described in the applicable military specification sheet.

1.2.1 Part numbers - Part numbers under this specification are coded as in the following example:

M81044/1	-	22	-	9
Applicable specification sheet		Wire size		Insulation color designator or designators

1.2.2 Temperature rating of finished wire - The maximum conductor temperature of the finished wire for continuous use shall be as specified in the applicable military specification sheet (6.1.1).

2. APPLICABLE DOCUMENTS

2.1 Government-furnished 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:

FSC 6145

SPECIFICATIONS

Federal

TT-I-735	Isopropyl Alcohol
UU-T-450	Tissue, Facial

Military

MIL-T-5438	Tester; Abrasion, Electrical Cable
MIL-H-5606	Hydraulic Fluid, Petroleum Base; Aircraft, Missile, and Ordnance
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-P-7254	Propellant, Nitric Acid
MIL-C-12000	Cable, Cord, and Wire, Electric; Packaging of
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-P-26536	Propellant, Hydrazine
MIL-P-26539	Propellant, Nitrogen Tetroxide
MIL-D-26937	Detergent, Synthetic, Anionic (Alkyl Benzene Sulfonate)
MIL-P-27402	Propellant, Hydrazine - uns-Dimethylhydrazine (50% N_2H_4 - 50% UDMH)

STANDARDS

Federal

FED-STD-228	Cable and Wire, Insulated; Methods of Testing

Military

MIL-STD-104	Limits for Electrical Insulation Color
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-109	Quality Assurance Terms and Definitions

STANDARDS (Cont'd)

Military

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-681	Identification Coding and Application of Hookup and Lead Wire

SUPPLEMENT

See Supplement 1 for list of applicable military specification sheets.

PUBLICATIONS

Defense Logistics Services Center

H4-1	Federal Supply Code for Manufacturers Part 1, Name to Code
H4-2	Federal Supply Code for Manufacturers Part 2, Code to Name

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

2.2 Other publications - The following documents form a part of this specification to the extent specified herein. Unless otherwise indicated, the issue in effect on date of invitation for bids or request for proposal shall apply:

American Society for Testing and Materials

B33-71	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
B298-70a	Standard Specification for Silver-Coated Soft or Annealed Copper Wire
B355-69	Standard Specification for Nickel-Coated Soft or Annealed Copper Wire

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.)

3. REQUIREMENTS

3.1 Specification sheets - The requirements for the individual wires under this specification shall be as specified herein and in accordance with the applicable military specification sheets. In the event of discrepancy between this specification and the requirements of the applicable military specification sheet, the requirements of the military specification sheet shall govern.

3.2 Classification of requirements - The applicable requirements are classified herein as follows:

Requirement	Paragraph
Qualification	3.3
Materials	3.4
Construction	3.5
Finished Wire	3.6

3.3 Qualification - The wire furnished under this specification shall be a product which is qualified for listing on the applicable qualified products list at the time set for opening of bids (see 4.3 and 6.3). The provisions of 4.6 for retention of qualification are included in this requirement.

3.4 Materials -

3.4.1 Conductor material - All strands used in the manufacture of the conductors shall be tin-coated, silver-coated, or nickel-coated soft annealed copper conforming to ASTM B33-71, B298-70a, or B355-69, as applicable, or shall be silver-coated or nickel-coated high strength copper alloy. Strands shall be free from lumps, kinks, splits, scraped or corroded surfaces and skin impurities. In addition, the strands shall conform to the following requirements as applicable.

3.4.1.1 Tin-coated copper strands - No additional requirements. The tin coating shall be as specified in ASTM B33-71.

3.4.1.2 Silver-coated copper strands - The strands shall have a coating thickness of not less than 40 micro-inches of silver when tested in accordance with ASTM B298-70a.

3.4.1.3 Nickel-coated copper strands - The strands shall have a coating thickness of not less than 50 micro-inches of nickel when tested in accordance with ASTM B355-69. Adhesion of the nickel coating shall be such that, after subjection to the procedures of 4.7.2.1, the strands shall still pass the continuity of coating test in ASTM B355-69.

3.4.1.4 High strength copper alloy - The strands shall be of the applicable AWG gage specified in Table I and of such tensile properties that the conductor from the finished wire conforms to the requirements of 3.5.1.3.2 for elongation and tensile strength. The strands shall be silver-coated or nickel-coated in accordance with 3.4.1.2 or 3.4.1.3 as applicable.

* 3.4.2 Insulating material - All primary insulation shall be crosslinked polyalkene, crosslinked alkane-imide polymer, or polyarylene, as specified in the applicable specification sheet. Insulation coatings or jackets, if present, shall also be of the material specified in the specification sheet. All insulating materials, including primary insulation and coating or jacket, shall be certified virgin material (3.4.2.1) containing no additives except those required as pigmentation for colors, lubricants used in extrusion and stabilizers. The physical properties of the materials shall be such that, when tested in accordance with 4.7.5.7 after extrusion on the finished wire, the insulation will meet the elongation and tensile strength requirements set forth in the specification sheet.

3.4.2.1 Virgin material - For purposes of this specification, virgin material shall be 100 percent new material which has been through only the processes essential to its manufacture and its application to the wire and has been through these essential processes one time only. Any material which has previously been processed in any other manner is considered nonvirgin material. This requirement shall apply to the manufacture of all ingredients and components used.

3.5 Construction - Construction of the wire shall be as specified herein and in the applicable military specification sheet.

3.5.1 Conductor -

3.5.1.1 Stranding -

3.5.1.1.1 Concentric lay stranding - The conductors of wire sizes 30 through 10 shall be concentric-lay conductors constructed as specified in Table I. Concentric lay shall be interpreted to be a central strand surrounded by one or more layers of helically wound strands. It is optional for the direction of lay of the successive layers to be alternately reversed (true concentric lay) or to be in the same direction (unidirectional lay). The strands shall be assembled in a geometric arrangement of concentric layers, so as to produce a smooth and uniform conductor, circular in cross-section and free of any crossovers, high strands, or other irregularities. The direction of lay of the individual strands in the outer layer of the concentrically stranded conductors of finished wire shall be left hand. The length of lay of the outer layer shall not be less than 8 nor more than 16 times the maximum conductor diameter as specified in the applicable military specification sheet.

3.5.1.1.2 Rope lay stranding - The conductors of wire sizes 8 through 0000 shall be rope-lay as specified in Table I and in (a) and (b) below.

(a) Rope-lay stranded conductors shall be laid up concentrically with a central member surrounded by one or more layers of helically wound members. It is optional for the direction of lay of successive layers to be alternately reversed (true concentric lay), or to be in the same direction (unidirectional lay). The length of lay of the outer layer of rope-lay stranded members forming the conductor shall not be less than 10 or more than 14 times the outside diameter of the completed conductor. The direction of lay of the outside layer shall be either left or right hand.

(b) Members of rope-lay stranded conductors: The length of lay of the wires composing the stranded members shall be not greater than 16 times the outside diameter of the member. Stranding of the individual members may be either concentric or bunch.

* 3.5.1.2 Splices - Splices in individual strands or members shall be butt brazed. There shall not be more than one strand-splice in any two lay lengths of a stranded concentric-lay conductor or in any two lay lengths of any member in a rope lay conductor, except that not more than one splice of an entire member shall be permitted in any two lay lengths of a rope lay conductor. Splices in members of a rope lay construction shall be so finished that the conductor diameter is not increased at the point of brazing. In no case shall the whole conductor be spliced at one point.

3.5.1.3 Elongation and tensile strength of conductor -

* 3.5.1.3.1 Soft or annealed copper - The individual strands removed from finished wires with soft or annealed copper conductors, wire sizes 20 and larger, or the whole soft or annealed copper conductor removed from finished wire, sizes 22 and smaller, shall have the following minimum elongation when tested in accordance with 4.7.5.6.1:

Sizes 24 and smaller - 6 percent (minimum)
Sizes 22 and larger - 10 percent (minimum)

There shall be no tensile strength requirements for soft or annealed copper conductors.

* 3.5.1.3.2 High strength copper alloy - The whole conductor removed from finished wires with high strength copper alloy conductors shall exhibit

TABLE I

DETAILS OF CONDUCTORS

Size Designation	Nominal Conductor Area (Cir.Mils) 1/	Stranding (No. of Strands x AWG Gage of Strands)	Allowable No. of Missing Strands (Max)	Nominal Dia of Individual Strands (inch) 1/	Diameter of Stranded Conductor							Maximum Resistance of Finished Wire (Ohms/1,000 Ft. at 20°C)					Breaking Strength, Alloy Conductor (lbs)(min)
					Min. (inch)	Max (Inch)											
						General Purpose		Small Dia(Cu)		Small Dia(Alloy)		Soft or Annealed Copper			High Str Cu Alloy		
						Silver Coated	Nickel or Tin Coated	Silver Coated	Nickel or Tin Coated	Silver Coated	Nickel Coated	Silver Coated	Nickel Coated	Tin Coated	Silver Coated	Nickel Coated	
30	112	7 x 38	0	0.0040	0.011	0.012	0.013	0.012	0.013	0.012	0.013	100.7	110.7	108.4	117.4	129.6	5.17
28	175	7 x 36	0	0.0050	0.014	0.015	0.016	0.015	0.016	0.015	0.016	63.8	67.9	68.6	74.4	79.0	8.16
26	304	19 x 38	0	0.0040	0.018	0.020	0.021	0.019	0.020	0.020	0.020	38.4	42.2	41.3	44.8	49.4	14.2
24	475	19 x 36	0	0.0050	0.023	0.025	0.026	0.024	0.024	0.024	0.025	24.3	25.9	26.2	28.4	30.1	22.4
22	754	19 x 34	0	0.0063	0.029	0.032	0.033	0.030	0.031	0.031	0.031	15.1	16.0	16.2	17.5	18.6	35.8
20	1,216	19 x 32	0	0.0080	0.037	0.040	0.041	0.038	0.039	0.039	0.040	9.19	9.77	9.88	10.7	11.4	58.1
18	1,900	19 x 30	0	0.0100	0.046	0.050	0.051	0.048	0.049	-	-	5.79	6.10	6.23			
16	2,426	19 x 29	0	0.0113	0.052	0.057	0.058	0.054	0.055	-	-	4.52	4.76	4.81			
14	3,831	19 x 27	0	0.0142	0.065	0.072	0.073	0.068	0.069	-	-	2.88	3.00	3.06			
12	5,874	37 x 28	0	0.0126	0.084	0.089	0.090	0.087	0.089	-	-	1.90	1.98	2.02			
10	9,354	37 x 26	0	0.0159	0.106	0.112	0.114	0.110	0.112	-	-	1.19	1.24	1.26			
8	16,983	133 x 29	0	0.0113	0.158	0.169	0.173	0.166	0.169	-	-	0.658	0.694	0.701			
6	26,818	133 x 27	0	0.0142	0.198	0.213	0.217	0.208	0.212	-	-	0.418	0.436	0.445			
4	42,615	133 x 25	0	0.0179	0.250	0.268	0.274	0.263	0.268	-	-	0.264	0.275	0.280			
2	66,500	665 x 30	2	0.0100	0.320	0.340	0.340	-	-	-	-	0.170	0.177	0.183			
1	81,700	817 x 30	2	0.0100	0.360	0.380	0.380	-	-	-	-	0.139	0.144	0.149			
0	104,500	1,045 x 30	3	0.0100	0.405	0.425	0.425	-	-	-	-	0.108	0.113	0.116			
00	133,000	1,330 x 30	3	0.0100	0.450	0.475	0.475	-	-	-	-	0.085	0.089	0.091			
000	166,500	1,665 x 30	4	0.0100	0.515	0.540	0.540	-	-	-	-	0.068	0.071	0.071			
0000	210,900	2,109 x 30	5	0.0100	0.580	0.605	0.605	-	-	-	-	0.054	0.056	0.056			

1/ Nominal values are for information only. Nominal values are not requirements.

elongation of 6 percent, minimum, and a tensile breaking strength conforming with Table I, when tested in accordance with 4.7.5.6.2.

* 3.5.1.4 Conductor diameter - The diameter of the conductor shall be as specified in Table I. Applicability of the "general purpose" or of the "small diameter" Table I requirements for maximum conductor diameter shall be as indicated in the military specification sheet.

3.5.2 Insulation - The insulation shall be constructed as specified in the applicable specification sheet. All insulation shall be readily removable by conventional wire stripping devices without damage to the conductor.

* 3.5.3 Flaws test of primary insulation - One hundred percent of the wire shall be inspected for dielectric flaws after application of the primary insulation and prior to the application of any other material to the wire. This inspection shall be made by either the chain electrode spark test of 4.7.4 or the impulse dielectric test of 4.7.5.1, at the option of the supplier, using the test voltages specified for primary insulation in the applicable specification sheet.

3.6 Finished wire - The finished wire shall conform to the requirements of Table II and those of the applicable military specification sheet. The requirements of 3.6.1 through 3.6.9 also apply.

* 3.6.1 Impulse dielectric test - One hundred percent of the finished wire shall pass the impulse dielectric test of 4.7.5.1, which test shall be made during the final winding of the wire on shipment spools or reels.

* 3.6.2 Color - The color of the finished wire shall be as specified in the procurement contract or order in accordance with this paragraph. The preferred colors are as indicated in the individual specification sheets. All solid colors and the colors of all striping or banding shall be in accordance with MIL-STD-104, Class 1. Striping or banding, if used, shall conform to MIL-STD-681, except that the background insulation color and the colors of the stripes or bands shall be as indicated in the part number of the wire and not necessarily in accordance with the preferred colors specified in MIL-STD-681. Striping or banding shall be capable of withstanding the striping durability test of 4.7.5.3 for the number of strokes and with the weight specified in the applicable specification sheet. This test shall not be required if the striping or banding is under a clear jacket.

* 3.6.3 Identification of product - Except as otherwise specified in the procurement contract or in the applicable specification sheet, the finished wire shall be identified by a printed marking applied to the outer surface of the wire or visible through the outer surface. When the wire is to be used in an end item for the Government, omission of the identification of product shall be permissible only when so stated in the specification sheet for the wire or the Government contract for the end item. The

TABLE II

PROPERTIES OF FINISHED WIRE

	EXAMINATION OR TEST	REQUIREMENT	METHOD
	Conductor stranding	Table I and 3.5.1.1	4.7.1
	Conductor diameter	Table I and 3.5.1.4	4.7.1
	Finished wire diameter	Specification sheet	4.7.1
*	Construction of insulation	Specification sheet	4.7.1
	Removability of insulation	3.5.2	4.7.1
*	Impulse dielectric test	3.6.1	4.7.5.1
	Insulation resistance	Specification sheet	4.7.5.2
	Color	3.6.2	4.7.1
	Color striping or banding durability	3.6.2	4.7.5.3
	Identification of product	3.6.3	4.7.1
	Durability of identification	3.6.3.1	4.7.5.3
	Finished wire weight	Specification sheet	4.7.5.4
	Conductor resistance	Table I	4.7.5.5
	Conductor elongation and tensile strength	3.5.1.3	4.7.5.6
	Insulation elongation and tensile strength	Specification sheet	4.7.5.7
*	Wrap test (as applicable) "Wrap back" test Mandrel wrap test	 3.6.4.1 3.6.4.2	 4.7.5.8.1 4.7.5.8.2
*	Insulation thickness	Specification sheet (also 3.6.5)	4.7.5.9
	Concentricity	70 percent (min) (also 3.6.6)	4.7.5.10

TABLE II (Continued)

EXAMINATION OR TEST	REQUIREMENT	METHOD
Blocking	3.6.7	4.7.5.11
Workmanship	3.6.8	4.7.1
Polyimide cure test (Modified imide polymer coated constructions, sizes 10 and smaller)	No cracking	4.7.5.12
Shrinkage	Specification sheet	4.7.5.13
Wicking	Specification sheet	4.7.5.14
Abrasion resistance, initial	Specification sheet	4.7.5.15
Low temperature (cold bend)	No cracking; no dielectric breakdown	4.7.5.16
Thermal shock resistance	Specification sheet	4.7.5.17
Flammability	Specification sheet	4.7.5.18
* Life cycle	No cracking in bend test No dielectric breakdown No pitting of conductor	4.7.5.19.2 4.7.5.19.3 4.7.5.19.1
Accelerated aging	No cracking in bend test No dielectric breakdown No pitting of conductor Product identification shall remain legible	4.7.5.20
Immersion tests	Diameter increase, 5 percent max No cracking on bending No dielectric breakdown Meet initial abrasion requirements after immersion	4.7.5.21

TABLE II (Continued)

EXAMINATION OR TEST	REQUIREMENT	METHOD
Humidity resistance	Specification sheet	4.7.5.22
Surface resistance	Specification sheet	4.7.5.23
Smoke test	Specification sheet	4.7.5.24
Propellant resistance (When required in specification sheet)	No dielectric breakdown	4.7.5.25
* Continuous lengths	3.6.9	4.7.5.26

printed identification shall consist of the following, at intervals of 9 inches to 60 inches, as measured from the beginning of one complete marking to the beginning of the succeeding complete marking.

Specification sheet part number
Manufacturer's code designation in accordance with publications H4-1 and H4-2

The printing shall be green in color in accordance with MIL-STD-104, Class 1, except that when the wire is solid green or any other solid color against which green is difficult to distinguish, the printing shall be white. Identification printing shall be applied with the vertical axes of the printed characters lengthwise of the wire when the nominal diameter of the finished wire is 0.050 inch or smaller. The vertical axes of the printed characters may be either crosswise or lengthwise of the wire when the nominal diameter of the wire exceeds 0.050 inch. All printed characters shall be complete and legible.

3.6.3.1 Durability and resistance to accelerated aging of identification - Identification printing, when applied to the outer surface of the finished wire, shall be capable of withstanding the durability test specified in 4.7.5.3 for the number of cycles and with the weight specified in the applicable specification sheet. This test shall not be required when the identification marking is under a clear jacket. The identification marking shall also be legible after the accelerated aging of 4.7.5.20.

3.6.4 Wrap test -

3.6.4.1 "Wrap back" test - Wire sizes 10 and smaller of this specification with insulation comprising an extruded primary of crosslinked alkane-imide polymer and an insulation coating of modified imide polymer shall show no cracking of the insulation when tested in accordance with 4.7.5.8.1.

* 3.6.4.2 Mandrel wrap test - Wire of this specification with insulation comprising an extruded crosslinked polyalkene primary and an extruded polyvinylidene fluoride jacket or with insulation composed entirely of polyarylene shall show no cracking of insulation and no dielectric breakdown when tested in accordance with 4.7.5.8.2. This requirement shall also be applicable to wire, sizes 8 and larger, with insulation comprising an extruded primary of crosslinked alkane-imide polymer and an insulation coating of modified imide polymer.

* 3.6.5 Insulation thickness - The requirement for thickness of insulation shall apply to the total insulation wall when the specification sheet specifies a value for this characteristic and shall also apply to any part of the total insulation (e.g., primary insulation, insulation coating, or jacket) for which the specification sheet specifies a value.

3.6.6 Concentricity - The concentricity requirement shall apply to both the primary insulation and the finished wire.

* 3.6.7 Blocking - Adjacent turns or layers of the wire shall not stick to one another when tested as specified in 4.7.5.11 at the temperature specified in the applicable specification sheet.

3.6.8 Workmanship - All details of workmanship shall be in accordance with high grade aircraft wire manufacturing practice. The insulation shall be free of cracks, splits, irregularities, and imbedded foreign material.

* 3.6.9 Continuous lengths - Unless otherwise specified in the contract or order, the individual continuous lengths of wire in each inspection lot shall be of such footage that the inspection lot shall conform to Table III when examined in accordance with 4.7.5.26. Unless otherwise specified in the contract or order, the footage of the individual continuous lengths in each spool or reel shall be marked on the spool or reel in the sequence in which the lengths will be unwound by the user.

TABLE III

MINIMUM CONTINUOUS WIRE LENGTHS

WIRE SIZE (RANGE)	REQUIRED MINIMUM PERCENTAGE OF THE TOTAL INSPECTION LOT FOOTAGE IN CONTINUOUS LENGTHS GREATER THAN		
	1000 feet	500 feet	100 feet
30 - 16	50%	80%	100%
14 - 10	30%	50%	100%
8 - 4	-	50%	100%
2 - 0000	-	-	100%

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection - Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or order, the supplier 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 the specification where such inspections are deemed necessary to assure that supplies and services conform to prescribed requirements.

4.2 Classification of inspections - The examinations and tests of wires under this specification shall be divided into the following classifications:

Classification	Paragraph
Qualification inspection	4.3
Quality conformance inspection	4.4
Process control inspection	4.5
Periodic qualification re-evaluation	4.6

4.3 Qualification inspection - Qualification inspection shall consist of all the tests of this specification.

* 4.3.1 Sampling for qualification inspection - Except as provided in 4.3.1.1, a finished wire sample of the required length shall be submitted for each range of wire sizes for which qualification is desired. The sample may be any size wire within the specified size range. Ten linear feet of the coated conductor strand used in the manufacture of the finished wire sample shall be submitted with the finished wire sample.

WIRE SIZE RANGE	REQUIRED LENGTH OF SAMPLE (FEET)
30 through 26	150
24 through 16	150
14 through 10	150
8 through 6	100
4 through 0000	100

* 4.3.1.1 Optional qualification samples - In cases where two or more specification sheets cover wires identical in materials and construction except for conductor (i.e., the specified conductor may be silver coated copper, nickel coated copper, tin coated copper, silver coated alloy, or nickel coated alloy in the different specification sheets), the finished wire sample and conductor strand sample in accordance with 4.3.1 may be submitted for any one of the specification sheets for which

qualification is desired. In addition, 10-foot samples of conductor strand only, applicable to the same wire size range or ranges as the finished wire sample, may be submitted for any of the other specification sheets which differ from the finished sample only in conductor. Approval of the finished wire qualification sample shall also qualify the same wire size range or ranges in each of the other specification sheets for which conductor strand samples have been submitted and approved. (Note: For purposes of determining identity of construction in specification sheets under this provision, small differences in specified finished wire diameter or weight which are obviously due to differences in the specified conductor shall not be considered as constituting differences in construction of the wires.)

4.3.2 Forwarding of qualification samples - Samples and the manufacturer's certified test reports shall be forwarded to the testing laboratory designated in the letter of authorization from the activity responsible for qualification (see 6.3), plainly identified by securely attached, durable tags marked with the following information:

Sample for qualification test
WIRE, ELECTRIC, CROSSLINKED POLYALKENE INSULATED,*
COPPER**
Specification sheet part number
Manufacturer's name and code number (Publications H4-1 and H4-2)
Manufacturer's part number
Comprehensive description and prime manufacturer's name and formulation number of the base materials from which the product is made. (This information will not be divulged by the Government.)
Place and date of manufacture of sample
Submitted by (name) (date) for qualification tests in accordance with the requirements of MIL-W-81044B under authorization (reference authorizing letter).

* or "CROSSLINKED ALKANE-IMIDE POLYMER INSULATED" or "POLYARYLENE INSULATED", as applicable
** or "COPPER ALLOY", as applicable

4.4 Quality conformance inspection - Quality conformance inspection shall consist of the examinations and tests listed in Table IV and described under "Test Methods" (4.7). Quality conformance inspection shall be performed on every lot of wire procured under this specification.

TABLE IV

QUALITY CONFORMANCE INSPECTION

	EXAMINATION OR TEST	REQUIREMENT	METHOD
	Group I Characteristics		
	Conductor stranding	Table I and 3.5.1.1	4.7.1
	Conductor diameter	Table I and 3.5.1.4	4.7.1
	Finished wire diameter	Specification sheet	4.7.1
*	Construction of insulation	Specification sheet	4.7.1
	Removability of insulation	3.5.2	4.7.1
*	Insulation resistance	Specification sheet	4.7.5.2
	Color	3.6.2	4.7.1
	Color striping or banding durability	3.6.2	4.7.5.3
	Identification of product	3.6.3	4.7.1
	Durability of identification	3.6.3.1	4.7.5.3
	Workmanship	3.6.8	4.7.1
	Finished wire weight	Specification sheet	4.7.5.4
	Conductor resistance	Table I	4.7.5.5
	Conductor elongation and tensile strength	3.5.1.3	4.7.5.6
	Insulation elongation and tensile strength	Specification sheet	4.7.5.7
	Group II Characteristics		
*	Wrap test (as applicable)		
	"Wrap back" test	3.6.4.1	4.7.5.8.1
	Mandrel wrap test	3.6.4.2	4.7.5.8.2

TABLE IV (Continued)

EXAMINATION OR TEST	REQUIREMENT	METHOD
Group II Characteristics (Continued)		
* Insulation thickness	Specification sheet (also 3.6.5)	4.7.5.9
Concentricity	70 percent (min) (also 3.6.6)	4.7.5.10
Polyimide cure test (Modified imide polymer coated constructions, sizes 10 and smaller)	No cracking	4.7.5.12
Shrinkage	Specification sheet	4.7.5.13
Wicking	Specification sheet	4.7.5.14
Abrasion resistance, initial	Specification sheet	4.7.5.15
Low temperature (cold bend)	No cracking; no dielectric breakdown	4.7.5.16
Thermal shock resistance	Specification sheet	4.7.5.17
Flammability	Specification sheet	4.7.5.18
Accelerated aging	Table II	4.7.5.20
* Group III Characteristic		
Impulse dielectric test	3.6.1	4.7.5.1
* Group IV Characteristic		
Continuous lengths	3.6.9	4.7.5.26

4.4.1 Sampling for quality conformance inspection - MIL-STD-109 shall apply for definitions of inspection terms used herein. For purposes of this specification, the following shall apply:

* 4.4.1.1 Lot - The inspection lot shall include all wire of one part number subjected to inspection at one time.

4.4.1.2 Unit of product - The unit of product for determining lot size for sampling shall be one continuous length of wire as offered for inspection.

4.4.1.3 Sample unit (Groups I and II tests) - The sample unit for Groups I and II tests, except for the Group I insulation resistance test, shall consist of a single piece of finished wire chosen at random from the inspection lot and of sufficient length to permit all applicable examinations and tests. Unless otherwise specified, the length of the sample unit for Group I tests of Table IV, other than insulation resistance, shall be 20 feet and the length of the sample unit for Group II tests shall be 25 feet. Not more than one sample unit for each group of tests shall be taken from a single unit of product.

* 4.4.1.3.1 Sample unit for insulation resistance test (Group I) - The sample unit for the Group I insulation resistance test shall be a specimen at least 26 feet in length selected at random from finished wire which has passed the Group III impulse dielectric test. It is optional whether the specimen is tested on the reel or removed from the reel for the test, provided the length of the specimen can be determined.

4.4.1.4 Inspection levels and acceptable quality levels (AQL) (Groups I and II tests) - For Group I characteristics, including the insulation resistance test, the inspection level shall be S-2 and the AQL shall be 6.5 percent defective units in accordance with MIL-STD-105. For Group II characteristics, the inspection level shall be S-3 and the AQL shall be 1.5 percent defective units.

* 4.4.1.5 Sampling and acceptance for the Group III (impulse dielectric) test - The sample for the Group III impulse dielectric test shall be 100 percent of the finished wire and every length of the wire shall be subjected fully to the test. Insulation breakdowns resulting from the test and ends or portions not subjected to the test shall be marked or cut out of the finished wire (4.7.5.1.3).

* 4.4.1.6 Sampling and acceptability levels for Group IV (continuous lengths) examination - The inspection level and acceptable quality level for this examination shall be as required for the applicable procedure of 4.7.5.26.

4.4.2 Nonconforming inspection lots - Disposition of inspection lots found unacceptable under initial quality conformance inspection shall be in accordance with MIL-STD-105.

4.5 Process control inspection - This inspection comprises tests and examinations of such a nature that they cannot be performed on

the finished wire as submitted for inspection and therefore must be conducted at the most appropriate stage of the manufacturing operations. The process control tests shall consist of the tests listed in Table V. Process control inspection shall be performed on every lot of wire procured under this specification.

4.5.1 Sampling for process control inspection -

4.5.1.1 Conductor material - From each weeks's production of individual coated strands or from every 1000 pounds of such strands, whichever is less, three ten-foot lengths of strand shall be selected in such a manner as to be representative of the material to be used in the finished wire.

* 4.5.1.2 Insulation material - If process control tests of the insulating material are required (4.7.3), three wire lengths, adequate for testing and representative of the insulating material to be used in each lot of wire, shall be selected after extrusion of the insulation on the wire.

TABLE V

PROCESS CONTROL INSPECTION

EXAMINATION OR TEST	REQUIREMENT	METHOD
Conductor material 1/	3.4.1	4.7.2
Insulating material	3.4.2	4.7.3, 4.7.5.7
Conductor splices	3.5.1.2	4.7.1
Flaws test of primary insulation (as applicable)		
Spark test	3.5.3	4.7.4
Impulse dielectric test	3.5.3	4.7.5.1

1/ Except adhesion of nickel coating. See Table VI.

4.5.1.3 Conductor splices - The manufacturer's method of splicing individual strands and entire members shall be observed at the discretion of the Government representative.

* 4.5.1.4 Flaws test of primary insulation - The sample for this test (3.5.3) shall be one hundred percent of the wire after application of the primary insulation and prior to the application of any other material. One hundred percent of the wire shall be subjected to either the spark test or the dielectric impulse test at this stage in production. Portions showing dielectric breakdown shall be cut out or removed and testing of the balance of production shall be resumed.

4.5.2 Rejection and retest in process control inspection - When a sample selected from a production run fails to meet the specified tests (except flaws test of primary insulation, see 4.5.1.4), no items still on hand or later produced shall be accepted until the extent and cause of the failure have been determined. After investigation, the contractor shall advise the Government of the action taken and, after corrections have been made, shall repeat all the process control tests. Rejection after corrective action will require that the contractor advise the procuring activity of the details surrounding the retest and cause for rejection. Nonconformities of primary insulation in the flaws test shall be handled as provided in 4.5.1.4.

4.5.2.1 Effect of process control failure on quality conformance testing - Quality conformance testing may be continued during the investigation of the failure of a process control sample, but final acceptance of the material shall not be made until it is determined that the lot meets all the process control requirements and quality conformance requirements of the specification.

4.6 Retention of qualification - Periodic qualification re-evaluations shall be made at two-year intervals after the date of the letter of notification of the product's acceptability for qualification. Materials from current production shall be evaluated against the requirements of Table VI in addition to the quality conformance requirements and process control requirements of Table IV and Table V.

TABLE VI

TESTS APPLICABLE ONLY TO QUALIFICATION INSPECTION AND QUALIFICATION RE-EVALUATION

TEST	REQUIREMENT	METHOD
Adhesion of nickel coating	3.4.1.3	4.7.2.1
Blocking	3.6.7	4.7.5.11
Life cycle	Table II	4.7.5.19
Immersion tests	Table II	4.7.5.21
Humidity resistance	Specification sheet	4.7.5.22
Surface resistance	Specification sheet	4.7.5.23
Smoke test	Specification sheet	4.7.5.24
Propellant resistance (When required in specification sheet)	No dielectric breakdown	4.7.5.25

4.6.1 Re-evaluation procedure - It shall be the responsibility of the qualified supplier to furnish to the Government, at two-year intervals, the data necessary to establish the continued conformity of the product to all qualification requirements. These data should preferably be complete test results of a sample representative of current production, tested against all the requirements of the specification. At the discretion of the qualifying activity, test records from current production may be accepted for the re-evaluation to the extent they are available and samples from current production need be subjected to only the tests for which no production test records are available. The qualifying activity shall be notified of the test results. If a failure occurs, no wire represented by the sample nor any other wire manufactured with the same materials and processes, which has not already been submitted for quality conformance inspection, shall be offered for acceptance until the cause for failure has been determined and concurred in by the qualifying activity as not affecting the ability of the wire to pass qualification inspection requirements. In the event the date for re-evaluation has passed and no current production materials or data are available for re-evaluation, the supplier shall still be eligible for contract award, but final acceptance of material from such a supplier is contingent upon his material meeting all the qualifying requirements of the specification.

4.7 Test methods -

4.7.1 Examination of product - All samples shall be examined carefully to determine conformance to this specification and to the applicable specification sheets with regard to requirements not covered by specific test methods.

4.7.2 Conductor material - Conductor strands, prior to use in the conductor, shall be tested for conformity to ASTM Standards B33-71, B298-70a, or B355-69, as applicable. Thickness of silver or nickel coating shall also be determined by the methods of ASTM Standards B298-70a and B355-69.

4.7.2.1 Adhesion of nickel coating - Two 6-inch specimens shall be cut from the sample of nickel-coated strand. One specimen shall be wrapped over its own diameter for eight close turns. The second specimen shall remain in its straight form. Both specimens shall then be subjected to ten continuous cycles of temperature change. Each cycle of temperature change shall consist of 4 hours at 250 $\pm$3°C (482 $\pm$5.4°F) followed by 4 hours at room temperature. Upon completion of the thermal cycling, the straight specimen shall be wrapped over its own diameter for eight close turns in a manner identical to that of the first specimen. Both wrapped specimens shall then be tested for continuity of coating in accordance with the procedure given in ASTM Standard B355-69.

* 4.7.3 Insulation material - Unless otherwise specified in the procurement contract or order (6.2), certification of conformity by the wire supplier shall be acceptable in lieu of process control tests of the insulation material. Such certification, however, shall not relieve the supplier's product from the necessity of passing all tests required of the finished wire including those relative to insulation. If the contract or order requires process control tests of the insulation material, samples selected in accordance with 4.5.1.2 shall be tested as specified in 4.7.5.7.

4.7.4 Spark test of primary insulation (when applicable, 3.5.3) - The wire, after application of the primary insulation and prior to the application of any other material, shall be passed through a chain electrode spark test device using the voltage and frequency specified in the applicable specification sheet. The electrode shall be of a suitable bead chain or fine mesh construction that will give intimate metallic contact with practically all the wire insulation surface. Electrode length and speed of wire movement shall be such that the insulation is subjected to the test voltage for a minimum of 0.2 second. Any portion showing insulation breakdown shall be cut out of the wire including at least 2 inches of wire on each side of the failure.

4.7.5 Finished wire - Methods of test of the finished wire (and of unfinished wire also, when so specified) shall be as follows:

* 4.7.5.1 Impulse dielectric test -

4.7.5.1.1 Test equipment - The electrode head through which the wire is passed in the impulse dielectric test shall be of a suitable bead chain construction such that the electrode will give intimate metallic contact with practically all of the wire insulation surface. The characteristics of the test impulse and of the equipment auxiliary to the electrode head shall be as follows:

(a) Test impulse - The wave form of the voltage supplied to the electrode head shall consist of a negative pulse, the peak magnitude of which shall be as specified in the applicable specification sheet, followed by a damped oscillation. The rise time of the negative impulse wave front from zero magnitude to 90 percent of the specified peak voltage shall be not more than 75 microseconds. The peak value of the first positive overshoot and each of the subsequent damped oscillations shall be smaller than the initial negative pulse. The time during which each pulse and accompanying damped oscillation (positive and negative) remains at an absolute potential of 80 percent or greater of the specified peak voltage shall be 20 to 100 microseconds. The pulse repetition rate shall be 200 to 250 pulses

per second, inclusive. Except for the final peak voltage adjustment (4.7.5.1.3), conformity to these test impulse parameters shall be determined with no capacitive load impressed upon the electrode.

(b) Capacitive tolerance - The tolerance of the equipment to change in capacitive load shall be such that the peak output voltage shall not be reduced by more than 12 percent in the event of an increase of capacitive load, between electrode and ground, from an initial load of 12.5 picofarads per inch to 25 picofarads per inch of electrode length.

(c) Instrument voltmeter - Connected to the electrode head, there shall be a peak reading voltmeter indicating continually the potential of the electrode. The voltmeter shall show full deflection at a potential not exceeding 15 kilovolts and shall have a minimum accuracy of ±4 percent at the specified test impulse potential.

(d) Failure detection circuit. There shall be a failure detection circuit to give a visible or audible indication of insulation failure, automatically deenergize the electrode head, and stop progress of the wire through the electrode. The detecting circuit shall be sufficiently sensitive to indicate a fault at 75 percent of the specified test voltage when the electrode is arced to ground through a 20 kilohm resistor and shall be capable of detecting a fault which lasts for the duration of only one impulse.

4.7.5.1.2 Calibration of equipment - The instrument voltmeter shall be calibrated by comparison with an external standard voltmeter capable of detecting the peak potential at the electrode head with or without auxiliary circuitry. In performing the calibration, the standard voltmeter shall be connected to one of the electrode beads directly or through a calibrated attenuator circuit. The impulse generator shall be energized and the voltage control of the impulse generator shall be adjusted until the reading on the standard voltmeter is the specified potential, at which point the reading on the instrument voltmeter shall be observed and recorded. This calibration shall be repeated for each peak potential at which it is intended to operate the equipment. An alternative procedure is by means of a calibrated oscilloscope connected to the bead electrode through a suitable attenuator. The peak magnitude of the negative pulse can then be read directly from the waveform display. An oscilloscope connected to the electrode head at suitable test points shall also be used to verify conformance to the other waveform parameters specified in 4.7.5.1.1(a).

4.7.5.1.3 Test procedure - The finished wire or unfinished wire (3.5.3), as applicable, shall be threaded through the electrode head and the conductor shall be grounded at one or both ends. The electrode shall be energized to the specified peak potential and, after final adjustment of the voltage with wire in the electrode head, the wire shall be passed from the pay-off spool through the electrode and onto the take-up spool. The speed of passage of the wire through the electrode shall be such that the wire is subjected to not less than 3 nor more than 100 pulses at any given point. Any dielectric failures which occur shall be cut out or marked for later removal along with at least 2 inches of wire on each side of the failure. During all parts of the test, including string-up of new lengths, every effort shall be made to test the entire length, including ends of the wire, in accordance with this procedure. All ends or other portions of the wire not so tested shall be removed subsequent to the test. When specified in contract or order (6.2), in tests of finished wire, the dielectric failures, untested portions of wire, or portions which have been exposed to fewer or more than the specified number of pulses may be marked by stripping the insulation or by other suitable method of marking as specified in the contract in lieu of being cut out of the wire.

4.7.5.2 Insulation resistance - The ends of a wire specimen at least 26 feet in length shall be connected electrically to a DC terminal. The specimen shall be immersed in a water bath, at 25 ±5°C (77 ±9°F), containing 0.5 to 1.0 percent of an anionic wetting agent, except that the electrical contacts and approximately six inches of insulated wire at each end of the specimen shall protrude above the surface of the water. After 4 hours minimum of immersion, the specimen shall be subjected to a potential of 250 to 500 volts applied between the conductor and the water bath, which serves as the second electrode. The insulation resistance of the specimen shall be determined after one minute of electrification at this potential and shall be calculated to megohms for 1000 feet as follows:

$$\text{Megohms for 1000 feet} = \frac{\text{Specimen resistance (megohms) x immersed length (feet)}}{1000}$$

4.7.5.3 Durability of color markings - The durability of product identification or color markings applied to the wire for coding shall be evaluated at 20 to 25°C (68 to 77°F) as follows:

4.7.5.3.1 Durability testing apparatus - The markings durability tester shall be designed to hold a short specimen of finished wire firmly clamped in a horizontal position with the upper longitudinal surface of the specimen fully exposed. The instrument shall be capable of rubbing a small cylindrical steel mandrel (usually a needle), 0.025 inch in diameter, repeatedly over the upper surface of the wire, in such position that the longitudinal axes of the mandrel and the specimen are at right angles to each other with cylindrical surfaces in contact. A weight affixed to a jig above the mandrel shall control the thrust exerted normal to the surface of the insulation. A motor driven, reciprocating cam mechanism and counter shall be used to deliver an accurate number of abrading strokes in a

direction parallel to the axis of the specimen. The length of the stroke shall be 3/8 inch and the frequency shall be 120 strokes (60 stroking cycles) per minute.

4.7.5.3.2 Durability testing procedure - In performing the test, a specimen of wire shall be mounted in the specimen clamp and the weight specified in the applicable specification sheet shall be applied through the abrading mandrel to the marked surface. The counter shall be set at zero and the drive motor started. The specimen shall be observed throughout the progress of the test and, as soon as the mandrel has developed a continuous line of erasure or obliteration through all applicable markings contacted in its strokes, the number of abrading cycles shall be recorded. Three specimens from each sample unit shall be tested and the results averaged.

4.7.5.4 Wire weight - The weight of each lot of finished wire shall be determined by Procedure I (4.7.5.4.1). Lots failing to meet the wire weight requirement of the applicable specification sheet when tested in accordance with Procedure I shall be subjected to Procedure II (4.7.5.4.2). All reels or spools failing to meet the requirements of the specification sheet when tested by Procedure II shall be rejected. The sampling plans of 4.4.1 are not applicable in Procedure II.

4.7.5.4.1 Procedure I - The length and weight of a specimen at least 10 feet long shall be accurately measured and the resultant measurements converted to pounds per 1000 feet.

4.7.5.4.2 Procedure II - The net weight of the finished wire on each reel or spool shall be obtained by subtracting the tare weight of the reel or spool from the gross weight of the reel or spool containing the finished wire. The net weight of wire on each reel or spool shall be divided by the accurately determined length of finished wire on that reel or spool and the resultant figure shall be converted to pounds per 1000 feet. When wood or other moisture absorbent materials are used for reel or spool construction, tare weight and gross weight shall be determined under substantially the same conditions of relative humidity.

* 4.7.5.5 Conductor resistance - The DC resistance of the conductor shall be measured in accordance with Method 6021 of FED-STD-228 except that the wire shall be tested dry without immersion.

4.7.5.6 Conductor elongation and tensile strength -

* 4.7.5.6.1 Soft or annealed copper - Elongation tests of soft or annealed copper conductors shall be performed in accordance with Method 3211 of FED-STD-228. For wire sizes 20 and larger, the tests shall be performed upon individual strands taken from the conductor of the finished wire. For sizes 22 and smaller, the tests shall be performed upon the whole conductor removed from the finished wire and the elongation shall be measured when the first strand of the conductor breaks. For wire sizes 20

and larger, only the values obtained with individual strands shall be considered and, for wire sizes 22 and smaller, only the values obtained with the whole conductor shall be considered, in determining the conformance of soft or annealed copper conductors to elongation requirements of this specification.

* 4.7.5.6.2 High strength copper alloy - Elongation and tensile strength tests of high strength alloy conductors shall be performed in accordance with Method 3211 of FED-STD-228, except that the rate of travel of the power-actuated grip shall be 2 ±1/2 inches per minute and that the tensile strength shall be reported as the tensile breaking strength of the conductor rather than in pounds per square inch. The tests shall be performed upon the whole conductor removed from the finished wire. Conductor elongation shall be measured when the first strand of the conductor breaks, and the total tensile force indicated by the testing machine at break of that strand shall be regarded as the breaking strength of the conductor. Only the values thus obtained with the whole conductor shall be considered in determining the conformity of high strength alloy conductors to the elongation and tensile strength requirements of this specification.

* 4.7.5.7 Insulation elongation and tensile strength - When the specification sheet specifies test of the primary insulation alone, specimens of the finished wire shall have the jacket or coating, if present, carefully removed from the primary insulation. When the specification sheet specifies test of the entire insulation, there shall be no removal of jacket or coating from the specimens. The primary insulation or entire insulation, as applicable, shall then be carefully removed from the conductor and tested for elongation and tensile strength by Methods 3031 and 3021, respectively, of FED-STD-228, utilizing one inch bench marks and one inch initial jaw separation. The rate of travel of the power-actuated jaw of the test instrument shall be in accordance with the applicable method of FED-STD-228 unless otherwise specified in the specification sheet.

4.7.5.8 Wrap test -

4.7.5.8.1 "Wrap back" test (see 3.6.4.1 for applicability) - A 12-inch specimen of finished wire shall be bent back on itself at the mid-portion, on a radius not less than the radius of the wire, and one end of the specimen shall be wound tightly around the other end as a mandrel for a total of four close turns. The specimen shall then be examined visually, without the aid of magnification, for cracks.

4.7.5.8.2 Mandrel wrap test (see 3.6.4.2 for applicability) - A specimen of finished wire, with a length of 12 inches plus the additional length required for winding on the mandrel, shall be wound tightly for two close turns around a mandrel of the diameter specified in the applicable specification sheet. The winding may be accomplished manually and shall be in the middle portion of the specimen so that 6 inches of each end shall remain straight. The specimen shall then be removed from the mandrel, examined for cracks visually without aid of magnification, and subjected to the dielectric test of 4.7.5.19.3.

* 4.7.5.9 Insulation thickness - All insulation thickness measurements shall be made on cross sections of the wire at suitable magnification. A wall thickness of the primary insulation or of the finished wire shall be the shortest distance, at the point of measurement, between the outer rim of the primary insulation or finished wire, as applicable, and the outer rim of the outermost strand of the conductor. For the coating or jacket, the thickness shall be the shortest distance, at the point of measurement, between the inner and outer surfaces of the coating or jacket. When a minimum thickness is specified in the specification sheet, the specimen shall be considered as meeting the requirement, if the smallest thickness measurement present in the cross section equals or exceeds the specified minimum. If a thickness range is specified in the specification sheet, the specimen shall be considered as meeting the requirement if both the smallest individual thickness measurement and the largest individual thickness measurement present in the cross section fall within the specified thickness range.

4.7.5.10 Concentricity - The concentricity of the primary insulation and of the finished wire shall be determined in accordance with the procedures of 4.7.5.10.1 and 4.7.5.10.2 as applicable. All wall thickness measurements shall be made on cross sections of the wire under suitable magnification. A wall thickness shall be the shortest distance between the outer rim of the primary insulation or finished wire, as applicable, and the outer rim of the outermost strand of the conductor.

4.7.5.10.1 Concentric-lay wires - The concentricity of the primary insulation or of the finished wire shall be determined by first locating and recording the minimum wall thickness measured on a cross section of the primary insulation or finished wire. The maximum wall thickness of this same cross section of the primary insulation or finished wire shall also be located and recorded. For concentric-lay wires, 100 times the ratio of the minimum wall thickness to the maximum wall thickness shall define the percent concentricity.

4.7.5.10.2 Rope-lay wires - The concentricity of the primary insulation or of the finished wire shall be determined by first locating and recording the minimum wall thickness measured on a cross section of the primary insulation or of the finished wire. From this point on the outer rim of the primary insulation or finished wire at which the minimum wall thickness was measured, three more reference points 90 degrees apart on the outside rim of the primary insulation or finished wire shall be established. At each of these three reference points the nearest member of the rope-lay conductor shall be selected and the minimum wall thickness between that member and the outer rim of the primary insulation or finished wire shall be measured. The average of the four readings shall be considered to be the average wall thickness. For rope-lay wires, 100 times the ratio of the minimum wall thickness to the average wall thickness shall define the percent concentricity.

4.7.5.11 Blocking - One end of a piece of finished wire, of sufficient length to perform the test, shall be affixed to a metal spool of the barrel diameter specified for the applicable wire size in Table VII. The wire shall then be wound helically on the spool for at least three turns, with the succeeding turns in close contact with one another. The tension for winding shall be equal to the test load specified for the cold bend test of the same size wire in the applicable specification sheet. The winding shall be continued until there are at least three closely-wound layers of such helical turns on the spool. The free end of the wire shall then be affixed to the spool or shall continue to be weighted with the winding tension load so as to prevent unwinding or loosening of the turns or layers and the spool and wire shall be placed for 24 hours in an air oven at the temperature specified on the applicable specification sheet. At the end of the 24-hour period, the spool and wire shall be removed from the oven and allowed to cool to room temperature. After cooling, the wire shall be unwound manually, meanwhile being examined for evidence of adhesion (blocking) of adjacent turns or layers.

4.7.5.12 Polyimide cure test - Two hundred milliliters of distilled water together with a few boiling chips or beads shall be placed in a 1 liter Erlenmeyer flask and the flask shall be closed by a rubber stopper fitted with a water cooled reflux condenser. The flask shall be heated by hot plate or heating mantle until the water is boiling and condensate is returning from the reflux condenser. One end of an approximately 12 inch length of the wire to be tested shall be inserted into the flask by passing it between the rubber stopper and the side of the flask or through a snugly fitting hole in the stopper, so that 5 inches of the wire length extends into the vapor phase inside the flask. The portion of the wire inside the flask shall be essentially straight and shall not be in contact with the glass sides of the flask or condenser, the layer of liquid water in the bottom of the flask, or the liquid condensate returning from the condenser. Heating of the flask shall be resumed, with stopper and reflux condenser again in place. The portion of wire inside the flask shall be exposed to the vapor phase above the boiling water for 1 hour $\pm$5 minutes and shall then be removed from the flask. A 4 inch specimen shall be cut from the vapor-exposed portion of the wire, avoiding the one inch which was nearest the rubber stopper during vapor exposure. The 4 inch specimen shall be allowed to cool at room temperature for a minimum of fifteen minutes, after which it shall be wrapped in a tight spiral for six turns or the full length of the specimen, whichever is lesser, around a mandrel which for wire sizes 18 and smaller shall be the specified maximum diameter of the wire and for wire sizes 16 and larger shall be three times the specified maximum diameter of the wire. The specimen shall then be inspected visually for cracks without the aid of magnification.

* 4.7.5.13 Shrinkage - A 12-inch specimen of the finished wire shall be cut so that the insulation and conductor are flush at both ends. The specimen shall be placed in an air-circulating oven and maintained for a period of 6 hours at the temperature specified in the applicable specification

sheet. The velocity of air past the specimen location in the oven shall be between 100 and 200 feet per minute as determined at room temperature. At the end of the 6-hour period, the specimen shall be removed from the oven and allowed to return to room temperature. Shrinkage of the insulation shall be measured as the greatest distance which any layer of the insulation, including jacket if present, has receded from either end of the conductor; that is, the measurement obtained at the end showing the greater shrinkage shall be considered the shrinkage of the specimen.

* 4.7.5.14 Wicking - A specimen of each finished wire size to be tested shall be cut 6 ± 1/16 inches with square ends. The specimen shall be vertically immersed for two inches of its length in a fluorescent dye solution contained in an open test tube and shall be conditioned thus for 24 hours at room temperature in a draft-free room. The fluorescent dye solution shall be prepared by dissolving 0.02 gram of Rhodamine B dye in 30 mls of ethyl alcohol and diluting with 2 liters of distilled water containing 3 mls of an anionic wetting agent, Specification MIL-D-26937. After this conditioning, the specimen shall be removed from the fluorescent dye solution and excess solution on the surface shall be removed immediately from the two inches immersed by wiping gently with a clean, dry, lint-free cloth. The jacket shall be removed from the specimen and the outside of the primary insulation and the inside of the jacket shall be examined under ultraviolet illumination for evidence of fluorescent dye. The distance that the dye has traveled, between jacket and primary insulation, from the end of the specimen shall be recorded as the distance of wicking.

4.7.5.15 Abrasion - Abrasion resistance shall be determined by Procedure I or II as specified in the applicable specification sheet.

4.7.5.15.1 Procedure I - The test shall be conducted on an abrasion testing machine conforming to MIL-T-5438, except that the machine shall be modified or supplemented by a device to determine the lengthwise tension of the wire specimen when it is being clamped into the machine. The abrasive tape shall be as specified in MIL-T-5438. The insulation of the wire sample shall be free of surface contaminants such as oil or moisture and, for referee tests, atmospheric conditions shall be standard as defined in FED-STD-228. In making the test, an inch of the insulation shall be removed from one end of a 30-inch specimen of the finished wire and this end shall be connected to the detection circuit of the tester. The specimen shall be clamped into the tester, using the lengthwise tensile load, the weight support bracket and the vertical weight specified in the applicable specification sheet. The specimen shall then be abraded. At the start of each measurement the center of a conducting stripe shall be at the point of contact with the wire. The reading of each measurement shall be the length of abrasion tape in inches to come in contact with the wire insulation to the point where the machine stops. After each reading, the specimen shall be moved forward 2 inches and rotated clockwise 90 degrees. Eight readings shall be obtained for each specimen. An average shall be obtained by calculating the arithmetic mean of all the readings which are individually less than the arithmetic mean of all the eight readings per specimen. This average shall define the abrasion resistance of the specimen under test.

4.7.5.15.2 Procedure II - The test method shall be in accordance with Procedure I, except that the abradant of the abrasive cloth tape shall be aluminum oxide, grit 400, and the detection cross stripes of conductive silver paint on the tape shall be 1/4 inch wide, spaced 3 inches apart, center to center.

4.7.5.16 Low temperature (cold bend) - One end of a wire specimen 36 inches in length shall be secured to a rotatable mandrel in a cold chamber and the other end to the load weight specified in the applicable specification sheet. The diameter of the mandrel shall be as specified in the specification sheet. Provision shall be made for rotating the mandrel by means of a handle or control located outside the chamber. The specimen of wire and the mandrel shall be conditioned for 4 hours at a temperature of -65 ±2°C (-85 ±3.6°F). At the end of this period and while both mandrel and specimen are still at this low temperature, the specimen shall be wrapped helically, for its entire length or for 20 turns whichever is the lesser number of turns, around the mandrel without opening the chamber. The bending shall be accomplished at a uniform rate of 2 ±1 RPM. At the completion of this test the specimen shall be removed from the cold box and from the mandrel without straightening. The specimen shall be examined for cracks in the insulation. The insulation shall then be removed for a distance of 1 inch from each end of the specimen and the specimen shall be subjected to the dielectric test specified in 4.7.5.19.3 with the bent portion submerged.

4.7.5.17 Thermal shock resistance -

4.7.5.17.1 Preparation of specimen - A specimen of wire, five feet long shall be prepared by carefully removing 1 inch of insulation from each end of the wire. (For purposes of this test, insulation is defined as all layers of non-conducting material covering the electrical conductor, e.g., primary insulation, all tapes and braids, and the jacket.) A razor blade or equivalent, held perpendicular to the axis of the wire, shall be used to cut the insulation for the removal operation. The length of exposed conductor at each end of the specimen shall be measured to the nearest 0.01 inch. The specimen shall be formed into a loose coil not less than 1 foot in diameter and shall be laid on a wire screen for handling throughout the test.

4.7.5.17.2 Test procedure - The specimen shall be placed for 30 minutes in a preheated air circulating oven at the temperature specified in the applicable specification sheet. The specimen shall then be removed from the oven and, within two minutes, placed in a chamber which has been precooled to -55 ±2°C (-67 ±3.6°F). It shall be exposed to this temperature for 30 minutes, after which it shall be removed and allowed a minimum of 30 minutes to return to room temperature, 20 to 25°C (68 to 77°F). At the conclusion of this cycle, the distance from the end of each layer of insulation to the end of the conductor shall be measured to the nearest 0.01 inch. This thermal shock cycle and the measurements shall be repeated

for an additional three cycles (a total of four cycles). Any measurement varying from the original measurement by more than the amount specified in the applicable specification sheet shall constitute failure. Any flaring of any layer shall also constitute failure.

4.7.5.18 Flammability -

4.7.5.18.1 Apparatus - The test shall be performed within a test chamber approximately one foot square by two feet in height, open at top and front to provide adequate ventilation for combustion but to prevent drafts. The specimen holder shall be so designed that the lower end of a 24-inch wire specimen is held by a clamp, while the upper end of the specimen passes over a pulley and can be suitably weighted to hold the specimen taut at an angle of 60 degrees with the horizontal, in a plane parallel to and approximately 6 inches from the back of the chamber. The test flame shall originate from a Bunsen type gas burner with a 1/4 inch inlet, a needle valve in the base for gas adjustment, a bore of 3/8 inch nominal, and a barrel length of approximately 4 inches above the air inlets. The burner shall be adjusted to furnish a 3 inch conical flame with an inner cone approximately 1 inch in length and a flame temperature not less than 954°C (1749°F) at its hottest point, as measured with an accurate thermocouple pyrometer. A sheet of facial tissue conforming to UU-T-450 shall be suspended taut and horizontal 9-1/2 inches below the point of application of the flame to the wire specimen and at least 1/2 inch from the chamber floor, so that any material dripping from the wire specimen shall fall upon the tissue.

4.7.5.18.2 Procedure - A 24-inch specimen of wire shall be marked at a distance of 8 inches from its lower end to indicate the point for flame application and shall be placed in the specified 60 degree position in the test chamber. The lower end of the specimen shall be clamped in position in the specimen holder and the upper end shall be passed over the pulley of the holder and weighted with the weight specified for life cycle test of the same wire in the applicable specification sheet. With the burner held perpendicular to the specimen and at an angle of 30 degrees from the vertical plane of the specimen, the hottest portion of the flame shall be applied to the lower side of the wire at the test mark. The period of test flame application shall be 30 seconds for all sizes of wire and the test flame shall be withdrawn immediately at the end of that period. The distance of flame travel upward along the specimen from the test mark and the time of burning after removal of the test flame shall be recorded; also the presence or absence of flame in the facial tissue due to incendiary drip from the specimen. Charred holes or charred spots in the tissue shall be ignored in the absence of actual flame. Breaking of the wire specimens in sizes 24 and smaller shall not be considered as failure provided the requirements for flame travel limits, duration of flame, and absence of incendiary dripping are met.

4.7.5.19 Life cycle -

4.7.5.19.1 Air oven - One inch of the insulation shall be removed from each end of a 24-inch specimen of the finished wire. The central portion of the specimen shall then be bent over a horizontally positioned smooth stainless steel mandrel of the diameter specified in the applicable specification sheet. To prevent sticking of the wire to the mandrel, the mandrel may be coated with polytetrafluoroethylene in the form of either enamel or wrapped tape, provided that the diameter of the mandrel after coating is still in conformity with the specification sheet. Each end of the conductor shall be weighted with the test load specified in the specification sheet, so that the portion of the insulation between the conductor and mandrel is under compression and the conductor is under tension. This specimen so prepared on the mandrel shall be placed in an air-circulating oven and maintained for the period of time and at the temperature specified in the specification sheet. The velocity of air past the specimen location in the oven shall be between 100 and 200 feet per minute as determined at room temperature. After completion of the air oven exposure, the specimen shall be allowed to cool to between 20 and 25°C (68 to 77°F). When cooled, the wire shall be freed from tension, removed from the mandrel, and straightened. The specimen shall then be subjected to the bend test (4.7.5.19.2), followed by dielectric test (4.7.5.19.3). After the dielectric test, the insulation shall be removed from the specimen. and the conductor shall be examined for pitting. Darkening of a tin coating caused by normal air oxidation shall not be cause for rejection.

4.7.5.19.2 Bend test - In a temperature maintained between 20 and 25°C (68 to 77°F), one end of the specimen shall be secured to the mandrel and the other end to the load weight specified in the applicable specification sheet. The mandrel shall be rotated until the full length of the specimen is wrapped around the mandrel and is under the specified tension with adjoining coils in contact. The mandrel shall then be rotated in reverse direction until the full length of the wire which was outside during the first wrapping is now next to the mandrel. This procedure shall be repeated until two bends in each direction have been formed in the same section of the wire. The outer surface of the wire shall then be observed for cracking of the insulation.

4.7.5.19.3 Wet dielectric test - The uninsulated ends of the specimen shall be attached to an electric lead. The specimen shall be immersed in a 5 percent, by weight, solution of sodium chloride in water at 20 to 25°C (68 to 77°F), except that the uninsulated ends and 1-1/2 inches of insulated wire at each end of the specimen shall protrude above the surface of the solution. After immersion for 5 hours, the voltage specified in the applicable specification sheet at 60 hertz (cycles per second) shall be applied between the conductor and an electrode in contact with the liquid.

The voltage shall be gradually increased at a uniform rate from zero to the specified voltage in 1/2 minute, maintained at that voltage for a period of 5 minutes, and gradually reduced to zero in 1/2 minute.

4.7.5.20 Accelerated aging - The specimen, apparatus and procedure for this test shall be exactly as specified for the life cycle test in 4.7.5.19 through 4.7.5.19.3, except that the temperature and duration of the oven exposure shall be as specified for accelerated aging in the applicable specification sheet. Also, unless the specification sheet specifies a separate accelerated aging temperature for determining retention of legibility of the product identification (3.6.3.1), the 24-inch accelerated aging specimen shall be selected to include a printed identification marking and shall be examined for legibility of the marking after the oven exposure. When the specification sheet specifies a separate temperature for accelerated aging of the product identification, a separate specimen including an identification marking shall be exposed at the temperature specified for test of the marking and shall be examined thereafter for legibility.

4.7.5.21 Immersion tests - Specimens of wire of sufficient length to perform the subsequent tests shall be gaged to determine their initial diameter and shall then be immersed to within 6 inches of their ends in each of the following fluids (using a separate specimen for each fluid) for 20 hours at a temperature of 48 to 50°C (118.4 to 122°F).

(a) Lubricating oil, aircraft, turbine engines, synthetic base, MIL-L-23699.

(b) Hydraulic fluid, petroleum base, aircraft, missile, and ordnance, MIL-H-5606.

(c) Isopropyl alcohol, TT-I-735.

(d) Turbine fuel, aviation, Grade JP-4, MIL-T-5624.

During the immersion tests, the radius of bend of the wire shall be not less than fourteen times the specified maximum diameter of the wire under test. Upon removal from the liquids, the specimen shall remain for 1 hour in free air at room temperature. The diameter shall be gaged and compared to the initial diameter. The insulation shall be removed for a distance of one inch from each end of a 24-inch length of the specimen and this length shall be subjected to the bend test of 4.7.5.19.2 followed by the dielectric test of 4.7.5.19.3. A sufficient length of each specimen, after immersion, shall also be subjected to the abrasion test of 4.7.5.15 by Procedure I or II as specified in the applicable specification sheet. The specimen shall be wiped free of the immersion fluid and air dried for 24 hours at 25 $\pm$4°C (77 $\pm$ 7.2°F) prior to abrasion.

4.7.5.22 Humidity resistance - A 52-foot specimen of wire shall be subjected to the following:

4.7.5.22.1 Apparatus - The apparatus shall consist of a test chamber capable of maintaining an internal temperature of 70 ±2°C (158 ±3.6°F) and an internal relative humidity of 95 ±5 percent. The test chamber shall be capable of being so sealed as to retain the total moisture content in the test space. The heat loss from the chamber shall be sufficient to reduce the internal temperature from the above specified operating temperature to not more than 38°C (100.4°F) within a period of 16 hours from the time of removal of the source of heat. Distilled or demineralized water shall be used to obtain the required humidity.

4.7.5.22.2 Procedure - The specimen shall be placed in the test chamber and the temperature and relative humidity raised over a 2-hour period to the values specified in 4.7.5.22.1 and maintained at such for a period of 6 hours. At the end of the 6-hour period the heat shall be shut off. During the following 16-hour period, the temperature must drop to 38°C (100.4°F) or lower. At the end of the 16-hour period, heat shall be again supplied for a 2-hour period to stabilize at 70 ±2°C (158 ±3.6°F). This cycle (2 hours heating, 6 hours at high temperature, 16 hours cooling) shall be repeated a sufficient number of times to extend the total time of the test to 360 hours (fifteen cycles). At the end of the fifteenth cycle, the 50-foot center section of the specimen shall be immersed in a 5 percent, by weight, solution of sodium chloride in water at room temperature.. The insulation resistance of the specimen shall be measured with the outer surface of the specimen grounded, through an electrode in the electrolyte, and with a potential of 250 to 500 volts DC applied to the conductor of the specimen after 1 minute of electrification at this potential. The insulation resistance shall be converted to megohms for 1000 feet by the calculation shown in 4.7.5.2.

* 4.7.5.23 Surface resistance - The surface resistance of the finished wire shall be measured in accordance with Method 6041 of FED-STD-228. All specimens, after having been provided with the required electrodes but prior to testing, shall be cleaned by the procedure described in the test method. In positioning the specimens in the test chamber, the specimens shall be so placed that their ends are a minimum of one inch from any wall of the chamber.

4.7.5.24 Smoke - This test shall be conducted in still air at an ambient temperature of 25 ±5°C (77 ±9°F). A specimen approximately 15 feet long of the wire shall be so suspended that at least the central 10-foot section is horizontal and unsupported. One end of the wire shall be suitably weighted in order that no sagging will occur throughout the test. An electric current shall be applied to the wire and the voltage drop shall be measured over the central 10-foot portion. From the current and voltage values, the resistance of the wire shall be calculated. The temperature of the wire conductor shall be determined from the change in resistance. The

current shall be so adjusted that the conductor temperature stabilizes at the temperature specified in the applicable specification sheet. This conductor temperature shall be thus maintained for 15 minutes during which time there shall be no indication of visible smoke. A flat-black background shall be used for this test.

4.7.5.25 Propellant resistance - Specimens of finished wire, 24 inches long shall be immersed to within 1-1/2 inches of each end in the following propellants for 30 minutes at normal room temperature, using a separate specimen for each propellant.

(a) Propellant, nitric acid, MIL-P-7254.

(b) Propellant, hydrazine, MIL-P-26536.

(c) Propellant, nitrogen tetroxide, MIL-P-26539.

(d) Propellant, hydrazine - uns-dimethylhydrazine (50% N_2H_4-50% UDMH), MIL-P-27402.

During immersion, the radius of bend of the wire shall be not less than fourteen times the maximum diameter of the wire specified in the applicable specification sheet. Upon removal from the liquids, the specimens shall remain for 1 hour in free air at room temperature. The insulation shall be removed for a distance of one inch from each end of the specimens and the specimens shall be subjected to the dielectric test of 4.7.5.19.3.

* 4.7.5.26 Continuous lengths - Unless otherwise specified in the ordering data (6.2), the inspection requirements for continuous wire lengths shall be satisfied by the supplier's certificate of conformity and the presence of the required piece length markings on the spools or reels (3.6.9). However, the Government reserves the right to examine such certified lots if deemed necessary to assure that the lengths actually conform to requirement. When the ordering data specifies examination of the wire lengths, the Government representative shall examine the wire at his own discretion to determine conformity in this characteristic. In measuring continuous wire lengths where the wire has been marked or stripped of insulation in lieu of being cut to mark insulation failures or identify untested or improperly tested areas (4.7.5.1.3), such marking or stripping shall be considered equivalent to complete severance of the wire at the two ends of each marked or stripped area.

4.8 Examination of preparation for delivery - Preparation for delivery of materials ready for shipment shall be examined to determine conformity to the requirements of Section 5.

5. PREPARATION FOR DELIVERY

5.1 Packaging - Packaging shall be Level A or C. Unless otherwise specified in the order (6.2), Level A shall be applicable.

5.1.1 Level A - Packaging shall be in accordance with the Level A requirements of MIL-C-12000 and as follows:

5.1.1.1 Reels and spools - Wire shall be delivered wound on reels and spools of a nonreturnable type. Each reel or spool shall have an appropriate diameter for the respective wire size. In no case shall the barrel of the reel or spool have a diameter less than that specified in Table VII or less than 3 inches, whichever is greater. Reels and spools shall be suitably finished to prevent corrosion under typical storage and handling conditions. The method of attachment of flanges to barrels on metal reels or spools shall be structurally equivalent to a full circumferential crimp.

TABLE VII

BARREL DIAMETERS OF SPOOLS AND REELS

WIRE SIZE (RANGE)	MINIMUM DIAMETER OF BARREL (AS TIMES NOMINAL DIAMETER OF FINISHED WIRE, EXCEPT SEE 5.1.1.1)
30-16	50X
14-10	40X
8-4	30X
2-0000	20X

* 5.1.1.2 Winding requirements - Unless otherwise specified in the order (6.2), there shall be no restriction on the number of wire lengths per reel or spool, provided the wire length requirements of 3.6.9 are met by the inspection lot.

5.1.2 Level C - Packaging shall be in accordance with the requirements of MIL-C-12000 for Level C packaging.

5.2 Packing - Packing shall be Level A, B, or C in accordance with MIL-C-12000. Unless otherwise specified in the order (6.2), Level C shall be applicable.

* 5.3 Marking - Unless otherwise specified in the contract or order, each reel or spool shall be marked with the footage of the individual

continuous lengths wound thereon, as specified in 3.6.9. In addition, interior packages and exterior shipping containers shall be marked in accordance with MIL-C-12000 and MIL-STD-129. The identification shall be composed of the following information listed in the order shown:

WIRE, ELECTRIC, CROSSLINKED POLYALKENE INSULATED*, COPPER**
Specification sheet part No.
Specification MIL-W-81044B
Length_____feet
Size
Date of manufacture
Name of manufacturer
*or "CROSSLINKED ALKANE-IMIDE POLYMER INSULATED," or "POLYARYLENE INSULATED" as applicable
**or "COPPER ALLOY," as applicable

6. NOTES

6.1 Intended use - The electric wires covered by this specification are intended for use in any application where their performance characteristics are required. The wires are suitable for installation on aerospace electrical systems within the limitations of applicable performance requirements.

* 6.1.1 Temperature rating - Temperature ratings as specified in specification sheets pertaining to this specification represent the maximum permissible operating temperature of the conductor. The maximum ambient temperature should be the rated maximum conductor temperature of the wire diminished by the operating rise in temperature of the conductor.

* 6.1.2 Compatibility note - The insulation systems of polyvinylidene fluoride-jacketed electric wires of this specification may be degraded by contact with hydraulic fluids of phosphate ester type at high temperatures. Wires of this specification with polyvinylidene fluoride jackets are not recommended for applications where they will be in contact with hydraulic fluids of phosphate ester type at temperatures above 50°C (122°F).

6.1.3 Size designations - The conductor sizes and the corresponding size designations of this specification are in accordance with established usage for stranded copper conductors for hookup wire in the electronic and aircraft industries. It should be noted that these sizes and size designations are not identical with American Wire Gage (AWG) sizes for solid wire and strands. The diameters and cross-sectional areas of the stranded conductors of this specification are, in most sizes, only roughly approximate to those of AWG solid conductors of the same numerical size designation.

* 6.2 Ordering data - Procurement documents should specify the following:

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

(b) Applicable specification sheet number, title, and date (1.2).

(c) Applicable specification sheet part number (1.2.1).

(d) Color required (3.6.2).

(e) Quantity of wire required.

(f) Levels of packaging and packing required.

(g) Exceptions, if any, to the optional provisions of this specification including:

(1) Exceptions to identification of product requirement (3.6.3), if applicable.

(2) Applicable minimum length requirements, if other than specified in 3.6.9 and Table III.

(3) Responsibility for inspection, if other than specified in 4.1.

(4) Requirement, if applicable, that insulation materials be subjected to process control test rather than accepted on suppliers certification of conformity (4.7.3).

(5) Marking of dielectric test failures by stripping of insulation or by other method specified in the contract in lieu of cutting of the wire, if applicable (4.7.5.1.3).

(6) Special preparation for delivery requirements, if applicable (Section 5).

6.3 Qualification - With respect to products requiring qualification, awards will be made only for such products as have, prior to the time set for opening of bids, been tested and approved for inclusion in the applicable Qualified Products List (QPL) whether or not such products have actually been so listed by that date. The attention of the suppliers is called to this requirement, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. The activity responsible for the Qualified Products List is the Naval Air Systems Command,

Washington, D.C. 20361; however, application for qualification of products should be made to the Commanding Officer, Naval Ammunition Depot (70515), Crane, Indiana 47522, who has been designated Naval Air Systems Command agent for establishing this Qualified Products List.

6.3.1 Conformity to qualified sample - It is understood that wire supplied under contract shall be identical in every respect to the qualification sample tested and found satisfactory, except for changes previously approved by the Government. Any unapproved changes from the qualification sample shall constitute cause for rejection.

* 6.4 Patent notice -

6.4.1 Crosslinked polyalkene - The Government has a royalty-free license under Patent No. 3,269,862 for the benefit of manufacturers of electric wire having an insulating covering comprising a crosslinked polyalkene layer and a crosslinked polyvinylidene fluoride layer either for the Government or for use in equipment to be delivered to the Government.

6.4.2 Alkane-imide polymer - The Government has a royalty-free license under Patent Nos. 3,607,387 and 3,551,200 for the benefit of manufacturers of electric wire having an insulating covering comprising a crosslinked alkane-imide polymer layer and a modified imide polymer layer either for the Government or for use in equipment to be delivered to the Government.

6.5 Marginal notations - 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 on the entire content as written irrespective of the marginal notations and relationship to the last previous issue.

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