MIL-C-7078C
9 August 1971
SUPERSEDING
MIL-C-7078B
17 March 1964
See also 6.3

MILITARY SPECIFICATION

CABLE, ELECTRIC, AEROSPACE VEHICLE, GENERAL SPECIFICATION FOR

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

1. SCOPE

1.1 Scope. This specification covers electric cable for use in aerospace vehicles and other applications for which its performance characteristics are suitable.

1.2 Classification. The cable shall be as described in the applicable military specification sheets and shall be of the following types:

Unshielded-unjacketed: Two or more spirally laid coded wires with no overall jacket or shield.
Jacketed: Two or more spirally laid coded wires with no shield over the spirally laid wires but with an overall jacket.
Shielded: A single wire or two or more spirally laid coded wires with an overall shield but with no jacket over the shield.
Shielded and jacketed: A single wire or two or more spirally laid coded wires with an overall shield and a jacket over the shield.

1.2.1 Part number. Part numbers in this specification are coded as in the following example:

M7078/1	-	22	-	2
specification sheet number		size number of basic wires		quantity of conductors (basic wires) in cable

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

QQ-W-423	Wire, Steel, Corrosion-Resisting
TT-I-735	Isopropyl Alcohol
UU-T-450	Tissue, Facial

Military

MIL-I-631	Insulation, Electrical, Synthetic-Resin Composition, Nonrigid
MIL-W-5086	Wire, Electric, Hookup and Interconnecting, Polyvinyl-Chloride Insulated, Copper or Copper Alloy Conductor
MIL-H-5606	Hydraulic Fluid, Petroleum Base; Aircraft, Missile and Ordnance
MIL-T-5624	Turbine Fuel, Aviation, Grades JP-4 and JP-5
MIL-W-7072	Wire, Electric, 600-Volt, Aluminum, Aircraft, General Specification for
MIL-W-8777	Wire, Electrical, Silicone-Insulated, Copper, 600-Volt, 200° C
MIL-C-12000	Cable, Cord, and Wire, Electric; Packaging of
MIL-M-20693	Molding Plastic, Polyamide (Nylon), Rigid
MIL-W-22759	Wire, Electric, Fluorocarbon-Insulated, Copper and Copper Alloy
MIL-L-23699	Lubricating Oil, Aircraft Turbine Engine, Synthetic Base
MIL-W-25038	Wire, Electrical, High Temperature and Fire Resistant, Aircraft

SPECIFICATIONS

Military (Continued)

MIL-W-81044	Wire, Electric, Crosslinked, Polyalkene Insulated, Copper
MIL-W-81381	Wire, Electric, Polyimide-Insulated, Copper and Copper Alloy

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

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

B 33-63	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
B 298-70a	Standard Specification for Silver-Coated Soft or Annealed Copper Wire
B 355-69	Standard Specification for Nickel-Coated Soft or Annealed Copper Wire

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

3. REQUIREMENTS

3.1 Specification sheets. The requirements for the cable covered by 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 requirements for cable are classified herein as follows:

Requirement	Paragraph
Materials	3.3
Design and construction	3.4
Finished cable	3.5
Identification of product	3.6

3.3 Materials.

3.3.1 Basic wire. All basic wire used in any cable construction shall be in accordance with the wire specification referenced by the applicable military specification sheet for that cable, except for the addition of coding to provide circuit

identification (3.4.2.1) for the individual wires of multiconductor cables and identification of product (3.6) for the finished cable. Prior to fabrication into cable, the basic wire shall be tested to determine its conformance to the requirements of the basic wire specification.

3.3.2 Shield strand material.

3.3.2.1 Copper shield strand material. All copper strands used in shields shall be coated strands of soft or annealed copper and shall conform to ASTM standards B 33-63, B 298-70a, or B 355-69, as applicable, before braiding. Coated copper 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 for the applicable coatings:

3.3.2.1.1 Tin-coated copper strands. No additional requirements.

3.3.2.1.2 Silver-coated copper strands. Strands shall have a coating thickness of not less than 40 micro-inches of silver when tested in accordance with ASTM B 298-70a.

3.3.2.1.3 Nickel-coated (nickel-plated) copper strands. Strands shall have a coating thickness of not less than 50 micro-inches of nickel when tested in accordance with ASTM B 355-69. After subjection to the adhesion of coating test of 4.5.3.1.1, the strands shall pass the continuity of coating test as specified in ASTM B 355-69.

3.3.2.1.4 Nickel-coated (nickel-clad) copper strands. Strands shall be drawn from bars consisting of a central core of copper and an outer shell of nickel so that the drawn strands are clad with nickel having a cross-sectional area that is 27 percent, minimum, of the total cross-sectional area of the drawn strand, when tested in accordance with ASTM B 355-69. Strands that have been coated by a plating process shall not be acceptable where nickel-clad strands are required. Nickel-clad copper strands shall conform to the elongation requirements for Class 27 strands of ASTM B 355-69 when tested in accordance with that standard.

3.3.2.2 Stainless steel shield strand material. All stainless steel strands shall conform to the requirements for Form I, Composition 302, Condition A wire of QQ-W-423. The strands shall be free of kinks, splits, or scraped surfaces.

3.3.3 Jacket and underlying tape materials. All jacket or underlying tape materials used in the construction of cable in accordance with this specification shall be certified virgin material. Virgin material shall be 100 percent new material which has been through only the processes essential to its manufacture and application to the cable, and has been through these essential processes one time only. Any material which has been previously processed in any other manner shall be considered as nonvirgin material and its use shall be cause for rejection of the finished cable.

3.4 Design and construction.

3.4.1 Design. The design of the cable shall conform to the applicable military specification sheet.

3.4.2 Construction.

3.4.2.1 Circuit identification (color code). The basic wire of single conductor cable constructions shall be colored as specified in the specification for the basic wire, without additional coding identification. The individual basic wires of multiconductor cable shall be color coded in accordance with 3.4.2.1.1 with the colors specified in Table I or Table II, as applicable. The colors shall be within the limits specified by MIL-STD-104, Class 1.

* 3.4.2.1.1 Color code application. The color code identification shall be applied to the individual wires in the form of a permanent colored spiral stripe applied to the outer surface of the wire or visible through the outer surface of the wire, except that no stripe shall be required on wires described in Tables I or II as being basic in color. The stripe may be applied by an inking process or incorporated in a textile braid. With either process, the width and length of lay of the stripe shall conform to MIL-STD-681. When the colored spiral stripe is incorporated in a textile braid, it shall be separated by at least two carriers from any other identification marker in the braid or shall be applied in the opposite direction from the other identification marker. The coloring material and method used in the application of color coding shall not affect the performance of the basic wire in any way.

TABLE I

CIRCUIT IDENTIFICATION FOR BASIC WIRES IN ACCORDANCE WITH MIL-W-5086 OR MIL-W-7072

QUANTITY OF WIRES IN CABLE	COLOR IDENTIFICATION FOR RESPECTIVE WIRES
1	Basic 1/
2	Red, blue
3	Red, blue, yellow
4	Red, blue, yellow, green
5	Red, blue, yellow, green, basic 1/
6	Red, blue, yellow, green, basic 1/, black
7	Red, blue, yellow, green, basic 1/, black, brown

1/ "Basic" is the color specified for the finished wire in the applicable basic wire specification.

TABLE II

CIRCUIT IDENTIFICATION COLORS FOR BASIC WIRES IN ACCORDANCE WITH MIL-W-8777, MIL-W-22759, MIL-W-25038, MIL-W-81044, OR MIL-W-81381

QUANTITY OF WIRES IN CABLE	COLOR IDENTIFICATION FOR RESPECTIVE WIRES
1	Basic 1/
2	Basic 1/, blue
3	Basic 1/, blue, orange
4	Basic 1/, blue, orange, green
5	Basic 1/, blue, orange, green, red
6	Basic 1/, blue, orange, green, red, black
7	Basic 1/, blue, orange, green, red, black, yellow

1/ "Basic" is the color specified for the finished wire in the applicable basic wire specification.

3.4.2.2 Cable layup. The required quantity of wires, as determined by the applicable military specification sheet, shall be cabled on a planetary-type twisting machine with left hand lay. The lay of the individual wires shall be not less than 16 nor more than 28 times the diameter of the individual basic wires. Unless otherwise specified in the applicable specification sheet, fillers shall not be used. There shall be no splicing of basic wires.

3.4.2.3 Underlying tapes. When specified in the military specification sheet, underlying tapes shall be applied under the shield or under the overall outer jacket.

3.4.2.3.1 Polyester tape. When polyester tape is specified as an underlying tape, it shall be in accordance with Type G (polyethylene terephalate), Class 1 of MIL-I-631. The tape shall be not less than 0.0005 inch in thickness and shall be spirally applied with not less than one-third lap.

3.4.2.3.2 Polytetrafluoroethylene tape. When polytetrafluoroethylene tape is specified as an underlying tape, it may be a supported or unsupported tape. It shall be not less than 0.001 inch in thickness and shall be spirally applied with not less than one-third lap.

3.4.2.4 Shield. When the military specification sheet specifies that a shield is to be incorporated in a cable construction, a closely woven braid of the type specified shall be applied over the basic wire or spirally laid basic wires.

3.4.2.4.1 Strand size, coated copper shield. Unless otherwise specified in the military specification sheet, the coated copper strands (3.3.2.1) used for the shield braid over a wire or spirally laid wires with an effective diameter (value D of 4.5.4) not exceeding 0.060 inch, shall be strands having a nominal diameter of 0.004 inch (size 38 AWG); the coated copper strands used for the shield braid over a wire or spirally laid wires with an effective diameter exceeding 0.060 inch but not exceeding 0.31 inch shall be strands having a nominal diameter of 0.005 inch (size 36 AWG); and the coated copper strands used for the shield braid over wire or spirally laid wires with an effective diameter exceeding 0.31 inch shall be strands having a nominal diameter of 0.005 inch through 0.0071 inch (size 36 through 33 AWG).

3.4.2.4.2 Strand size, stainless steel shield. Unless otherwise specified in the military specification sheet, the stainless steel strands (3.3.2.2) used for shield braid for all cable diameters shall be sizes 38 through 36 AWG.

* 3.4.2.4.3 Braid angle. The shield braid shall be a push-back type. The angle of the carriers of the braid shall be not less than 10 degrees nor more than 40 degrees except that, when the effective diameter of the wire or spirally laid wires under the shield is greater than 0.31 inch, the shield shall be suitably applied to provide a push-back characteristic.

3.4.2.4.4 Shield coverage. The shield braid shall be applied in such a manner as to provide coverage of not less than 85 percent when determined as specified in 4.5.4.

3.4.2.5 Jacket. When the military specification sheet specifies application of a jacket over spirally laid wires or over a shield, the jacket, whether braided, taped, extruded, or combinations thereof, shall be capable of easy removal from the finished cable without adherence to the underlying shield or spirally laid wires. The color of the jacket, when specified, shall be in accordance with MIL-STD-104, Class 1.

3.4.2.5.1 Extruded clear nylon jacket. Extruded clear nylon jackets shall be limited in application to cables having a major diameter not greater than 0.25 inch prior to application of the jacket. The jackets shall be concentrically applied and shall have a wall thickness in accordance with the applicable military specification sheet when measured as specified in 4.5.5. The nylon shall be in accordance with Type III, Grade E of MIL-M-20693.

3.4.2.5.2 Nylon braid jacket. Braided nylon jackets shall be limited in application to cable having a major diameter greater than 0.25 inch prior to application of the jacket. The jacket shall be constructed with nylon fibers woven in such a manner as to provide complete coverage and shall be coated with a clear nylon finisher. The color of the jacket shall be white.

3.4.2.5.3 Polyester braid jacket. Braided polyester jackets shall be constructed of polyethylene terephthalate fibers woven in such a manner as to provide complete coverage and shall be coated with a high temperature finisher. The color of the jacket shall be white.

3.4.2.5.4 Extruded or tape polytetrafluoroethylene jackets. Polytetrafluoroethylene jackets shall be concentrically extruded or of tape construction, as specified in the applicable military specification sheet. If polytetrafluoroethylene tapes are used, they shall be unsupported tapes, applied with a minimum of two-thirds lap and subsequently sintered to form a homogeneous wall. The thickness of polytetrafluoroethylene jackets shall be as prescribed in the specification sheet when measured as specified in 4.5.5. The color of the jacket shall be white.

3.4.2.5.5 Extruded polyvinyl chloride jacket. Extruded polyvinyl chloride jackets shall be concentrically applied and shall have a wall thickness in accordance with the applicable military specification sheet when measured as specified in 4.5.5. The color of the jacket shall be white.

3.4.2.5.6 Extruded fluorinated ethylene propylene jacket. Jackets shall be concentrically extruded with wall thickness in accordance with the military specification sheet when measured in accordance with 4.5.5. Jackets shall be clear or white as prescribed in the military specification sheet.

3.4.2.5.7 Glass braid jacket, polytetrafluoroethylene coated. Jackets shall be constructed of treated white glass yarns containing not less than 15 percent by weight of polytetrafluoroethylene, woven in a manner to provide complete coverage and coated with polytetrafluoroethylene finisher. The color of the finished jacket shall be white.

3.4.2.5.8 Extruded polyvinylidene fluoride jacket. Jackets shall be made of polyvinylidene fluoride concentrically extruded with wall thickness in accordance with the applicable military specification sheet when measured in accordance with 4.5.5. The polyvinylidene fluoride shall be crosslinked polyvinylidene fluoride when so specified in the military specification sheet and may be crosslinked or not crosslinked, at the cable supplier's option, when crosslinking is not specified in the specification sheet. The color of the jacket shall be white.

3.4.2.5.9 Fluorinated ethylene propylene-polyimide tape jackets. Jackets shall be made of natural color polyimide tape laminated to fluorinated ethylene propylene film. Jackets shall be spirally wrapped and heat sealed. The tape construction, method of application, and jacket wall thickness shall be in accordance with the military specification sheet. The surface of the jacket shall be coated with fluorinated ethylene propylene resin, polyimide resin, or fused polytetrafluoroethylene tape when required by the specification.

* 3.4.2.5.10 Extruded crosslinked alkane-imide polymer. Jackets shall be concentrically extruded crosslinked alkane-imide polymer with a wall thickness in accordance with the applicable military specification sheet when measured in accordance with 4.5.5.

3.5 Finished cable.

* 3.5.1 Cable diameter (major). The major diameter of the finished cable as determined in 4.5.6 shall conform to the requirements of the military specification sheet.

3.5.2 Cable weight. Weight per 1,000 feet of the finished cable as determined in 4.5.7 shall conform to the requirements of the military specification sheet.

* 3.5.3 Jacket tensile strength and elongation. When specified in the military specification sheet, the jacket of the cable shall be subjected to the tensile strength and elongation tests of 4.5.8, and shall meet the minimum requirements prescribed for these characteristics in the specification sheet.

3.5.4 Cold bend (jacketed and shielded-and-jacketed cable only). Jacketed and shielded-and-jacketed cable shall withstand the cold bend test of 4.5.9 without cracking of the jacket. When specified in the military specification sheet, the cable shall then withstand the wet dielectric test of 4.5.9.1 without breakdown. Subsequent to cold bend test or to cold bend followed by dielectric test of the cable, as applicable, the individual basic wires shall be dissected from the cable and shall withstand the dielectric test of 4.5.9.1 at 1,000 volts (rms) without breakdown.

3.5.5 Thermal shock. When specified in the military specification sheet, the finished cable shall withstand the thermal shock test of 4.5.10 or 4.5.10.1, as applicable, without cracking of the jacket or any unraveling or separation of tape jackets either along the length of the specimen or at the ends.

3.5.6 Heat resistance (aging stability). When specified in the military specification sheet, the finished cable shall withstand the heat resistance (aging stability) test of 4.5.11 without cracking of the jacket or any unraveling of tape jackets either along the length of the specimen or at the ends. When specified in the military specification sheet, the cable shall then withstand the wet dielectric test of 4.5.9.1 without breakdown.

* 3.5.7 Immersion tests. When specified in the military specification sheet, the finished cable shall withstand the immersion test of 4.5.12 without cracking of the jacket, and without showing diameter increase greater than the maximum specified in the specification sheet. When specified in the specification sheet, the cable shall then withstand the wet dielectric test of 4.5.9.1 without breakdown.

* 3.5.8 Flammability. When specified in the military specification sheet, the cable shall be subjected to the flammability test of 4.5.13 and shall conform to the flammability requirements of the specification sheet.

* 3.5.9 Blocking (jacketed and shielded-and-jacketed cable only). When a test of blocking resistance is specified in the specification sheet, adjacent turns or layers of the cable shall not stick together when tested as specified in 4.5.14 at the rated temperature of the cable.

3.5.10 Dielectric flaws (spark test) (except shielded-unjacketed cable). One hundred percent of all finished cable, except shielded-unjacketed cable, shall withstand the dielectric flaws test (spark test) of 4.5.15 without breakdown.

3.5.11 Dry dielectric strength. One hundred percent of all finished cable shall withstand the dry dielectric test of 4.5.16 without breakdown.

3.5.12 Conductor continuity. All conductors in one hundred percent of all finished cable shall be tested for conductor continuity in accordance with 4.5.17 without indication of discontinuity.

* 3.5.13 Continuous lengths. The cable shall conform to any requirements for footage per continuous length which may be prescribed in the contract or order (4.6, 6.2).

3.5.14 Workmanship. The cable shall be constructed and finished in accordance with high grade aircraft wire manufacturing practice. There shall be no evidence of inferior workmanship in the finished cable.

* 3.6 Identification of product. Cable of this specification shall be identified by a printed marking (3.6.1) showing the specification sheet part number of the cable and the Federal code number of the manufacturer (Publications H4-1 and H4-2). For unshielded-unjacketed cable, this marking shall be applied to the outer surface or be visible through the outer surface of one basic wire of the cable, with no basic wire product identification on that wire. For shielded cable with no overall jacket, the marking shall be on one basic wire otherwise free of product identification, as specified for unshielded-unjacketed cable, or shall be printed on a continuous tape under the shield. For jacketed or shielded-and-jacketed cable, the marking shall be on the outer surface or visible through the outer surface of the cable or shall be on a continuous tape under the shield or jacket. No markings not required by this specification shall be applied to the basic wires of any cable, except that printed product identification required by the specification for the basic wire shall be permitted, at the option of the cable supplier, on component wires other than the wire, if any, bearing the product identification of the cable.

* 3.6.1 Requirements for printing of product identification. The printed characters of the product identification shall be complete, durable, clearly legible, and compatible in size with the size of the printed surface. The color of the printing shall be black, except that any suitable alternative color shall be used if the marking is to be applied to basic wire of such color that black marking is impractical. The distance between the end of one complete marking and the beginning of the next complete marking shall be not greater than 3 inches if covered by a

shield or jacket and not greater than 12 inches if on the outer surface of the cable. Printing shall be applied with the vertical axis of the characters lengthwise of the cable when the diameter of the surface being imprinted is 0.050 inch or less and may be applied with the vertical axis either lengthwise or crosswise of the cable when the diameter of the imprinted surface exceeds 0.050 inch. When the printing is applied to a continuous tape under the shield or jacket, the tape used for the purpose shall be one-eighth inch in width, white in color in accordance with Class 1 of MIL-STD-104, fungus-resistant, electrically nonconducting, and at least equal in temperature rating to the rated temperature of the cable.

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 cables under this specification shall be divided into the following classifications:

Classifications	Paragraph
Quality conformance inspection	4.3
Process control inspection	4.4
Continuous lengths inspection	4.6
Inspection of preparation for delivery	4.7

4.3 Quality conformance inspection. Quality conformance inspection shall consist of Groups I, II, and III examinations and tests listed in Table III and described under "Test Methods" (4.5). Quality conformance inspection shall be performed on every lot of cable procured under this specification.

4.3.1 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:

4.3.1.1 Lot. The inspection lot shall consist of all cable of a single specification sheet part number subjected to inspection at one time.

TABLE III

QUALITY CONFORMANCE INSPECTION

	EXAMINATION OR TEST	REQUIREMENT	METHOD
	Group I Characteristics		
	Cable design	3.4.1	4.5.1
	Circuit identification	3.4.2.1	4.5.1
	Cable layup	3.4.2.2	4.5.1
	(Direction of lay; length of lay; absence of fillers)	3.4.2.3	4.5.1
	Underlying tapes		
	(Presence when required)	3.4.2.4.3	4.5.4
	Shield braid angle	3.4.2.4.4	4.5.4
	Shield coverage	3.4.2.5 to	4.5.1
	Jacket construction	3.4.2.5.10	
	Jacket wall thickness	Specification sheet	4.5.5
	Cable diameter (major)	3.5.1	4.5.6
	Cable weight	3.5.2	4.5.7
	Workmanship	3.5.14	4.5.1
	Identification of product	3.6, 3.6.1	4.5.1
	Group II Characteristics		
*	Jacket tensile strength and elongation 1/	3.5.3	4.5.8
	Cold bend	3.5.4	4.5.9
	Thermal shock	3.5.5	4.5.10
	Heat resistance	3.5.6	4.5.11
*	Immersion tests 1/	3.5.7	4.5.12
*	Flammability 1/	3.5.8	4.5.13
*	Blocking 1/	3.5.9	4.5.14
	Group III Characteristics		
	Dielectric flaws (spark test)	3.5.10	4.5.15
	Dry dielectric strength	3.5.11	4.5.16
	Conductor continuity	3.5.12	4.5.17

* 1/ When required in the specification sheet

4.3.1.2 Unit of product. The unit of product for determining lot size for sampling shall be one continuous length of cable as offered for inspection.

4.3.1.3 Sample unit (Groups I and II tests). The sample unit shall consist of a single piece of finished cable 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 III shall be 5 feet and the length of the sample unit for Group II tests shall be 20 feet. Not more than one sample unit for each group of tests shall be taken from a single unit of product.

* 4.3.1.4 Inspection levels and Acceptable Quality Levels (Groups I and II tests). For Group I characteristics, the Inspection Level shall be S-3 in accordance with MIL-STD-105 and the Acceptable Quality Level (AQL) shall be 6.5 percent defective. For Group II characteristics, the number of sample units shall be the same as the number of sample units selected for the Group I sample except that it shall not exceed 8 sample units, and the AQL for Group II characteristics shall be 0 defective units in the Group II sample.

4.3.1.5 Sampling and acceptance level for Group III tests. Unless otherwise specified, the sample for Group III tests shall be 100 percent of the finished cable and every length of cable for which a Group III test is required shall be subjected to the specified test procedure. Portions of the cable showing nonconformity in these tests shall be cut out or removed and the remaining lengths shall be tested until no further failures occur in the lot.

4.3.2 Nonconforming inspection lots. Disposition of inspection lots found unacceptable under initial acceptance inspection shall be in accordance with MIL-STD-105.

4.4 Process control inspection. This inspection comprises examinations and tests of such a nature that they cannot be performed on the finished cable as submitted for inspection and therefore must be conducted at the most appropriate stage of the manufacturing operations. The process control examinations and tests shall consist of those listed in Table IV. Process control inspection shall be performed on every lot of cable procured under this specification.

TABLE IV

PROCESS CONTROL INSPECTION

EXAMINATION OR TEST	REQUIREMENT	METHOD
Basic wire, conformity	3.3.1	4.5.2
Shield strand material	3.3.2.1; 3.3.2.2	4.5.3.1; 4.5.3.2
Shield strand coating thickness	3.3.2.1.2; 3.3.2.1.3; 3.3.2.1.4	4.5.3.1
Adhesion of nickel coating (Plated strands only)	3.3.2.1.3	4.5.3.1.1
Shield strand gage	3.4.2.4.1; 3.4.2.4.2	4.5.3.1; 4.5.3.2
Underlying tape material	3.4.2.3.1; 3.4.2.3.2	4.5.1 or applicable specification
Jacket material	3.3.3; 3.4.2.5.1 through 3.4.2.5.10	4.5.1 or applicable specification

4.4.1 Sampling for process control inspection.

4.4.1.1 Shield strand. From each week's production of shield strands or from every 100 pounds of strands, whichever is less, three 10-foot lengths of each type and size of shield strand shall be selected in such a manner as to be representative of the material to be used in the finished cable.

4.4.1.2 Basic wire. Sampling shall be in accordance with the sampling plan of the basic wire specification.

4.4.1.3 Jacket or underlying tape material. When underlying tapes are specified or when tapes or yarn are specified for jackets, three samples of tape or yarn representative of each inspection lot shall be selected before application. When extruded jackets are required, a sample of the extrusion compound suitable for identification shall be selected from each production lot.

4.4.2 Rejection and retest in process control inspection. When a process control sample selected from a production run fails to pass the specified examinations and tests, no item still on hand or later produced shall be accepted until the extent and cause of the failure have been determined. After investigation, the supplier 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.

4.4.2.1 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 there shall be no final acceptance of the finished cable until it is determined that the lot meets all the process control requirements and quality conformance requirements of the specification.

4.5 Test methods.

4.5.1 Examination of product. All samples of cable or component materials 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.

4.5.2 Conformity of basic wire. Conformity of the basic wire to the applicable wire specification or specification sheet shall be determined by the methods specified in those documents.

4.5.3 Shield strands.

4.5.3.1 Coated copper strands. Coated copper strands, prior to use in the shield, shall be tested for conformity to ASTM B 33-63, B 298-70a, or B 355-69, as applicable, including conformity to the specified diameters. Test methods shall be as specified in the applicable ASTM Standard. Thickness of silver coatings and nickel coatings shall also be determined by the methods of ASTM B 298-70a and B 355-69.

4.5.3.1.1 Adhesion of nickel coating (nickel-plated strands only). 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 ±2° C (482 ±3.6° F), followed by 4 hours, minimum, 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 B 355-69.

4.5.3.2 Stainless steel strands. Stainless steel strands shall be tested for conformity to QQ-W-423 by the methods specified therein. Gage shall be determined with a micrometer caliper with vernier graduated to 0.0001 inch.

4.5.4 Shield braid angle and shield coverage. The shield braid angle and the percent coverage of the braid shall be determined by the following formulae:

$$\text{Tan } a = 2\pi (D + 2d)\, P/C$$

$$K = 100\,(2F - F^2)$$

where:
- a = Shield braid angle (angle of braid with axis of cable)
- K = percent coverage
- d = shield strand diameter in inches
- C = number of carriers
- D = diameter of cable under braid, in inches
- F = NPd/Sin a
- N = number of strands per carrier
- P = picks per inch of cable length

Note: For 2-conductor cable only

$$D = \frac{(\pi + 2)\, b}{\pi}$$

where: b = diameter of basic wire

4.5.5 Jacket wall thickness. Thickness of the jacket wall shall be measured by Method 1013 of FED-STD-228, using the procedure for average thickness.

* 4.5.6 Cable diameter (major). The greatest linear dimension of a cross-section of the cable shall be determined with a micrometer caliper or a dial micrometer. This dimension shall be considered the major diameter of the cable.

* 4.5.7 Cable weight. The weight of each lot of finished cable shall be determined by Procedure I (4.5.7.1). Lots failing to meet the weight requirement of the applicable specification sheet when tested in accordance with Procedure I shall be subjected to Procedure II (4.5.7.2). All reels or spools failing to meet the weight requirements of the applicable specification sheet by Procedure II shall be rejected. The sampling plans of 4.3.1 are not applicable to Procedure II.

4.5.7.1 Procedure I. The length and weight of a cable specimen at least 5 feet long shall be accurately measured and the resultant measurements shall be converted to pounds per 1,000 feet.

4.5.7.2 Procedure II. The net weight of the finished cable 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 cable. The net weight of cable on each reel or spool shall be divided by the accurately determined length of cable on the reel or spool and the resultant figure converted to pounds per 1,000 feet. When wood or other moisture absorbent materials are used for reel or spool construction, weight determinations shall be made under substantially the same conditions of relative humidity.

* 4.5.8 Jacket tensile strength and elongation. Specimens of the jacket shall be carefully removed from the finished cable and tested for tensile strength and elongation in accordance with FED-STD-228, Methods 3021 and 3031 respectively. Dumbbell or straight specimens may be used as appears the more feasible.

4.5.9 Cold bend. A previously untested specimen of cable shall be suspended from a horizontally positioned mandrel in a cold chamber. The securing of the cable to the mandrel shall be at a point 5 inches from the upper end of the specimen so that the 5-inch end portion will not be included in the subsequent low temperature bend. The other end of the specimen shall be secured to a weight sufficient to keep the cable vertical and tangent to the mandrel during the bending

operation. The size of the mandrel shall be as specified in Table V and provision shall be made for rotating the mandrel by means of a handle or control located outside the chamber. The temperature of the chamber shall be lowered to -55 ±2° C (-68 ±3.6° F) at a rate not to exceed 50° C (90° F) per minute. The specimen and mandrel shall be conditioned at this temperature for 4 hours. At the end of this period and while specimen and mandrel are still in the closed cold chamber at the specified low temperature, the cable shall be wrapped around the mandrel by rotating the mandrel through 180 degrees or until 24 inches of the specimen is wrapped, whichever is lesser. The rate of rotation of the mandrel shall be 1 ±1/2 rpm. The specimen shall then be removed from the cold box without straightening and examined visually without magnification, for cracks in the jacket. When required in the specification sheet, the specimen shall then be subjected to the wet dielectric test of 4.5.9.1. All cable specimens, after subjection to the cold bend test or to the cold bend followed by wet dielectric test, as applicable, shall be dissected and the individual wires shall be subjected to the test of 4.5.9.1, using a test potential of 1,000 volts (rms).

* TABLE V

DIAMETERS OF TEST MANDRELS

COLD BEND (4.5.9) WET DIELECTRIC (4.5.9.1)		THERMAL SHOCK (4.5.10, 4.5.10.1) IMMERSION TESTS (4.5.12)		HEAT RESISTANCE (4.5.11) BLOCKING (4.5.14)	
CABLE DIAMETER 1/ (in.)	MANDREL DIAMETER (in.)	CABLE DIAMETER 1/ (in.)	MANDREL DIAMETER (in.)	CABLE DIAMETER 1/ (in.)	MANDREL DIAMETER (in.)
0 to 0.125	3.0	0 to 0.083	0.75	0 to 0.083	0.25
		0.084 to 0.111	1.00	0.084 to 0.167	0.50
		0.112 to 0.139	1.25		
0.126 to 0.250	6.0	0.140 to 0.194	1.75	0.168 to 0.250	0.75
		0.195 to 0.250	2.25		
0.251 to 0.360	10.0	0.251 to 0.334	3.0	0.251 to 0.333	1.00
		0.335 to 0.444	4.0	0.334 to 0.417	1.25
0.361 to 0.750	18.0	0.445 to 0.556	5.0	0.418 to 0.583	1.75
		0.557 to 0.667	6.0	0.584 to 0.750	2.25

TABLE V (Continued)

COLD BEND (4.5.9) WET DIELECTRIC (4.5.9.1)		THERMAL SHOCK (4.5.10, 4.5.10.1) IMMERSION TESTS (4.5.12)		HEAT RESISTANCE (4.5.11) BLOCKING (4.5.14)	
CABLE DIAMETER 1/ (in.)	MANDREL DIAMETER (in.)	CABLE DIAMETER 1/ (in.)	MANDREL DIAMETER (in.)	CABLE DIAMETER 1/ (in.)	MANDREL DIAMETER (in.)
0.751 to 1.200	30.0	0.668 to 0.889	8.0		
		0.890 to 1.111	10.0	0.751 to 1.000	3.0
1.201 to 2.00	48.0	1.112 to 1.556	14.0	1.001 to 1.333	4.0
		1.557 to 2.00	18.0	1.334 to 2.000	6.0

1/ Specified major diameter (max.).

4.5.9.1 Wet dielectric (supplementary test). The cable specimen for this test shall be selected so that the portion of the cable which has been bent, wound over a mandrel, or otherwise subjected to a preceding test will be in the immersed part of the specimen for the dielectric test. The outer jacket shall be removed from both ends of the specimen for a distance of 1-3/4 inches without damaging the insulation of the basic wires. The insulation shall then be removed from both ends of each basic wire for a distance of 1 inch, leaving 3/4 inch of insulation on each basic wire exposed beyond the jacket of the cable. The shield, if present, and the conductors of the basic wires shall be connected at both ends of the specimen by means of a copper wire. The specimen shall be bent in the shape of a "U", with the diameter of the bend not less than the applicable mandrel diameter specified in Table V. Each specimen shall be so immersed in a 5 percent sodium chloride solution at a temperature of 20 to 25° C (68 to 77° F) that the jacket of the cable specimen protrudes 3 inches from the surface of the solution. After submersion for 1 hour, the potential specified in the applicable specification sheet shall be applied between the conductors connected with the shield and an electrode in contact with the sodium chloride solution. The potential shall be increased at a uniform rate from zero to the specified potential in one-half minute, maintained at that voltage for a period of one minute, and reduced to zero at a uniform rate in one-half minute.

4.5.10 Thermal shock (except extruded nylon jackets). A specimen of the finished cable shall be wrapped around a mandrel for six close turns with the ends of the specimens secured to the mandrel. The mandrel diameter shall be as specified in Table V. The specimen on the mandrel shall be subjected for a period of 4 hours to the temperature specified in the specification sheet. If no test temperature is specified for this test in the

specification sheet, the temperature shall be as prescribed in Table VI. At the end of the 4-hour period, the specimen shall be examined visually, without magnification, for cracks and for unraveling or separation of tape jackets.

4.5.10.1 Thermal shock (extruded nylon jackets only). The specimen shall be tested as specified in 4.5.10 except that subjection to high temperature shall be for 15 minutes only, instead of 4 hours. At the end of the 15-minute period, the specimen shall be removed from the oven without uncoiling, cooled to room temperature, straightened, and examined visually, without magnification, for cracks.

TABLE VI

TEMPERATURES FOR THERMAL SHOCK AND HEAT RESISTANCE TESTS

JACKET MATERIAL	THERMAL SHOCK TEMPERATURE (Deg. C) (±2° C)	HEAT RESISTANCE TEMPERATURE (Deg. C) (±2° C)
Nylon	150	130
Polytetrafluoroethylene	300	275
Polyvinyl chloride	135	120
Fluorinated ethylene propylene	250	250
Polyvinylidene fluoride (crosslinking not specified)	150	150
Polyvinylidene fluoride (crosslinking specified)	200	200
Fluorinated ethylene propylene/ polyimide	230	230
* Alkane-imide	180	180

4.5.11 Heat resistance (aging stability). The specimen shall be exposed for 96 hours in an air-circulating oven at the temperature specified in the military specification sheet. If no test temperature is specified in the specification sheet, the temperature shall be as prescribed in Table VI. After the 96-hour period, the specimen shall be removed from the air oven, shall be allowed to cool at room temperature for 30 minutes, and shall then be wrapped for 5 close turns around a mandrel of diameter in accordance with Table V. The specimen shall be removed from the mandrel as a helical coil and shall be examined visually, without the aid of magnification, for cracks in the jacket. With laminated jackets, separation of layers along the length of the jacket or at the ends, either upon removal from the oven or after cooling and straightening, shall also be noted. When required in the specification sheet, the specimen shall then be subjected to the wet dielectric test of 4.5.9.1.

* 4.5.12 Immersion tests. Cable specimens, each 24 inches in length, 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 50 ±2° C (122 ±3.6° F) for fluids (a) and (b) and 20 ±2° C (68 ±3.6° F) for fluids (c) and (d):

(a) Lubricating oil, aircraft turbine engine, 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, the radius of bend of the specimens shall be not less than the applicable mandrel diameter specified in Table V. Upon removal, the specimens shall remain for 1 hour in free air at room temperature. The specimens shall be straightened and examined for cracking of the jackets, and the diameter shall be gaged for comparison with the original diameter. When required in the specification sheet, the specimens shall then be subjected to the wet dielectric test of 4.5.9.1.

* 4.5.13 Flammability.

4.5.13.1 Apparatus. The flammability test chamber shall be approximately one foot square by two feet in height and shall be open at top and front to provide adequate air access for combustion but prevent drafts. Means shall be provided in the chamber to hold the test specimens taut at an angle of 60 degrees from horizontal in a vertical plane parallel to and 6 inches in front of the rear wall of the chamber. The test burner shall be a Bunsen type gas burner having a 1/4 inch inlet, a needle valve in the base for gas adjustment, a bore of 3/8 inch nominal, and a length of approximately 4 inches above the air inlets. A sheet of facial tissue conforming to UU-T-450 shall be suspended taut and horizontal 9-1/2 inches below the the cable 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.

4.5.13.2 Procedure: The cable specimen, marked at a distance of 8 inches from the lower end to indicate the point of contact for the test flame, shall be clamped tautly at 60 degrees from horizontal in the specimen holder of the test chamber. The burner shall be adjusted to produce a 3-inch high flame with an inner cone approximately one-third of the flame height. The temperature of the hottest portion of the flame, as measured with a thermocouple pyrometer, shall be 955 ±30° C (1751 ±54° F). With the burner positioned perpendicular to the length of the specimen and at an angle of 30 degrees from the vertical plane of the specimen, the hottest portion of the test flame shall be applied for a period of 30 seconds to the test mark on the cable.

The distance of flame travel upward along the wire from the test mark and the duration of flaming (after-flame) in the cable after withdrawal of the gas flame shall be recorded, also any flame in the tissue paper due to incendiary particles or drip from the specimen. Charred holes or charred spots in the tissue shall not constitute failure.

* 4.5.14 Blocking. One end of a sufficent length of finished cable shall be affixed to a mandrel of diameter conforming to Table V. The cable shall then be wound helically on the mandrel for at least three turns, with the succeeding turns in close contact with one another. The winding shall be continued until there are at least three closely-wound layers of such helical turns on the mandrel. The free end of the cable shall then be affixed to the mandrel to prevent unwinding or loosening of the turns or layers and the mandrel and cable shall be placed for 24 hours in an oven at the rated temperature of the cable as specified on the specification sheet. At the end of the 24-hour period, the mandrel and cable shall be removed from the oven and allowed to cool to room temperature. After cooling, the cable shall be unwound manually, meanwhile being examined for evidence of adhesion (blocking) of adjacent turns or layers.

4.5.15 Dielectric flaws (spark test). One hundred percent of all finished cable, except shielded-unjacketed cable, shall be passed through a suitable spark test device that will give intimate metallic contact with practically all of the cable outer surface and impress the potential specified in the specification sheet between the electrode of the spark test device and the cable shield. If there is no shield in the cable, the potential shall be applied between the electrode of the spark test device and the cable conductors electrically connected together. The length of the electrode and the speed of cable through the electrode shall be such that the cable surface will be subjected to the test potential for a minimum of 0.2 second. Any portion of the cable showing breakdown of the jacket or of the wire insulation as a result of this test shall be cut out of the finished cable.

4.5.16 Dry dielectric strength. One hundred percent of all finished cable in shipment reels, spools, or coils shall be subjected to the potential specified in the specification sheet applied in turn between each conductor of the cable and all other conductors of the cable electrically connected together. When the cable contains a shield, the shield shall be treated as a conductor for purposes of this test. In making the test, the potential shall be increased at a uniform rate from zero to the specified potential in one-half minute, maintained at the specified potential for a period of one minute, and reduced to zero at a uniform rate in one-half minute. Any portions of cable showing breakdown in this test shall be cut out and the remaining lengths shall be retested until no breakdown occurs.

4.5.17 Conductor continuity. Each basic wire in 100 percent of all finished cable in shipment reels, spools, or coils shall be tested for continuity of conductor with an ohm-meter or other suitable testing device. Portions showing discontinuity in any conductor shall be removed from the lot.

* 4.6 Continuous lengths inspection. Unless otherwise specified in the ordering data, the requirements for footage per continuous length of cable (3.5.13) may be satisfied by the supplier's certificate of conformity to any length specifications prescribed in the contract or order. The Government reserves the right, however, to confirm such certification by actual inspection at any appropriate point of lot preparation or delivery, if deemed necessary to assure that the length requirements are actually being met.

4.7 Inspection of preparation for delivery. Packaging, packing, and marking shall be examined to determine conformity to Section 5.

5. PREPARATION FOR DELIVERY

5.1 Preservation, packaging, and packing. Cable shall be preserved, packaged, and packed in accordance with MIL-C-12000. The levels of preservation, packaging, and packing shall be as specified in the ordering data (6.2).

5.2 Marking of shipments. In addition to any special marking required by the contract or order, interior packages and exterior shipping containers shall be marked in accordance with MIL-C-12000 and MIL-STD-129.

6. NOTES

6.1 Intended use. The electric cables covered by this specification are suitable for installation in the electrical systems of aerospace vehicles within the limitations of applicable performance requirements. They may also be used in any other applications where their performance characteristics are required.

6.2 Ordering data. Procurement documents should specify the following:

(a) Title, number, and date of this specification and of the applicable military specification sheet (1.2, 3.1).

(b) Specification sheet part number of cable.

(c) Quantity of cable required.

(d) Continuous length requirements, if applicable (3.5.13, 4.6).

(e) Applicable levels of preservation, packaging, and packing. Special requirements, if applicable, for preservation, packaging, packing, and marking (Section 5).

* 6.3 Supersession data. This specification includes, in part, the requirements of specification MIL-C-27500 (USAF). The cables covered in the fully coordinated specification sheets of this specification meet the requirements of the corresponding constructions of MIL-C-27500(USAF) and in addition are subject to certain standardization requirements (weight, finished diameter) not included in MIL-C-27500 (USAF).

6.4 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 whatever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document on the basis of the entire content as written, irrespective of the marginal notations and relationships to the last previous issue.

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