SAE Aerospace
An SAE International Group

AEROSPACE STANDARD

SAE AS50861

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Wire, Electric, Polyvinyl Chloride Insulated, Copper or Copper Alloy

FSC 6145

NOTICE

This document has been taken directly from U.S. Military Specification MIL-W-5086C, Supplement 1, Amendment 1 and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-W-5086C, Supplement 1, Amendment 1. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this technical report.

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1. SCOPE:

1.1 Scope:

This specification covers polyvinyl chloride insulated single conductor electric wires made with tin-coated copper conductors or silver-coated copper alloy conductors as specified in the applicable military specification sheet. The polyvinyl chloride insulation of these wires may be used alone or in combination with other insulating or protective materials.

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:

M5086/1	-	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:

SPECIFICATIONS

Federal

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

2.1 (Continued):

Military

MIL-C-572	Cords, Yarns and Monofilaments, Organic Synthetic Fiber
MIL-Y-1140	Yarn, Cord, Sleeving, Cloth, and Tape, Glass
MIL-H-5606	Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-C-12000	Cable, Cord, and Wire, Electric, Packaging of
MIL-M-20693	Molding Plastic, Polyamide (Nylon), Rigid
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-W-5086/1	Wire, Electric, Polyvinyl Chloride Insulated, Nylon Jacket, Tin-Coated Copper Conductor, 600-Volt, 105°C
MIL-W-5086/2	Wire, Electric, Polyvinyl Chloride Insulated, PVC - Glass - Nylon, Tin-Coated Copper Conductor, 600-Volt, 105°C
MIL-W-5086/3	Wire, Electric, Polyvinyl Chloride Insulated, PVC - Glass - PVC - Nylon, Tin-Coated Copper Conductor, 600-Volt, 105°C
MIL-W-5086/4	Wire, Electric, Polyvinyl Chloride Insulated, Nylon Jacket, Tin-Coated Copper Conductor, 3000-Volt, 105°C
MIL-W-5086/5	Wire, Electric, Polyvinyl Chloride Insulated, Polyvinylidene Fluoride Jacket, Tin-Coated Copper Conductor, 600-Volt, 110°C
MIL-W-5086/6	Wire, Electric, Polyvinyl Chloride Insulated, Polyvinylidene Fluoride Jacket, Silver-Coated Copper Alloy Conductor, 600-Volt, 110°C
MIL-W-5086/7	Wire, Electric, Polyvinyl Chloride Insulated, Nylon Jacket, Tin-Coated Copper Conductor, Medium Weight, 600-Volt, 105°C
MIL-W-5086/8	Canceled, 14 November 1974 (Wire, Electric, Polyvinyl Chloride Insulated, Polyvinylidene Fluoride Jacket, Tin-Coated Copper Conductor, Light Weight, 600-Volt, 110°C)

2.1 (Continued):

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

MIL-STD-129 Marking for Shipment and Storage

MIL-STD-681 Identification Coding and Application of Hookup and Lead Wire

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

ANSI/ASTM B 3-74 Standard Specification for Soft or Annealed Copper Wire

ANSI/ASTM B 33-74 Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes

ANSI/ASTM B 298-74a Standard Specification for Silver-Coated Soft or Annealed Copper Wire

ANSI/ASTM D 1371-78 Recommended Practice for Cleaning Plastic Specimens for Insulation Resistance, Surface Resistance, and Volume Resistivity Testing

(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, except that all specification sheet provisions concerning resistance to tape abrasion shall be considered as cancelled as of the issue date of Amendment 1 to this specification.

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 6.4). 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 soft annealed copper or silver coated high strength copper alloy, as specified in the applicable specification sheet. 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 soft annealed copper strands: The strands shall be as specified in ANSI/ASTM B 33-74.

3.4.1.2 Silver-coated high strength copper alloy strands: The strands shall be of the applicable AWG gage specified in Table II 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 have a coating thickness of not less than 40 micro-inches of silver and shall meet the continuity of coating requirement of ANSI/ASTM B 298-74a when tested in accordance with that standard.

3.4.2 Insulating material:

3.4.2.1 Primary and secondary insulation: The primary insulation and, when specified, secondary insulation for all wires under this specification shall be an extruded polyvinyl chloride composition. The properties of the extruded polyvinyl chloride in the finished wire shall be as specified in Table I.

TABLE I
PROPERTIES OF EXTRUDED POLYVINYL CHLORIDE INSULATION
AND POLYVINYLIDENE FLUORIDE JACKET COMPOUNDS

PROPERTY	POLYVINYL CHLORIDE	POLYVINYLIDENE FLUORIDE
Tensile strength Initial (psi) (min ave)	1800	5000
Elongation Initial (%) (min ave)	100	250
After aging: Qualification procedure (% of initial) (min ave)	70	---
Acceptance procedure (% of initial) (min ave)	90	---
Corrosive effect	To pass test (See 4.7.5.3)	---

3.4.2.2 Glass braid: When a glass braid is specified in the applicable specification sheet, it shall be a tightly formed, uniformly surfaced braid composed of electrical-grade continuous filament glass yarn of MIL-Y-1140. For wire sizes 10 and larger, the yarn shall gage 13,000 to 16,000 yards per pound, before treatment. For wire sizes 12 and smaller, the yarn shall gage 13,000 to 24,000 yards per pound, before treatment. The braid shall be treated with suitable saturants to facilitate stripping and to cause the braid to adhere to the next outer layer of material.

3.4.2.3 Jacket:

3.4.2.3.1 Polyamide (nylon): When an extruded polyamide jacket is specified, it shall be made of clear Type III, Grade E molding plastic of MIL-M-20693. Certified test data shall be furnished by the wire supplier to establish conformity of the polyamide extruding material to the required type and grade. When a braided polyamide jacket is specified, the material shall conform to Type P of MIL-C-572 and shall be impregnated with polyamide finisher.

3.4.2.3.2 Polyvinylidene fluoride: Jackets of this material shall be extruded clear polyvinylidene fluoride having the tensile and elongation properties shown in Table I.

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 II. 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 II 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.

TABLE II
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: Min. (inch)	Diameter of Stranded Conductor, Max (Inch), General Purpose: Tin Coated Copper	Diameter of Stranded Conductor, Max (Inch), General Purpose: Silver Coated Alloy	Diameter of Stranded Conductor, Max (Inch), Small Diameter: Tin Coated Copper	Diameter of Stranded Conductor, Max (Inch), Small Diameter: Silver Coated Alloy	Maximum Resistance of Finished Wire 2/: Tin Coated Copper	Maximum Resistance of Finished Wire 2/: Silver Coated Alloy	Breaking Strength, Alloy Conductor (lbs) (min)
30	112	7 x 38	0	0.0040	0.011	0.013	0.012	0.013	0.012	111.1	117.4	5.17
28	175	7 x 36	0	0.0050	0.014	0.016	0.015	0.016	0.015	68.6	74.4	8.16
26	304	19 x 38	0	0.0040	0.018	0.021	0.020	0.020	0.020	41.3	44.8	14.2
24	475	19 x 36	0	0.0050	0.023	0.026	0.025	0.024	0.024	26.2	28.4	22.4
22	754	19 x 34	0	0.0063	0.029	0.033	0.032	0.031	0.031	16.2	17.5	35.8
20	1,216	19 x 32	0	0.0080	0.037	0.041	0.040	0.039	0.039	9.88	10.7	58.1
18	1,900	19 x 30	0	0.0100	0.046	0.051	-	0.049	-	6.23		
16	2,426	19 x 29	0	0.0113	0.052	0.058	-	0.055	-	4.81		
14	3,831	19 x 27	0	0.0142	0.065	0.073	-	0.069	-	3.06		
12	5,874	37 x 28	0	0.0126	0.084	0.090	-	0.089	-	2.02		
10	9,354	37 x 26	0	0.0159	0.106	0.114	-	0.112	-	1.26		
8	16,983	133 x 29	0	0.0113	0.158	0.173	-	0.169	-	0.701		
6	26,818	133 x 27	0	0.0142	0.198	0.217	-	0.212	-	0.445		
4	42,615	133 x 25	0	0.0179	0.250	0.274	-	0.268	-	0.280		
2	66.500	665 x 30	2	0.0100	0.320	0.340	-	-	-	0.183		
1	81,700	817 x 30	2	0.0100	0.360	0.380	-	-	-	0.149		
0	104,500	1,045 x 30	3	0.0100	0.405	0.425	-	-	-	0.116		
00	133,000	1,330 x 30	3	0.0100	0.450	0.475	-	-	-	0.091		
000	166,500	1,665 x 30	4	0.0100	0.515	0.540	-	-	-	0.071		
0000	210,900	2,109 x 30	5	0.0100	0.580	0.605	-	-	-	0.056		

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

2/ Ohms per 1000 feet at 20°C.

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 4.7.5.10.1:

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 elongation of 6 percent, minimum, and a tensile breaking strength conforming with Table II, when tested in accordance with 4.7.5.10.2.

3.5.1.4 Conductor diameter: The diameter of the conductor shall be as specified in Table II. Applicability of the “general purpose” or of the “small diameter” Table II 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 military 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 4.7.5.4, 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 III and those of the applicable military specification sheet. The requirements of 3.6.1 through 3.6.8 also apply.

3.6.1 Surface smoothness: The outer surface of the completed wire shall have an even, smooth finish and shall be free of lumps and abraded areas.

3.6.2 Impulse dielectric test: One hundred percent of the finished wire shall pass the impulse dielectric test of 4.7.5.4, which test shall be made during the final winding of the wire on shipment spools or reels.

TABLE III
PROPERTIES OF FINISHED WIRE

EXAMINATION OR TEST	REQUIREMENT	METHOD
Conductor stranding	Table II and 3.5.1.1	4.7.1
Conductor diameter	Table II and 3.5.1.4	4.7.1
Finished wire diameter	Specification sheet	4.7.1
Construction of insulation	Specification sheet	4.7.1
Tensile strength of insulation (primary and secondary) (initial)	Table I	4.7.5.1
Elongation of insulation (primary and secondary)		
Initial	Table I	4.7.5.2.1
After aging	Table I	4.7.5.2.2
Corrosive effect of insulation (primary and secondary)	Table I	4.7.5.3
Tensile strength of extruded jacket (initial) (when applicable)	Table I	4.7.5.1
Elongation of extruded jacket (initial) (when applicable)	Table I	4.7.5.2.1
Removability of insulation	3.5.2	4.7.1
Wire surface smoothness	3.6.1	4.7.1
Impulse dielectric test	3.6.2	4.7.5.4
Insulation resistance	Specification sheet	4.7.5.5
Color	3.6.3	4.7.1
Color striping or banding durability	3.6.3	4.7.5.6
Identification of product	3.6.4	4.7.1

TABLE III (Continued)

EXAMINATION OR TEST	REQUIREMENT	METHOD
Durability of identification	3.6.4.1	4.7.5.6
Blocking	3.6.5	4.7.5.7
Workmanship	3.6.7	4.7.1
Finished wire weight	Specification sheet	4.7.5.8
Conductor resistance	Table II	4.7.5.9
Conductor elongation and tensile strength	3.5.1.3	4.7.5.10
Thermal shock resistance	Specification sheet	4.7.5.11
Concentricity	70 percent (min) (also 3.6.6)	4.7.5.12
Low temperature (cold bend)	No cracking; no dielectric breakdown	4.7.5.14
Wrap test (extruded jackets only)	No cracking	4.7.5.15
Flammability	Specification sheet	4.7.5.16
Shrinkage	Specification sheet	4.7.5.17
Life cycle	Air oven exposure No cracking in bend test No dielectric breakdown No pitting	4.7.5.18.1 4.7.5.18.2 4.7.5.18.3 4.7.5.18.1
Immersion tests	Diameter increase, 5 percent max No cracking in bend test No dielectric breakdown	4.7.5.19 4.7.5.19 4.7.5.19
Humidity resistance	Specification sheet	4.7.5.20
Surface resistance	Specification sheet	4.7.5.21
Smoke test	Specification sheet	4.7.5.22
Continuous lengths	3.6.8	4.7.5.23

3.6.3 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 or of fibrous braid tracers shall be in accordance with MIL-STD-104, Class 1. Striping or banding or braided tracers, 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 4.7.5.6 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 and shall not be required of braided tracers. Conformity to color requirements after the air oven test of 4.7.5.18.1 is not required.

3.6.4 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 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, except that inclusion of the color code portion of the part number is not required. At the option of the supplier, the color code portion of the part number may be included but, if included, it shall be included in full, not in part.

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.

3.6.4.1 Durability of identification: Identification printing, when applied to the outer surface of the finished wire, shall be capable of withstanding the durability test specified in 4.7.5.6 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.

3.6.5 Blocking: Adjacent turns or layers of the wire shall not stick to one another when tested as specified in 4.7.5.7 at the temperature specified in the applicable specification sheet.

3.6.6 Concentricity: The concentricity requirement (Table III) shall apply to the primary insulation, to the secondary insulation when present, and to the finished wire.

3.6.7 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.

3.6.8 Continuous lengths: The individual continuous lengths of wire in each inspection lot shall be of such footage that, when inspected in accordance with 4.7.5.23, the inspection lot shall conform to the continuous length requirements of Table IV. 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 IV
MINIMUM CONTINUOUS WIRE LENGTHS

WIRE SIZE (RANGE)	REQUIRED MINIMUM PERCENT OF THE TOTAL INSPECTION LOT FOOTAGE IN CONTINUOUS LENGTHS OF NOT LESS THAN				
	500 feet	250 feet	100 feet	50 feet	25 feet
30-6	85%	--	100%	--	--
4-1	--	85%	--	100%	--
0-0000	--	--	85%	--	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: A finished wire sample consisting of 150 linear feet for size 10 or smaller and 100 linear feet for size 8 or larger shall be submitted for each wire size and part number for which qualification is desired, except that certain sizes will qualify additional sizes as follows:

Sample wire	will qualify sizes
Size 28	30 through 24
Any size, 26 through 22	30 through 22
Size 20, 18, or 16	22 through 16
Size 14, 12, or 10	14 through 10
Size 8, 6, or 4	8 through 4
Any size, 2 through 0000	2 through 0000

In addition to the finished wire sample, ten linear feet of each size of coated conductor strand and fifty linear feet of each yarn used in the manufacture of the wire shall be submitted.

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 6.4), plainly identified by securely attached, durable tags marked with the following information:

Sample for qualification test
WIRE, ELECTRIC POLYVINYL CHLORIDE INSULATED, COPPER OR COPPER ALLOY
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-5086C under authorization (reference authorizing letter).

4.4 Quality conformance inspection:

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

TABLE V
QUALITY CONFORMANCE INSPECTION

EXAMINATION OR TEST	REQUIREMENT	METHOD
Group I Characteristics		
Conductor stranding	Table II and 3.5.1.1	4.7.1
Conductor diameter	Table II and 3.5.1.4	4.7.1
Finished wire diameter	Specification sheet	4.7.1
Construction of insulation	Specification sheet	4.7.1
Tensile strength of insulation (primary and secondary) (Initial)	Table I	4.7.5.1
Elongation of insulation (primary and secondary)		
Initial	Table I	4.7.5.2.1
After aging (acceptance procedure)	Table I	4.7.5.2.2

TABLE V (Continued)

EXAMINATION OR TEST	REQUIREMENT	METHOD
Tensile strength of extruded jacket (initial) (when applicable)	Table I	4.7.5.1
Elongation of extruded jacket (initial) (when applicable)	Table I	4.7.5.2.1
Removability of insulation	3.5.2	4.7.1
Wire surface smoothness	3.6.1	4.7.1
Insulation resistance	Specification sheet	4.7.5.5
Color	3.6.3	4.7.1
Color striping or banding durability	3.6.3	4.7.5.6
Identification of product	3.6.4	4.7.1
Durability of identification	3.6.4.1	4.7.5.6
Workmanship	3.6.7	4.7.1
Finished wire weight	Specification sheet	4.7.5.8
Conductor resistance	Table II	4.7.5.9
Conductor elongation and tensile strength	3.5.1.3	4.7.5.10
Group II Characteristics		
Thermal shock resistance	Specification sheet	4.7.5.11
Concentricity	70 percent (min) (also 3.6.6)	4.7.5.12
Low temperature (cold bend)	No cracking; no dielectric breakdown	4.7.5.14
Wrap test (extruded jackets only)	No cracking	4.7.5.15
Flammability	Specification sheet	4.7.5.16

TABLE V (Continued)

EXAMINATION OR TEST	REQUIREMENT	METHOD
Group III Characteristic Impulse dielectric test	3.6.2	4.7.5.4
Group IV Characteristic Continuous lengths	3.6.8	4.7.5.23

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 V, 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 (4.7.5.4.3).

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 4.7.5.23.

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 VI. Process control inspection shall be performed on every lot of wire procured under this specification.

TABLE VI
PROCESS CONTROL INSPECTION

EXAMINATION OR TEST	REQUIREMENT	METHOD
Conductor material	3.4.1	4.7.2
Conductor splices	3.5.1.2	4.7.1
Glass braid yarns	3.4.2.2	4.7.3
Polyamide braid yarns	3.4.2.3.1	4.7.3
Flaws test of primary insulation (as applicable)		
Spark test	3.5.3	4.7.4
Impulse dielectric test	3.5.3	4.7.5.4

4.5.1 Sampling for process control inspection:

4.5.1.1 Conductor material: From each week'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 Conductor splices: The manufacturer's method of splicing individual strands and entire members shall be observed at the discretion of the Government representative.

4.5.1.3 Braid yarns: When a glass braid or polyamide braid is specified in the wire construction, three representative thirty-foot lengths of each type of component yarn before braiding shall be selected from each lot of wire.

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 impulse dielectric 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 VII in addition to the quality conformance requirements and process control requirements of Table V and Table VI.

TABLE VII
TESTS APPLICABLE ONLY TO QUALIFICATION INSPECTION
AND QUALIFICATION RE-EVALUATION

TEST	REQUIREMENT	METHOD
Elongation of insulation after aging (qualification procedure)	Table I	4.7.5.2.2
Corrosive effect of insulation	Table I	4.7.5.3
Blocking	3.6.5	4.7.5.7
Shrinkage	Specification sheet	4.7.5.17
Life cycle	Table III	4.7.5.18
Immersion tests	Table III	4.7.5.19
Humidity resistance	Specification sheet	4.7.5.20
Surface resistance	Specification sheet	4.7.5.21
Smoke test	Specification sheet	4.7.5.22

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 of wire shall be examined carefully to determine conformance to this specification with regard to requirements not covered by specific test methods.

4.7.2 Conductor material: Tin coated soft annealed copper conductor strands selected before stranding, in accordance with 4.5.1.1, shall be tested for conformity to ANSI/ASTM B 33-74 by the methods prescribed therein. Silver coated high strength copper alloy conductor strands, similarly selected, shall be tested for coating thickness and continuity of coating in accordance with ANSI/ASTM B 298-74a.

4.7.3 Braid yarns: Samples of the glass braid yarns or polyamide braid yarns selected in accordance with 4.5.1.3 shall be tested for conformity to MIL-Y-1140, or MIL-C-572, as applicable.

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 Tensile strength of insulation or jacket (finished wire): Specimens of the extruded primary insulation, secondary insulation, or jacket, as applicable, shall be removed carefully from the finished wire and tested for tensile strength in accordance with Method 3021 of FED-STD-228. Dumbbell or straight specimens may be used as appears most feasible.

4.7.5.2 Elongation of insulation or jacket (finished wire):

4.7.5.2.1 Initial elongation: Specimens of the extruded primary insulation, secondary insulation, or jacket, as applicable, prepared in accordance with 4.7.5.1 shall be tested by Method 3031 of FED-STD-228.

4.7.5.2.2 Elongation after aging: Specimens of the insulation or jacket shall be prepared in accordance with 4.7.5.2.1 and shall be subjected to accelerated aging in a circulating air atmosphere by Method 4031 of FED-STD-228. The oven shall be adjusted to give a high rate of air circulation and air change in order to avoid a buildup of plasticizer in the oven atmosphere. Duration and temperature of aging shall be as follows:

For qualification - 60 days at 111 to 115°C (232 to 239°F)
For acceptance - 4 days at 133 to 137°C (271.5 to 278.5°F)

After aging, the specimens shall be conditioned and tested in accordance with 4.7.5.2.1, together with the initial specimens. The elongation of the aged specimens shall be expressed as percent of the initial elongation.

4.7.5.3 Corrosive effect (primary and secondary insulation): A 6-inch specimen of wire (for fine gage wires, a longer specimen may be used) shall be stripped mechanically of all material exterior to the polyvinyl chloride insulation, primary or secondary, which is to be tested. (Alternatively, the manufacturer may furnish a wire sample taken before any material has been added exterior to the applicable layer of insulation.) The specimen and a 30-inch length of AWG No. 34 uncoated soft annealed copper wire conforming to ANSI/ASTM B 3-74 shall be cleaned in accordance with the procedure for Group I materials in ASTM D1371-68 and shall subsequently be handled with maximum care, preferably with clean gloves, to avoid even the slightest contamination, including direct contact with the fingers. The AWG No. 34 wire shall be passed to its midpoint through a small loop formed near one end of the insulated specimen and shall then be wrapped helically in an evenly spaced bifilar winding over the specimen. (In lieu of the loop in the speciment, a short length of AWG No. 18 uncoated soft annealed copper wire of ANSI/ASTM B 3-74, cleaned and handled as with the specimen and winding wire, may be twisted tightly around the specimen near one end and formed into a hook to anchor the midpoint of the winding wire.) The ends of the winding shall be welded to leads of AWG No. 18 copper wire of ANSI/ASTM B 3-74 and the specimen shall be placed in a test tube with the leads extending through the cork stopper. The end of the insulated specimen may conveniently be anchored in a hole drilled into the small end of the cork. Approximately 3/4 inch of distilled water shall be placed in the test tube (the specimen shall be above water level) to maintain a high relative humidity and the cork shall be coated with microcrystalline wax to produce a vapor-tight seal. The test assembly shall be placed in a vertical position in an oven at 70 ±2°C (158 ±3.6°F) for a period of 720 hours. The electrical resistance of the winding shall be determined when the test assembly has attained temperature equilibrium, periodically throughout the test period, and at the end of the test. A low voltage and a momentary contact switch should be used in order to avoid heating of the winding wire during the resistance determinations. An increase in resistance exceeding 2 percent over the 720 hour period shall constitute failure of the test. Absence of water in the test tube at the end of the test period shall invalidate the test.

4.7.5.4 Impulse dielectric test:

4.7.5.4.1 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 (4.7.5.4.3), 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.

4.7.5.4.2 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 4.7.5.4.1(a).

4.7.5.4.3 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.

4.7.5.5 Insulation resistance: The uninsulated ends of a wire specimen at least 26 feet in length shall be connected to a positive DC terminal and the specimen shall be immersed to within 6 inches of its ends in a water bath, at 25 ±5°C (77 ±9°F), containing 0.5 to 1.0 percent of an anionic wetting agent. The specimen shall remain immersed for not less than 4 hours, after which a potential of not less than 250 volts nor more than 500 volts shall be applied between the conductor and the water bath which serves as the second electrode. The insulation resistance shall be determined after one minute of electrification at this potential, and shall be expressed as megohms for 1000 feet by the following calculation:

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

4.7.5.6 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:

4.7.5.6.1 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, 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.

4.7.5.6.2 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.

4.7.5.7 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 VIII. 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 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.

4.7.5.8 Wire weight: The weight of each lot of finished wire shall be determined by Procedure I (4.7.5.8.1). 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 (4.7.5.8.2). All reels or spools failing to meet the requirements of the applicable specification sheet, shall be rejected. The sampling plans of 4.4.1 are not applicable in Procedure II.

4.7.5.8.1 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.

4.7.5.8.2 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 converted to pounds per 1000 feet. When wood or other moisture absorbent materials are used for reel or spool construction, weight determinations shall be made under substantially uniform conditions of relative humidity.

4.7.5.9 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.

4.7.5.10 Conductor elongation and tensile strength:

4.7.5.10.1 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.

4.7.5.10.2 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 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.

4.7.5.11 Thermal shock resistance:

4.7.5.11.1 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 and secondary 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.

4.7.5.11.2 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 pre-cooled 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.

4.7.5.12 Concentricity: The concentricity of the primary insulation, the secondary insulation, if present, and the finished wire shall be determined in accordance with 4.7.5.12.1, 4.7.5.12.2, and 4.7.5.12.3, as applicable. All wall thickness measurements shall be made on cross sections of the wire under suitable magnification. For primary insulation or finished wire, a wall thickness shall be the shortest distance, at 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 secondary insulation, a wall thickness shall be the shortest distance, at the point of measurement, between the outer surface and the inner surface of the tubular form comprising the secondary insulation.

4.7.5.12.1 Primary insulation or finished wire (procedure for 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. One hundred times the ratio of the minimum wall thickness to the maximum wall thickness shall define the percent concentricity.

4.7.5.12.2 Primary insulation or finished wire (procedure for 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. One hundred times the ratio of the minimum wall thickness to the average wall thickness shall define the percent concentricity.

4.7.5.12.3 Secondary insulation (all wires): The concentricity of the secondary insulation shall be determined by first locating and recording the minimum wall thickness measured on a cross section of the secondary insulation. The maximum wall thickness of this same cross section of the secondary insulation shall be measured and recorded. One hundred times the ratio of the minimum wall thickness to the maximum wall thickness shall define the percent concentricity.

4.7.5.13 through 4.7.5.13.2 deleted entirely per Amendment 1.

4.7.5.14 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 the temperature specified in the applicable specification sheet. 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 4.7.5.18.3 with the bent portion submerged.

4.7.5.15 Wrap test (extruded jackets only): The specimen of finished wire shall be wrapped four turns around a smooth metal mandrel of the diameter shown in the applicable specification sheet. The ends of the specimens shall be secured in a manner that will leave four complete turns of the specimen exposed. The specimen and mandrel shall be placed for 24 hours in a circulating air oven in accordance with Method 4031 of FED-STD-228 at the temperature specified in the applicable specification sheet, after which specimen and mandrel shall be removed from the oven and cooled to room temperature in a silica gel desiccator or equivalent. After cooling, the specimen shall be straightened immediately upon removal from the desiccator and shall then be inspected for surface cracks. For detection of cracks too small to be otherwise visible, the specimen shall be immersed for 30 ±5 minutes in a 5 percent, by weight, aqueous solution of gentian violet, keeping the cut ends of the specimen above solution level. The specimen shall then be wiped carefully with a damp cloth to remove the dye solution from the jacket surface and shall be examined to determine whether there has been any penetration of the jacket by the dye. Any cracking in the extruded jacket shall constitute failure.

4.7.5.16 Flammability: Resistance to flame shall be determined by Method I or II as specified in the applicable specification sheet.

4.7.5.16.1 Method I:

4.7.5.16.1.1 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. Means shall be provided in the chamber to hold a 10-inch wire specimen taut in a horizontal position 10 to 12 inches above the floor of the chamber in a vertical plane parallel to and about 6 inches in front of the rear wall of the chamber. The test flame shall be 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 fitted with a wing top flame spreader having a 1/16 inch by 2 inch opening and shall be adjusted to provide an all blue flame 2 inches high. A sheet of facial tissue conforming to UU-T-450 shall be suspended taut and horizontal 9-1/2 inches below the wire specimen and at least 1/2 inch from the chamber floor, so that any material dropping from the wire specimen shall fall upon the tissue.

4.7.5.16.1.2 Procedure: A 10 inch specimen of wire shall be placed in the specified horizontal position on the test chamber. With the burner held vertically and the long dimension of the flame spreader parallel to the length of the wire specimen, the 2 inch test flame shall be applied directly under the center section of the specimen so that the top edge of the flame is in contact with the under side of the specimen. The period of test flame application shall be 15 seconds, for wire sizes 10 and smaller, and 30 seconds for wire sizes 8 and larger. The test flame shall be withdrawn immediately at the end of the test period. The distance of flame travel in each direction on the specimen after removal of the burner and the self-extinguishing time (duration of after-flame) in the wire shall be recorded; also, the presence or absence of flame in the underlying facial tissue due to incendiary drip from the specimen. Charred holes or spots in the tissue shall be ignored in the absence of actual flame.

4.7.5.16.2 Method II:

4.7.5.16.2.1 Apparatus: The test chamber shall be as in Method I except that the specimen shall be positioned 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 burner shall be as specified in Method I except that there shall be no wing top flame spreader and the burner shall be adjusted to furnish a 3 inch conical flame with an inner cone approximately 1 inch in length. The temperature of the hottest part of the flame, as measured with an accurate thermocouple pyrometer, shall be not less than 954°C (1750°F). A facial tissue shall be suspended, as in Method I, to receive drip, if any, from the specimen.