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MILITARY SPECIFICATION

CABLE, ELECTRICAL SHIELDED AND UNSHIELDED, AEROSPACE

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

1. SCOPE

1.1 Scope. This specification covers the requirements for aerospace electrical cable (see 6.1).

1.2 Classification. The cable shall be of the following types and shall be furnished in the basic wire size and basic wire type, number of wires, and shield and jacket styles, as specified.

Unjacketed - 2 to 7 color-coded wires, spirally laid without an overall outer jacket

Jacketed - 2 to 7 color-coded wires, spirally laid with an overall outer jacket

Shielded - A single wire, or 2 to 7 color-coded wires spirally laid, with one or two overall shields

Shielded and Jacketed - A single wire, or 2 to 7 color-coded wires spirally laid with one or two shields and jacket.

1.2.1 Cable designation. Cable shall be identified by a combination of digits and letters (not to exceed 15), in accordance with the following (see 3.4.1).

M27500	-22	AA	3	T	10
Specification number	Conductor size	Basic wire specification	Number of wires in cable	Shield style and material	Jacket material
1.2.1.1	1.2.1.2	1.2.1.3	1.2.1.4	1.2.1.5	1.2.1.6

Example: M27500-22AA3T10

1.2.1.1 Cable specification number. The finished cable shall be identified by the number of this specification.

1.2.1.2 Conductor size. The basic wire size shall be identified. All wires used in the cable shall be of the same size.

1.2.1.3 Basic wire specification. A letter symbol shall be used to designate the specification, type, and class in accordance with table I.

1.2.1.4 Number of wires per cable. The number of wires per cable shall be as designated and shall be 1 to 7 for shielded or shielded and jacketed cables and 2 to 7 for unshielded unjacketed or unshielded jacketed cables.

Beneficial comments (recommendations, additions, deletions,) and any pertinent data which may be of use in improving this document should be addressed to: Gentile Air Force Station (AFALD-PTS), 1507 Wilmington Pike, Dayton, Ohio 45444 by using the self addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

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1.2.1.5 Shield style and material. The shield style and material of the overall shields shall be designated by a single letter as follows:

Symbol single shield style	Symbol double shield style	Shield material	Maximum temperature limit for shield material (information only)
U	-	No shield	-----
T	V	Tin-coated copper, round	150°C (302°F)
S	W	Silver-coated copper, round	200°C (392°F)
N	Y	Nickel-coated copper, round	260°C (500°F)
F	Z	Stainless steel, round	400°C (752°F)
C	R	Nickel-clad copper, round	400°C (752°F)
M	K	Silver-coated high strength copper alloy, round	200°C (392°F)
P	L	Nickel-coated high strength copper alloy, round	260°C (500°F)
G	A	Silver-coated copper, flat	200°C (392°F)
H	B	Silver-coated high strength copper alloy, flat	200°C (392°F)
J	D	Tin-coated copper, flat	150°C (302°F)
E	X	Nickel-coated high strength copper alloy, flat	260°C (500°F)
I	Q	Nickel-chromium alloy, flat	400°C (752°F)

1.2.1.6 Maximum temperature for jacket material. The single jacket symbol shall be used for cables with an outer jacket only. The double jacket symbol shall be used in conjunction with a double shield symbol to describe constructions with a jacket in between two shields with another jacket over the outer shield. The single jacket symbol shall be used in conjunction with the double shield symbol to describe constructions with two overlaid shields with a single outer jacket as follows:

Single jacket symbol	Double Jacket symbol	Jacket material	Temperature limit for jacket material (information only)
00	00	No Jacket	----
01	51 1/	Extruded white polyvinyl chloride	90°C (194°F)
02	52	Extruded clear nylon in accordance with type III, grade E, MIL-M-20693	105°C (221°F)
03	53	White nylon braid impregnated with clear nylon finisher over a polyester tape	105°C (221°F)
04	54	Polyester braid impregnated with high temperature finishers over polyester tape	150°C (302°F)

1/ Polyvinyl chloride materials shall not be used for aerospace applications.

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Single jacket symbol	Double Jacket symbol	Jacket material	Temperature limit for jacket material (information only)
05	55	Extruded clear fluorinated ethylene propylene	200°C (392°F)
06	56	Extruded or taped and fused white polytetrafluoroethylene	260°C (500°F)
07	57	White polytetrafluoroethylene treated glass braid impregnated and coated with polytetrafluoroethylene finisher	260°C (500°F)
08	58	Cross linked white extruded polyvinylidene fluoride	150°C (302°F)
09	59	Extruded white fluorinated ethylene propylene	200°C (392°F)
10	60	Extruded clear polyvinylidene fluoride	125°C (257°F)
11	61	Tape of natural polyimide combined with clear fluorinated ethylene propylene (EEP) wrapped and heat sealed with FEP outer surface	200°C (392°F)
12	62	Tape of natural polyimide combined with fluorinated ethylene propylene (FEP) wrapped and heat sealed with polyimide outer surface	200°C (392°F)
14	64	Extruded white ethylene-tetrafluoro-ethylene copolymer (ETFE)	150°C (302°F)
15	65	Extruded clear ethylene-tetrafluoro-ethylene (ETFE) copolymer	150°C (302°F)
16	66	Braid of aromatic polyamide with high temperature finisher over presintered polytetrafluoroethylene tape	200°C (392°F)
17	67	White extruded ethylene chloro-trifluoroethylene (ECTFE)	150°C (302°F)
18	68	Clear extruded ethylene chlorotrifluoroethylene (ECTFE)	150°C (302°F)
20	70	Extruded white perfluoroalkoxy (PFA)	260°C (500°F)
21	71	Extruded clear perfluoroalkoxy (PFA)	260°C (500°F)
22	72	Tape of natural polyimide combined with clear fluorinated ethylene propylene (FEP)-wrapped and heat sealed with dip coated modified aromatic polyimide outer surface	200°C (392°F)
23	73	Crosslinked, extruded, modified, ethylene, tetrafluoroethylene copolymer (XLETFE)	200°C (392°F)

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2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications, standards, and handbooks. Unless otherwise specified, the following specifications, standards, and handbooks of the issue listed in that issue of the Department of Defense Index of Specifications and Standards (DoDISS) specified in the solicitation, form a part of this specification to the extent specified herein.

SPECIFICATIONS

FEDERAL

QQ-W-423	-	Wire, Steel, Corrosion-Resisting.

MILITARY

MIL-W-5086	-	Wire, Electric, Polyvinyl Chloride Insulated, Copper Or Copper Alloy.
MIL-W-8777	-	Wire, Electrical, Silicone-Insulated, Copper, 600-Volt, 200°C.
MIL-C-12000	-	Cable, Cord, and Wire, Electric; Packaging Of.
MIL-W-22759	-	Wire, Electric, Fluoropolymer-insulated, Copper Or Copper Alloy.
MIL-W-25038	-	Wire, Electrical, High Temperature And Fire Resistant, General Specification For.
MIL-W-81044	-	Wire, Electric, Crosslinked Polyalkene, Crosslinked, Alkaneimide Polymer, or Polyarylene Insulated, Copper Or Copper Alloy.
MIL-W-81381	-	Wire, Electric, Polyimide-insulated, Copper Or 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-681	-	Identification Coding And Application Of Hookup and Lead Wire.
MIL-STD-686	-	Cable And Cord, Electrical; Identification Marking And Color Coding Of.

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

2.1.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this specification to the extent specified herein.

NATIONAL BUREAU OF STANDARDS

H4-1 - Federal Supply Code for Manufacturers, United States and Canada, Name to Code
H4-2 - Federal Supply Code for Manufacturers, United States and Canada, Code to Name

NBS HDBK 100 - International Annealed Copper Standard (IACS)

(Applications for copies should be addressed to Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402).

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2.2 Other publications. The following documents form a part of this specification to the extent specified herein. The issues of the documents which are indicated as DoD adopted shall be the issue listed in the current DoDISS and the supplement thereto, if applicable.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ANSI/ASTM B3	Soft or Annealed Copper Wire
ANSI/ASTM B33	Standard Specification for Tinned Soft or Annealed Copper Wire for Electrical Purposes
ASTM B170	Oxygen free Electrolyte Copper Refinery Shapes
ASTM B272	Copper Flat Copper Products with Finished (Rolled or Drawn) Edges (Flat Wire and Strip)
ANSI/ASTM B298	Silver-Coated Soft or Annealed Copper Wire
ANSI/ASTM B355	Nickel-coated Soft or Annealed Copper Wire
ASTM B624	High-strength, High-conductivity Copper Alloy Wire for Electronic Application Standard Specification for
ASTM D3032	Hookup Wire Insulation, Standard Methods of Testing
ASTM D4066	Nylon Injection and Extrusion Materials (PA)

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

(Industry association specifications and standards are generally available for reference from libraries. They are also distributed among technical groups and using Federal agencies.)

2.3 Order of precedence. In the event of a conflict between the text of this specification and the references cited herein, the text of this specification shall take precedence.

3. REQUIREMENTS

3.1 Materials.

3.1.1 Copper shield round strand material. Before shielding, the copper strands used in shields shall be annealed or soft-drawn copper wire from commercially pure copper and shall conform to ASTM B3. Nickel-plated strands shall conform to ASTM B3 or ASTM B170. It shall be possible to solder or crimp the material to approved terminals. Wire shall be free from lumps, kinks, splints, abrasions, scraped or corroded surfaces and skin impurities.

3.1.2 Strainless steel shield material. Before shielding, the stainless steel strands shall conform to QQ-W-423, form I. (or form II as applicable) composition 302, condition A. It shall be possible to crimp the wire to approved terminals. The wire shall be free from kinks, abrasions, or scraped surfaces.

3.1.3 High-strength copper alloy shield round strands. Before shielding, the high strength copper allow strands shall conform to ASTM B624 except that the minimum tensile strength shall be 55,000 lbf/in^2, the minimum elongation shall be 6 percent, and the conductivity shall be 80 percent (minimum) as stated in NBS Handbook 100.

3.2 Construction. Construction shall comply with the breakdown given in 1.2. Combinations of shield style and material, basic wire specification and jacket materials shall be restricted to those allowed in table II unless otherwise approved by the preparing activity of this document.

3.2.1 Basic wire. Wire used in the construction of the cable shall be qualified to the basic wire specification (see table I) before cabling. The producer of the finished cable shall be a qualified source under the applicable basic wire specification, or shall provide evidence that qualified wire from a qualified source was used in the construction of the cable. Color added to the insulation (as helical stripe or circumferential band) for the purpose of wire number identification shall not degrade the wire insulation as evidenced by failure to meet the requirements herein. Unless otherwise specified (see 6.2), the manufacturer of the cable is responsible for assuring that the basic wire meets the wire specification requirements prior to being fabricated into cable.

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3.2.1.1 Identification of cable wire. The insulation of single or multiconductor wire shall be colored to provide a method of determining the wire number. Unless otherwise specified (see 6.2), the preferred identification method (see 3.2.1.1.1) shall be used.

3.2.1.1.1 Preferred identification method. The insulation of wire used in the cable shall be white (or basic color) with one colored spiral stripe in accordance with tables IIIA ro IIIB, as applicable. The color stripe may be applied by an inking process or be incorporated in the textile braid when the braid is employed in the basic wire. When the inking process is used, the stripe shall be in accordance with MIL-STD-681 except stripe color and sequence shall be as specified herein. When the braid is used, colored fibers shall be used for two parallel and adjacent carriers of the braid. The color identification fibers shall be woven in the opposite direction of any identification marker. Except for the colored fibers and any identification marker, all carriers shall be white.

3.2.1.1.2 Optional identification, method 1. The insulation shall be solid color in accordance with either IIIA or IIIB, as applicable. Solid coloring shall be done by the manufacturer of the wire and the coloring shall meet the requirements of the basic wire specification.

3.2.1.1.3 Optional identification, method 2. The insulation on each wire in the cable shall be the same solid color. The color shall denote wire size in accordance with table IIIC. In order to identify each wire in the cable, color bands shall be applied in accordance with table IIID. Color of the bands shall be a contrasting color to the base color of the insulation. The bands shall be 0.030 inch to 0.120 inch wide and spaced 0.030 inch to 0.120 inch apart in a group. Group separation shall be 0.38 to 1.50 inch. The distance between the beginning of one group and the end of the next group shall be three inches maximum.

3.2.2 Cable layup. The required number of wires for mulitconductor construction determined by the cable designation shall be cabled with a left-hand lay. The lay of the individual wires shall be not less than eight nor more than 16 times the outside diameter of the unshielded, unjacketed cable. Fillers and binder tapes shall be used only when approved by the acquiring activity (see 6.2). The basic wire shall not be spliced.

3.2.3 Shield. When the cable designation specifies that a shield is to be incorporated in the cable construction, either a closely woven braid using round strand or a closely woven braid of flat strand shall be applied over the basic wire or cable.

3.2.3.1 Braided round shields.

3.2.3.1.1 Braided round wire. Before application to the cable, individual tin, silver, or nickel coated copper strands shall have a minimum elongation of six percent.

3.2.3.1.2 Strand size. Braided shields with round copper and copper alloy wires shall conform to shield group B for cables with component wires per MIL-W-81044/8 through /13, MIL-W-22759/16 through /19 and /28 and /29. MIL-W-22759/32 through /43 and all MIL-W-81381 specification sheets. All other braided shields shall conform to shield group A. The dimensions shown under groups A and B are based on the same diameter over the cabled component wires. (For stainless steel braids see 3.2.3.1.4 and for flat shields see 3.2.3.2).

Group A Cable O. D.	Group B Cable O. D.	Shield size
to .060 in.	to .250 in.	38 AWG
.061 - .310 in.	.251 - .400 in.	36 AWG
.311 - .750 in.	.401 to 1000 in.	34 AWG
.751 in. and larger	1.001 in. and larger	32 AWG

3.2.3.1.3 Coating.

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3.2.3.1.3.1 Tin-coated copper strands. When the cable designation specifies a tin-coated shield, the individual strands shall be coated uniformly with a smooth, continuous layer of commercially pure tin. Prior to braiding, the strands shall meet the requirments of ASTM B33. The thickness of the tin coating shall be 250 microinches maximum.

3.2.3.1.3.2 Silver-coated copper and high strength copper alloy strands. When the cable designation specifies a silver-coated high strength copper alloy shield, the individual strands shall be coated uniformly with a smooth continuous layer of commercially pure silver. Prior to braiding, silver-coated copper strands shall meet the requirements of ASTM B298. Silver-coated high strength copper alloy strands shall meet the requirements of 3.1.3 and the adhesion and continuity of coating requirements of ASTM B298. The thickness of the silver shall be not less than 40 microinches.

3.2.3.1.3.3 Nickel-coated copper and high strength alloy strands. When the cable designation specifies a nickel-coated shield, the individual strands shall be coated uniformly with a smooth, continuous layer of commercially pure nickel having a coating thickness of not less than 50 microinches nor greater than 250 microinches. The wire shall meet the coating requirements of ASTM B355 prior to braiding.

3.2.3.1.3.4 Nickel clad copper strands. When the cable designation specifies a nickel clad copper shield, the individual strands shall have a nickel coating having a cross-sectional area that is 27 percent minimum of the total cross-sectional area of the drawn strand. The wire shall meet the coating requirements of ASTM B355 prior to braiding.

3.2.3.1.4 Stainless steel shield.

3.2.3.1.4.1 Stainless steel strand size. On cable with outside diameter (under the shield) of less than 0.060 inch, the strand size shall be AWG 40. On cable with an outside diameter of 0.060 inch to 0.120 inch, the strand size shall be AWG 38. On cable with outside diameter of 0.121 inch and larger, the strand size shall be AWG 36.

3.2.3.2 Braided flattened wire strands. Flat wire shields shall be braided of copper, high-strength copper alloy, or nickel alloy. The flattened wire shall be 0.0015 inch ±0.0004 inch in thickness.

3.2.3.2.1 Copper wire, flattened. Copper flattened wire shall meet the requirements of ASTM B272 except the wire shall be made by flattening round wire.

3.2.3.2.2 Flattened high strength copper alloy flat wire. Flattened high strength copper alloy wire shall be made by flattening round wire. The flattened wire tensile strength shall be not less than 55,000 lbf/in^2 and the elongation shall be six percent minimum.

3.2.3.2.3 Coating of flattened wire strands.

3.2.3.2.3.1 Tin-coated copper flattened wire. Tin coated copper strands before flattening shall conform to ASTM B33. Flattened wire strands shall meet the continuity of coating test of ASTM B33. The thickness of coating shall be 250 microinches maximum.

3.2.3.2.3.2 Silver-coated copper or silver-coated high strength copper alloy flattened wire. Silver-coated copper or silver-coated high-strength copper alloy strands shall conform to ASTM B298 after flattening. The flattened wire strands shall have a minimum coating thickness of 40 microinches and shall meet the continuity of coating requirements of ASTM B298 before flattening.

3.2.3.2.3.3 Nickel-coated copper or nickel-coated high strength copper alloy flattened wire. Nickel-coated copper or nickel-coated high-strength copper alloy strands shall conform to ASTM B355 after flattening. The flattened wire strands shall have a minimum coating thickness of 50 microinches and shall meet the continuity of coating requirements of ASTM B355 after flattening.

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3.2.3.3 Braid angle. The shield braid shall be a push-back type. The angle of the carriers of the braid with the axis of the cable in woven round wire shields shall be not less than 18° nor more than 40°. The angle of flat wire with the axis of the cable in braided flat wire shields shall be not less than 25° nor more than 60°. When the major diameter of the cable beneath the braid is greater than 0.31 inch, the above braid angle restriction shall not apply. In this case, the shield shall be suitably applied to provide good push-back characteristic. For determination of braid angle see 4.5.5.

3.2.3.4 Shield coverage. The shield braid shall be applied in such a manner as to provide coverage of not less than 85 percent for each individual shield (see 4.5.5).

3.2.4 Jacket. When a jacket is applied over a cable or shield, all jackets shall meet the following requirements. The jacket shall be easily removable from the finished cable without adherence to the underlying shield or cable when tested in accordance with 4.5.17. The minimum wall thickness of the jacket shall be as specified in table IV for applicable material. The jacket between double shield and double jacket shall be 75 percent of the values specified in table IV. The jacket of specimens prepared for jacket thickness measurements shall not flare or raise up by more than .016 inch. When a taped jacket is used, the tape ends shall not open more than 0.125 inch when tested in accordance with 4.5.17. Stripping time (for jacketing styles 11, 12, and 22 only) shall be 5 seconds maximum when testing in accordance with 4.5.17.

3.2.4.1 Jacket material.

3.2.4.1.1 Extruded clear nylon. Extruded 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. Extruded nylon jackets shall be applied concentrically and shall have a minimum wall thickness in accordance with table IV. The nylon shall be in accordance with ASTM D4066.

3.2.4.1.2 White nylon braid and nylon finishers. Jackets shall be constructed with white nylon fibers, 210 denier, woven in such manner as to provide complete coverage and shall be impregnated with a clear nylon finisher.

3.2.4.1.3 Polyester fiber braid with high-temperature finishers. Braided polyester fiber jackets shall be constructed with the fibers woven in such a manner as to provide complete coverage and shall be impregnated with a high-temperature finisher. The color of the finished braids shall be white or tan. After subjection to the heat aging test, the finisher shall show no indications of decomposition.

3.2.4.1.4 Extruded or taped polytetrafluoroethylene. Concentrically extruded or taped polytetrafluoroethylene jackets shall have minimum wall thicknesses in accordance with table IV (see 4.5.11). If polytetrafluoroethylene tapes are used, they shall be unsupported and shall be a minimum of two contrahelically wrapped tapes each applied with a 25 percent minimum overlap. The tapes shall subsequently be sintered to form a homogeneous wall. The polytetrafluoroethylene jackets shall be white.

3.2.4.1.5 Extruded white polyvinyl chloride. Extruded polyvinyl chloride jackets shall be colored white anh shall have minimum wall thicknesses in accordance with table IV (see 4.5.11). The tensile strength and elongation of the jacket shall be 2000 lbf/in^2 minimum and 150 percent minimum, respectively, and shall be tested in accordance with 4.5.11.1.

3.2.4.1.6 Extruded fluorinated ethylene propylene. Jackets shall be constructed of a clear or white fluorinated ethylene propylene as indicated by the style and shall be concentrically extruded with minimum wall thickness in accordance with table IV. The tensile strength and elongation of the jacket shall be 3000 lbf/in^2 minimum and 200 percent minimum, respectively, and shall be tested in accordance with 4.5.11.1.

3.2.4.1.7 Glass braid with polytetrafluoroethylene finishers. Braided polytetrafluoroethylene coated glass fiber jackets shall be constructed with treated glass fiber containing not less than 15 percent by weight of polytetrafluoroethylene and woven in a manner that will provide complete coverage. The braid shall be impregnated and coated with a polytetrafluoroethylene finisher.

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3.2.4.1.8 Extruded crosslinked polyvinylidene fluoride. Jackets of extruded and crosslinked polyvinylidene fluoride shall be in accordance with table IV. The tensile strength and elongation of the jacket shall be 4,000 lbf/in^2 minimum and 200 percent minimum, respectively, when tested in accordance with the methods specified for primary insulation in MIL-W-81044.

3.2.4.1.9 Polyvinylidene fluoride. These jackets shall be extruded of clear polyvinylidene fluoride. The tensile strength and elongation of the jacket shall be 5,000 lbf/in^2 minimum and 225 percent minimum, respectively, and shall be tested in accordance with 4.5.11.1.

3.2.4.1.10 Taped polyimide/fluorinated ethylne propylene. The jackets of polyimide/fluorinated ethylene propylene tapes shall consist of two or more tapes. The first tape shall be a one-side polyimide/FEP coated tape applied with not less than 20 percent overlap and with the polyimide side facing the shield or component wires. Succeeding tapes shall be in alternating directions and with not less than 30 percent overlap. The tapes shall be fused together to provide a jacket with a minimum wall thickness in accordance with table IV.

3.2.4.1.11 Ethylene-tetrafluoroethylene copolymer. These jackets shall be extruded ethylene-tetrafluoroethylene copolymer and shall have a minimum wall thickness as shown in table IV. The tensile strength and elongation of the jacket shall be 5,000 lbf/in^2 minimum and 150 percent minimum, respectively, and shall be tested in accordance with 4.5.11.1.

3.2.4.1.12 Ethylene chlorotrifluoroethylene copolymer. Jackets of ethylene chlorotrifluoroethylene copolymer shall have a minimum wall thickness specified in table IV. The tensile strength and elongation of the jacket shall be 5,000 lbf/in^2 minimum and 150 percent minimum, respectively, and shall be tested in accordance with 4.5.11.1.

3.2.4.1.13 Extruded perfluoroalkoxy. Jackets of extruded perfluoroalkoxy shall have a minimum wall thickness as specified in table IV. The tensile strength and elongation shall be 3000 lbf/in^2 minimum and 150 percent minimum, respectively, and shall be tested in accordance with 4.5.11.1.

3.2.4.1.14 Extruded, crosslinked, modified, ethylene-tetrafluoroethylene. Jackets of extruded and crosslinked modififed ethylene-tetrafluoroethylene shall a minimum wall thickness as specified in table IV. The color shall be white. The tensile strength and elongation shall be 5000 lbf/in^2 minimum and 50 percent minimum, respectively, and shall be tested in accordance with 4.5.11.1.

3.2.4.2 Concentricity of extruded jackets. The concentrictiy of extruded jackets shall be not less than 70 percent when tested in accordance with 4.5.16.

3.3 Functional characteristics

3.3.1 Dielectric withstand. One hundred percent of all finished cable shall be tested in accordance with 4.5.3, 4.5.3.1 and 4.5.3.2. Following these tests, there shall be no evidence of electrical breakdown or arcing.

3.3.2 Jacket flaws (shielded and jacketed cables only). One hundred percent of all finished cable shall be tested in accordance with 4.5.4. All flaws shall be removed or marked consistent with the requirements for packaging (see 5.1).

3.3.3 Conductor continuity. All conductors in all lengths of finished cable shall withstand the conductor continuity test of 4.5.8 without indication of discontinuity.

3.3.4 Cold bend (jacketed and shielded-and-jacketed cables only). All finished jacketed and shielded-and-jacketed types of cable shall withstand the cold bend test of 4.5.6 without evidence of cracking of jackets. Shielded and jacketed cable with jacket material listed in 4.5.6 shall then pass the voltage withstand test of 4.5.7 without electrical breakdown (see 4.3).

3.3.5 Thermal shock. All finished cable with jacket materials listed in table V shall withstand the thermal shock test of 4.5.9 without cracking of the jacket (see 4.3).

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3.3.5.1 Aging stability. All finished cable with jacket styles listed in table V shall withstand the aging stability test of 4.5.9.2 without cracking of the jacket (see 4.3).

3.3.6 Heat resistance. All finished cable with jacket material 02 shall withstand the heat resistance test of 4.5.10 without cracking of the jacket (see 4.3).

3.3.7 Blocking. Adjacent layers of cable with all jacket materials shall not stick together nor to the metal mandrel when subjected to the test for blocking in 4.5.15 at rated temperature of the jacket or basic wire, whichever is lower, for six hours.

3.3.8 Flammability. Cable specimens with all jacket materials loaded with sufficient weight to remain taut throughout test shall not burn for more than 30 seconds, nor more than three inches, nor shall there be any flaming of the tissue paper when tested in accordance with 4.8.

3.3.9 Immersion. Cable specimens with jacket materials 08, 10, 11, 12, 22, and 23 shall not increase in diameter more than five percent and shall not crack when tested in accordance with 4.5.12 or 4.5.13, as applicable.

3.3.10 Lamination sealing. Cable specimens with jacket materials 11, 12, or 22 shall exhibit no complete separation of layers either along the insulation or at the ends when tested in accordance with 4.5.14.

3.3.11 Crosslinked verification. All finished cable with jacket material 23 or 08 shall withstand the test of 4.5.9.3 without cracking of the jacket, dielectric breakdown, or pitting of metallic coatings, as applicable (see 4.3). Normal oxidation of the conductor coating shall not be cause for rejection.

3.3.12 Temperature rating. The temperature rating of the cable shall be defined as the lowest rating of the basic wire, shield material, or jacket material as defined in 1.2.1.5 or 1.2.1.6.

3.4 Identification of product

3.4.1 Cable product identification. The only cable product identification shall consist of the cable designation (see 1.2.1). Size, basic wire specification, number of wires in the cable shield, style and material and jacket material shall be in accordance with 1.2.1.1, 1.2.1.2, 1.2.1.3, 1.2.1.4, 1.2.1.5, and 1.2.1.6, and the manufacturer's code designation in accordance with publications H4-1 and H4-2.

3.4.1.1 Unshielded, unjacketed cable. The cable product identification shall be imprinted on the insulation of wire number 1 (see 3.4.2). Cable product identification shall not be required on components whenever the wire product identification is not required by the basic wire specification for that size.

3.4.1.2 Shielded cable. The cable product identification shall be one of the following:

a. Imprinted on the insulation of wire number 1.
b. Imprinted on a tape placed beneath the shield (see 3.4.2 and 3.4.4).

3.4.1.3 Jacketed cable. The cable product identification shall be one of the following:

a. Imprinted on the insulation of wire number 1.
b. Imprinted on a tape placed beneath the jacket (see 3.4.2 and 3.4.4).
c. Imprinted on the outer surface of the jacket.

3.4.1.4 Shielded and jacketed cable. The cable product identification shall be one of the following:

a. Imprinted on the insulation of wire number 1.
b. Imprinted on a tape placed beneath the shield (see 3.4.2 and 3.4.4).
c. Imprinted on a tape placed beneath the jacket (see 3.4.2 and 3.4.4).
d. Imprinted on the outer surface of the jacket.

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3.4.2 Wire product identification. The wire product identification shall not be imprinted on the insulation of wire number 1 whenever this wire carries the cable product identification (see 3.4.1.1, 3.4.1.2a, 3.4.1.3a and 3.4.1.4a). It may be omitted on all wires when identified in accordance with 3.4.1.2b, 3.4.1.3b, 3.4.1.3c, 3.4.1.4b, 3.4.1.4c or 3.4.1.4d.

3.4.3 Printed marking. The printed marking shall be durable, legible, and shall be black in color, except where black is the color of the insulation in which case the color of the printing shall be white (see 3.2.1.1 and 3.4.1.1). The size of the printed characters shall be consistent with the magnitude of the surface upon which it is printed. The distance between the end of one marker and the beginning of next marker shall be not greater than:

a. Three inches if covered by a shield or jacket (see 3.4.1.2, 3.4.1.3a, 3.4.1.3b, 3.4.1.4a, 3.4.1.4b, and 3.4.1.4c), or
b. Twelve inches if on the outer surface (see 3.4.1.1, 3.4.1.3c, and 3.4.1.4d).

The printed marking shall be applied with the vertical axes of the printed characters lengthwise on cable (or wire) whose nominal diameter is 0.050 inch or smaller. The vertical axes of the printed characters may be crosswise or lengthwise on cable (or wire) whose nominal diameter is 0.051 inch, or larger, or whenever tape is used (see 3.4.4).

3.4.4 Identification tape. When tape is used for carrying the imprinted cable product identification, the tape shall be one continuous length of electrically nonconducting, fungi-resistant material with a temperature rating equivalent to the cable rating without the tape. The tape shall be approximately 0.125 inch wide. The color of the tape shall be white in accordance with MIL-STD-104, class 1, except when polyimide tape is used, in which case the natural color of the polyimide is acceptable.

3.5 Workmanship. The cable shall be constructed and finished in a thoroughly workmanlike manner and shall exhibit uniform quality throughout.

3.6 Cable diameter. The major diameter of the cable shall be determined as specified in paragraph 4.6 and shall not exceed the maximum calculated in accordance with the paragraph.

3.7 Cable weight. The maximum weight of the cable shall be determined as specified in 4.7. The measured weight shall not exceed the calculated weight.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Classification of inspection. The inspection requirement specified herein are classified as follows:

a. Quality conformance inspection (see (4.3.1).
b. Process control tests (see 4.3.2).

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions in FED-STD-228.

4.3.1 Sampling tests. Sampling tests shall consist of the tests listed in table VI.

4.3.1.1 Lot. A lot shall consist of all cable of a single cable designation offered for inspection at one time except that the lot shall not exceed 1,000,000 feet or one week's production, whichever is less. The lot shall be expressed in units of thousands of feet (total footage in lot divided by 1,000).

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4.3.1.2 Sample. A sample shall consist of individual lengths of cable chosen at random from any one lot for the purpose of inspection or test. The sample size or number of lengths to be chosen from each lot shall be determined by the sampling plan.

4.3.1.3 Sample unit. A sample unit shall consist of one of the individual lengths of the sample. Each sample unit shall be of sufficient length to permit the performance of all applicable inspections or tests.

4.3.1.4 Specimen. A specimen shall consist of a piece of one sample unit upon which a particular inspection or test is to be made.

4.3.1.5 Sampling for groups I and II tests. For each group of tests, a random sample of the size specified shall first be selected from the lot. A specimen of sufficient length shall then be selected from each sample unit for the specified tests.

4.3.1.5.1 Group I tests. Sampling inspection for group I tests shall be in accordance with MIL-STD-105, inspection level S-4, AQL 6.5 (single sampling plan), (defects per hundred units).

4.3.1.5.2 Group II tests. Sampling inspection for group II tests shall be in accordance with MIL-STD-105, inspection level S-4, acceptance number 0 (single sampling plan).

4.3.1.6 Resubmitted inspection lots. MIL-STD-105 shall apply except that a resubmitted lot shall be inspected by the contractor using tightened inspection. Before resubmitting, full particulars concerning the cause of previous rejection and the action taken to correct the defects found in the lot shall be furnished by the contractor to the acquiring activity.

4.3.2 Process control tests. The process control tests are either of such nature that they cannot be performed on finished cable submitted for inspection and therefore must be conducted at the most appropriate stage of manufacturing operations, or they are tests conducted on 100 percent of the finished cable. The process control tests shall consist of the tests listed in table VII.

4.3.2.1 Sampling for process control tests

4.3.2.1.1 Shield strand material. From each week's production of individual shield strands or from every 100 pounds of individual shield strand, whichever is less, three 10-foot lengths of each style of shield strand representative of the material to be used in the finished cable shall be selected.

4.3.2.1.2 Coating. A sample shall consist of at least 3.5 feet of strand, before braiding, that is representative of the strand to be used in each lot of finished cable (see 4.3.1.1).

4.3.2.1.3 Coated copper strand elongation. A sample shall consist of at least 3.5 feet of strand, before braiding, that is representative of the strand to be used in each lot of finished cable (see 4.3.1.1).

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

4.3.3 Rejection and retest. When the sample selected from a production run fails to meet the specified tests, no items still on hand or later produced shall be accepted until the extent and cause of failure have been determined. After investigation, the contractor shall advise the acquiring activity of the action taken and after corrections have been made, all process control tests shall be repeated.

4.3.3.1 Tests may continue. For production reasons, testing may be continued pending the investigation of the process control sample failure, but final acceptance of the material shall not be made until it is determined that the lot meets all the requirements of the specification.

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4.4 Inspection of packaging. The sampling and inspection of the preservation, packing, and container marking shall be in accordance with the requirements of MIL-C-12000.

4.5 Methods of inspection

4.5.1 Inspection of product. All samples of cable shall be carefully inspected for packaging and all other requirements of this specification not covered by tests to ascertain conformance to this specification.

4.5.2 Shield strands

4.5.2.1 Elongation. Elongation tests on the coated copper strand shall be conducted in accordance with FED-STD-228, method 3211, using a 12-inch specimen, 10-inch bench marks, and a 10-inch initial jaw separation. Soft annealed copper shall be pulled at a rate between 5 and 10 inches per minute.

4.5.2.2 Coating

4.5.2.2.1 Thickness. The thickness of the coating shall be determined by the electronic determination method of ASTM B298 or ASTM B355.

4.5.2.2.2 Continuity of silver and nickel coating. Continuity of silver and nickel coating tests shall be conducted in accordance with ASTM B298 or ASTM B355, as applicable. There shall be no evidence of exposed copper.

4.5.2.2.3 Adhesion of nickel coating. Two 6-inch specimens shall be cut from the sample of nickel-coated strand. One specimen shall be wrapped over its own diameter for eight close turns. The second specimen shall remain in its straight form. Both specimens shall then be subjected to 10 continuous cycles of temperature change. Each cycle shall consist of four hours at 250°C ±5°C followed by four hours at room temperature. Upon completion of the thermal cycling, the straight specimen shall be wrapped over its own diameter for eight close turns in a manner identical to that of the first specimen. Both wrapped specimens shall then be subjected to the test specified in 4.5.2.2.2. There shall be no indication of exposed copper.

4.5.2.2.4 Continuity of tin coating. The continuity of coating test shall be conducted in accordance with the test procedure in ASTM B33. There shall be no evidence of exposed copper.

4.5.3 Dielectric withstand

4.5.3.1 Dielectric withstand-component wires. The finished cable shall be tested in accordance with method 6111 of FED-STD-228, except that immersion is not required. Each conductor, in turn, shall be tested against all others tied together with the (inner) shield (if any). The test voltage shall be 1,500 V rms for 600-volt rated basic wire and 2,500 V rms for 1,000 volt rated basic wire. The time of electricification shall be not less than 15 nor more than 30 seconds.

4.5.3.2 Dielectric withstand-inner jacket. The inner jacket of a double shielded cable shall be subjected to a dry dielectric test. A potential of 500 V rms shall be applied to the inner shield with the outer shield grounded. The time of electrification shall be not less than 15 seconds nor more than 30 seconds.

4.5.4 Jacket flaws. One-hundred percent of all finished shielded and jacketed cable shall pass through a suitable spark test device that will give intimate metallic contact with practically all of the jacket surface and impress a potential of 1,500 V ac at commercial frequency between the electrode of the spark test device and the cable shield. Electrode length and speed of cable through the electrode shall be such that the jacket will be subjected to the test potential for a minimum of 0.2 second.

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4.5.5 Braid angle and shield coverage. The braid angle and the percent coverage of the braid shall be determined by the following formula.

$$\text{Tan } \alpha = 2\pi \ (D+2d_1) \ P/C$$
$$K = 100 \ (2F-F2)$$

Where:

K = percent coverage
F = $EPd_2/\sin \alpha$
P = picks per inch of cable length
α = angle of braid with axis of cable
E = number of strands per carrier
d_1 = diameter of one of the round shield strands or thickness of flattened strand
d_2 = diameter of one of the round shield strands or width of flattened strands
D = diameter of cable under shield
D = Gb (for cables with no fillers, cable factor from column G of table VIII)
C = number of carriers
n = number of basic wires (see table VIII)
b = basic wire diameter

* 4.5.6 Cold bend. The ends of previously untested samples of finished cable shall be secured to a mandrel in a cold chamber. The other end of each specimen shall be secured to separate load weights sufficient to keep the cable vertical and tangent to the mandrel during the bending operation. The mandrel size shall be as specified in table IX. The temperature of the chamber shall be lowered to -55°C ±5°C at a rate not to exceed 50°C per minute. The specimens and the mandrel shall be conditioned at this temperature for four hours. At the end of this period, and while both mandrel and specimen are still at this low temperature, the cable shall be wrapped around the mandrel for 180° without opening the chamber. The time required for bending around 180° of the mandrel shall be one-half minute at a uniform rate of speed. A revolving mandrel operated externally from the chamber shall be used. The specimens shall then be removed from the mandrel and visually inspected, without magnification, for cracks. Specimens of shielded-and jacketed types of cable with jacket materials 01, 02, 05, 06, and 08 through 12, 14 through 18, 20, 22, and 23 shall be subjected to the voltage withstand test specified in 4.5.7. After being subjected to the cold bend test or voltage withstand test of the jacket, all specimens shall be dissected. The individual wires shall then be immersed within three inches of their ends for one hour in a five percent salt solution. At the end of this period, a potential of 1000 V rms at commercial frequency shall be applied for one minute from each conductor in the salt solution.

4.5.7 Voltage withstand, jacket. Specimens shall be formed into the shape of a U. All conductors shall be electrically connected together with the shields (if any) on both ends of the specimen. The specimens shall be tested in accordance with method 6111 of FED-STD-228, except the time of immersion shall be one hour minimum. The test voltage shall be 1,000 V rms, and the time of electrification shall be one minute. The test voltage shall be applied between the conductors (plus shield) and the immersion liquid.

4.5.8 Conductor continuity. Each basic wire in 100 percent of all finished cable in shipment reels or coils shall be tested for conductor continuity with an ohmmeter or other suitable testing device. There shall be no indication of discontinuity.

4.5.9 Thermal shock. Specimens of finished cable with jacket materials listed in table V shall be wrapped around a mandrel for at least six close turns with the ends of the specimens tied to the mandrel. The mandrel diameter shall be as specified in table VI. The specimens on the mandrel shall be subjected to a temperature within ±5°C of the values specified in table IX for four hours. At the end of this period, the specimen shall be inspected visually for cracks.

4.5.9.1 Thermal shock (crosslinked-polyvinylidene fluoride jackets, 08 only). Specimens shall be tested for six hours at 200°C ±5°C in accordance with the procedures specified for accelerated aging in MIL-W-81044 using the voltage withstand test procedure of 4.5.7 and the mandrel specified in table IX. The insulation shall

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be removed from each end of each conductor in the specimen. The conductors shall be tied together at each end and loaded with weights equal to 0.5 times the number of conductors times the test load specified for the basic wire.

4.5.9.2 Aging stability. Specimens of finished cable with jacket styles listed in table V, shall be aged for 96 hours at temperatures within ±5°C of the values specified in table V in a forced draft air oven. These specimens shall be wrapped at a uniform rate of 15 ±3 RPM at room temperature around a mandrel as specified in table IX. At the end of this period, the specimens shall be inspected visually for cracks, without the aid of magnification (see 3.3.5.1).

4.5.9.3 Crosslinked verification-air oven. Twenty-four inch specimens of finished cable with crosslinked jackets (jacket symbols 08, 23, 58, and 73) shall have one inch of insulation removed from each end of each conductor. The conductors of each end shall be tied together and loaded with weights equal to one-half the test load weight specified on the basic wire specification sheet times the number of conductors. This shall be done at each end of the specimen. The central portion of the specimen shall then be bent over a horizontally positioned smooth stainless steel mandrel of the diameter specified in table IX. To prevent sticking of the wire to the mandrel, the mandrel may be coated with polytetrafluoroethylene in the form of either enamel or wrapped tape, provided that the diameter of the mandrel after coating is still in conformity with table IX. This speciman so prepared on the mandrel shall be placed in an air-circulating oven and maintained for six hours at 200°C ±5°C for 08 and 58 jackets and 300°C ±5°C for 23 and 73 jackets. The velocity of air past the specimen location in the oven shall be between 100 and 200 feet per minute as determined at room temperature. After completion of the air oven exposure, the specimen shall be allowed to cool to between 20 and 25°C (68 to 77°F). When cooled, the wire shall be freed from tension, removed from the mandrel, and straightened. The specimen shall then be subjected to the bend test (4.5.9.4), followed by voltage withstand test procedure of 4.5.7. After the voltage withstand test, the insulation shall be removed from the specimen and the conductor shall be inspected for pitting. Darkening of the copper coating caused by normal oxidation shall not be cause for rejection.

4.5.9.4 Bend test. In a temperature maintained between 20 and 25°C (68 to 77°F), one end of the specimen shall be secured to the mandrel and the other end to the load weight specified in 4.5.9.3. The mandrel shall be rotated until the full length of the specimen is wrapped around the mandrel and is under the specified tension with adjoining coils in contact. The mandrel shall then be rotated in reverse direction until the full length of the wire which was outside during the first wrapping is now next to the mandrel. This procedure shall be repeated until two bends in each direction have been formed in the same section of the wire. The outer surface of the wire shall then be observed for cracking of the insulation.

4.5.10 Heat resistance. Specimens of the finished cable with jacket material 02 shall be aged for 96 hours at 150°C ±5°C in a forced draft air oven. The specimens shall then be removed from the oven, allowed to cool at room temperature for 30 minutes, and wrapped around a mandrel for not less than five close turns. The specimen shall be removed from the mandrel as a helical coil and visually inspected for cracks without the aid of magnification. The mandrel shall be as specified in table IX.

4.5.11 Jacket wall thickness. Specimens of finished cable with jacket material listed in table IV shall be measured for wall thickness of jacket in accordance with method 1013 of FED-STD-228.

4.5.11.1 Insulation tensile strength and elongation (see 3.2.4). The tensile strength and elongation shall be tested in accordance with ASTM D3032, using 1-inch bench marks, a 1-inch initial jaw separation, and a jaw separation speed of 2-inch per minute.

4.5.12 Immersion of polyvinylidene fluoride jackets. Jacket material 08 and 10 specimens shall be tested in accordance with MIL-W-81044 using the voltage withstand test procedure of 4.5.7.

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4.5.13 Immersion of polyimide/fluorinated ethylene propylene jackets. Jacket styles 11, 12 and 22 specimens shall be tested in accordance with MIL-W-81381 using the voltage withstand test procedure of 4.5.7.

4.5.14 Lamination sealing (polyimide/fluorinated ethylene propylene jackets only, jacket materials 11, 12 and 22). Specimens shall be tested for six hours at 230°C ±5°C in accordance with MIL-W-81381. The jacket shall be visually inspected for delamination. Any complete separation of layers either along the insulation or at the ends shall constitute failure.

4.5.15 Insulation blocking. One end of the continuous length of finished cable shall be fixed to a mandrel. The cable shall then be spirally wound around the mandrel so that at least three turns are in close contact with one another. The winding shall be continued until there are three layers of turns with each layer in close contact with one another. One end of previously untested samples of finished cable shall be secured to a mandrel. The other end of each specimen shall be secured to separate load weights sufficient to keep the cable vertical and tangent to the mandrel during the bending operation. The mandrel size shall be as specified in table IX. The mandrel and cable shall then be placed within an air oven for the specified time period (see 3.3.7). After removal from the oven, the mandrel and cable shall be cooled to room temperature and the cable shall be unwound. There shall be no adhesion or sticking of adjacent turns or layers during the unwinding process.

4.5.16 Concentricity. The minimum wall thickness in a cross section of the extruded jacket shall be located and recorded. The maximum wall thickness of the jacket in this same cross section shall be measured and recorded. The ratio of the minimum wall thickenss to the maximum wall thickness times 100 shall define the percent concentricity.

4.5.17 Cable jacket removability (styles 11, 12, and 22) (see 3.2.4). The cable jacket shall be severed circumferentially 4 inches from the cable end. The cable shall be flexed at the point of serverance to ensure that the jacket is parted completely. The 4-inch slug of jacket material shall be removed by pulling or working off the cable with the fingers. Finger gripping aids may be used. Stripping time shall start when the jacket slug is gripped for removable after severance and shall end when the jacket slug has been completely removed from the cable.

4.6 Cable diameter. The major diameter of the finished cable shall be determined with a micrometer caliper or dial micrometer the greatest straight-line dimension of a cross section of the cable except that for 3-conductor cable, the figure so obtained shall be increased as follows:

a. For unshielded-unjacketed, cable, increase the measurement by 7.7 percent of the caliper or micrometer reading.
b. For shielded, jacketed, or shielded and jacketed cable, increase the caliper or micrometer reading by 15 percent of the specified nominal or median diameter of the basic wire as given in the applicable wire specification. The cable diameter as thus determined shall not exceed the maximum calculated as follows:

(1) Unshielded, shielded and single jacketed cables.
Maximum O.D. = b x A +4.45 x d +4 x t (inches).
(2) Double shielded and jacketed cables.
Maximum O.D. = b x A +9.90 x d +7 x t (inches).
(3) Double shielded and single jacketed cables.
Maximum O.D. = b x A +9.90 x d +4 x t (inches).

Where O.D. = diameter of circumscribed circle.

b = Maximum diameter of basic wires in inches.
A = Cable factor from column A of table VIII.
d = Shield wire diameter or thickness (for flat braids), in inches (= 0 for unshielded cables).
t = Minimum jacket wall thickness as listed in table IV, (= 0 for unjacketed cables).

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4.7 Cable weight.

4.7.1 Measured. The finished cable shall be weighed in accordance with method 8311 of FED-STD-228.

4.7.2 Calculated. The finished cable maximum weight shall be calculated by the following procedures.

a. Unshielded and single shield cables.

$$\text{Cable weight (lbs/1000 ft)} = W \times 1.02 \times n + k \times d\,(2.23 \times d + b \times B) + 2720 \times t \times s\,(b \times B + 4.45 \times d + 2 \times t)$$

b. Double shielded and jacketed cables.

$$\text{Cable weight (lbs/1000 ft)} = W \times 1.02 \times n + k \times d\,(8.91 \times d + 2 \times b \times B + 3 \times t) + 4760 \times t \times s\,(7 \times d + b \times 6 + 3.5 \times t)$$

c. Double shielded single jacket.

$$\text{Cable weight (lbs/1000 ft)} = W \times 1.02 \times n + k \times d\,(2.23 \times d + b \times B) + k \times d\,(6.68 \times d + b \times B) + 2720 \times t \times s\,(b \times B + 8.90 \times d + 1.5 \times t).$$

Where W = Maximum weight of component wires, pounds/1000 feet.
b = Maximum dimensions of component wires, in inches.
n = Number of conductors in the cable.
d = Shield wire diameter or thickness (for flat braids), in inches (= 0 for unshielded cables).
t = Minimum jacket wall thickness from 4.5.11 (= 0 for unjacketed cables).
B = Effective geometry factor from Column B of table VIII.
S = Effective specific gravity of jacket material from table X.
K = 12750 for copper shields and 11150 for stainless steel shields.

4.8 Flammability

4.8.1 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 ventilation for combustion but prevent drafts. Means shall be provided in the chamber to hold the test specimen taut at an angle of 60 degrees from horizontal in a vertical plane parrallel to and about 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. The burner shall be fitted with a wing top flame spreader having a 1/16 inch by 2 inch opening.

4.8.2 Procedure. A 24-inch specimen of wire, 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 deliver an all-blue flame, 2 inches high, at a temperature of 955 ±30°C (1751 ±54°F), as measured with a thermocouple pyrometer. With the burner held at a 90 degree angle to the wire specimen and the long dimension of the flame spreader parallel to the axis of the specimen, the hot tip of the flame shall be applied to the wire so that the midpoint of the flame touches the 8-inch mark on the specimen. The period of flame application shall be 15 seconds for wire sizes 30 through 18, 30 seconds for sizes 16 through 12, 1 minute for sizes 10 through 4, and 2 minutes for larger sizes. At the close of the application period, the flame shall be withdrawn and the duration of the after flame in the specimen shall be noted.

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5. PACKAGING

5.1 Packaging. The requirements for packaging shall be in accordance with MIL-C-12000.

6. NOTES

6.1 Intended use. The cable covered by this specification is intended for use in aerospace applications requiring wires in a cable configuration for additional versatility and protection.

6.2 Ordering data

6.2.1 Acquisition requirements. Acquisition documents should specify the following:

a. Title, number and date of this specification.
b. Cable designation (see 1.2.1).
c. Applicable specification date and issue for basic wires.
d. Wire number identification color code if other than preferred (see 3.2.1.1.1)
e. Fillers, binder tapes, if required.
f. Nominal and minimum lengths.

6.3 Shield material. Shield materials N, F, C, Y, Z, R, E, and X provide corrosion resistance. Shield materials I and Q are intended to provide magnetic shielding.

6.4 Recommended shield-style and jacket material. The recommended shield and jacket material for cable types of this specification are as specified in table II. For special applications, construction may be other than those recommended.

6.5 Superseded symbols. The following is a list of superseded basic wire symbols and their replacements which appear in table I of MIL-C-27500E(USAF).

Canceled military document	Former table I symbol	Table I symbol replacement wire	Active military document
MIL-W-7139 class I	D	EA	MIL-W-22759/1
MS17411	V	VA	MIL-W-22759/5
MS17412	W	WA	MIL-W-22759/6
MS18000	S	SA	MIL-W-22759/7
MS18001	T	TA	MIL-W-22759/8
MS18104	LC	JB	MIL-W-22759/28
MS18105	LD	JC	MIL-W-22759/29
MS18113	LA	LE	MIL-W-22759/9
MS18114	LB	LH	MIL-W-22759/10
MS21985	R	RC	MIL-W-22759/11
MS21986	L	RE	MIL-W-22759/12
MIL-W-22759/24	TT	No replacement	---
MIL-W-22759/25	TP	No replacement	---
MIL-W-22759/26	TR	No replacement	---
MIL-W-22759/27	TS	No replacement	---
MIL-W-22759/28	SA	JB	MIL-W-22759/28
MIL-W-22759/29	SB	JC	MIL-W-22759/29
MIL-W-22759/30	SC	JD	MIL-W-22759/30
MIL-W-22759/31	SE	JE	MIL-W-22759/31
MIL-W-22759/36	SF	No replacement	---
MIL-W-22759/37	SG	No replacement	---
MIL-W-22759/38	SJ	No replacement	---
MIL-W-22759/39	SK	No replacement	---
MIL-W-22759/40	SL	No replacement	---
MS24284	K	RE	MIL-W-22759/12
MS27125	J	JA	MIL-W-25038/1
MIL-W-27300	K	RE	MIL-W-22759/12

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Canceled military document	Former table I symbol	Table I symbol replacement wire	Active military document
MIL-W-81044/1	M	ME	MIL-W-81044/6
MIL-W-81044/2	MA	ME	MIL-W-81044/6
MIL-W-81044/3	MB	ML	MIL-W-81044/12
MIL-W-81044/4	MC	ML	MIL-W-81044/12
MIL-W-81044/14	MN	MH	MIL-W-81044/9
MIL-W-81044/15	MP	MJ	MIL-W-81044/10
MIL-W-81044/16	BA	MW 2/	MIL-W-81381/11
MIL-W-81044/17	BB	NA	MIL-W-81381/13
MIL-W-81044/18	BC	MR 2/	MIL-W-81381/7
MIL-W-81044/19	BE	MT	MIL-W-81381/9
MIL-W-81044/20	BF	MW 2/ or	MIL-W-81381/11
		ME	MIL-W-81044/6
MIL-W-81044/21	BG	MW 2/	MIL-W-81381/11
MIL-W-81044/22	BH	NA	MIL-W-81381/13
MIL-W-81044/23	BJ	LH	MIL-W-22759/10
MIL-W-81044/24	BK	TL	MIL-W-22759/21
MIL-W-81044/25	BL	MR 2/ or	MIL-W-81381/7
		ML	MIL-W-81044/12
MIL-W-81044/26	BM	MR 2/ or	MIL-W-81381/7
		RC	MIL-W-22759/11
MIL-W-81044/27	BN	MH	MIL-W-81044/9
MIL-W-81044/28	BP	RE	MIL-W-22759/12
MIL-W-81044/29	BR	TN	MIL-W-22759/23
MIL-W-81044/30	MR 1/	No replacement	---
MIL-W-81044/31	MT 1/	No replacement	---
MIL-W-81381/1	Y	MW 2/ or	MIL-W-81381/11
		MR 2/	MIL-W-81381/7
MIL-W-81381/2	YA	MY 2/ or	MIL-W-81381/12
		MS 2/	MIL-W-81381/8
MIL-W-81381/3	YB	MW 2/	MIL-W-81381/11
MIL-W-81381/4	YC	MY 2/	MIL-W-81381/12
MS90294	N	RB	MIL-W-22759/4

1/ Duplicate of symbols assigned to other specifications now currently assigned to specification MIL-W-81381.
2/ These wires are not suitable for contact with missile propellants.

6.5.1 Manned aerospace replacements. For manned aerospace applications, the following substitutions are suggested for new design.

Replacable symbols	Replacing symbol
A	ME
AA	CA
AB	MM
AD	CA
B	AA
C	AB
P	NONE

6.5.2 Changed symbols. The table I symbols for the following wires have been changed.

Applicable specification sheet	Former symbol	Present symbol
MIL-W-22759/28	SA	JB
MIL-W-22759/29	SB	JC
MIL-W-22759/30	SC	JD
MIL-W-22759/31	SE	JE

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TABLE I. Basic wire specification.

Symbol sequence				Specification sequence			
A	MIL-W-5086/1 1/	NB	MIL-W-81381/14	MIL-W-5086/1 1/	A	MIL-W-22759/32	SB
AA	MIL-W-5088/5 1/	NE	MIL-W-81381/17	MIL-W-5086/2 1/ 2/	B	MIL-W-22759/33	SC
AB	MIL-W-5086/6 1/	NF	MIL-W-81381/18	MIL-W-5086/3 1/ 2/	C	MIL-W-22759/34	SD
AD	MIL-W-5086/7 1/	NG	MIL-W-81381/19	MIL-W-5086/4 1/	P	MIL-W-22795/35	SE
B	MIL-W-5086/2 1/ 2/	NH	MIL-W-81381/20	MIL-W-5086/5 1/	AA	MIL-W-22795/41	SM
C	MIL-W-5086/3 1/ 2/	NK	MIL-W-81381/21	MIL-W-5086/6 1/	AB	MIL-W-22975/42	SN
CA	MIL-W-22759/13	NL	MIL-W-81381/22	MIL-W-5086/7 1/	AD	MIL-W-22759/43	SP
CB	MIL-W-22759/14	P	MIL-W-5086/4 1/	MIL-W-8777, MS25471	H	MIL-W-25038/1	JA
CC	MIL-W-22759/15	RA	MIL-W-22759/3	MIL-W-8777, MS27110	F	MIL-W-81044/5 2/	MD
E	MIL-W-22759/2	RB	MIL-W-22759/4	MIL-W-22759/1	EA	MIL-W-81044/6	ME
EA	MIL-W-22759/1	RC	MIL-W-22759/11	MIL-W-22759/2	E	MIL-W-81044/7	MF
F	MIL-W-8777, MS27110	RE	MIL-W-22759/12	MIL-W-22759/3	RA	MIL-W-81044/8 2/	MG
H	MIL-W-8777, MS25471	SA	MIL-W-22759/7	MIL-W-22759/4	RB	MIL-W-81044/9	MH
JA	MIL-W-25038/1	SB	MIL-W-22759/32	MIL-W-22759/5	VA	MIL-W-81044/10	MJ
JB	MIL-W-22759/28	SC	MIL-W-22759/33	MIL-W-22759/6	WA	MIL-W-81044/11 2/	MK
JC	MIL-W-22759/29	SD	MIL-W-22759/34	MIL-W-22759/7	SA	MIL-W-81044/12	ML
JD	MIL-W-22759/30	SE	MIL-W-22759/35	MIL-W-22759/8	TA	MIL-W-81044/13	MM
JE	MIL-W-22759/31	SM	MIL-W-22759/41	MIL-W-22759/9	LE	MIL-W-81381/7	MR
LE	MIL-W-22759/9	SN	MIL-W-22759/42	MIL-W-22759/10	LH	MIL-W-81381/8	MS
LH	MIL-W-22759/10	SP	MIL-W-22759/43	MIL-W-22759/11	RC	MIL-W-81381/9	MT
MD	MIL-W-81044/5 2/	TA	MIL-W-22759/8	MIL-W-22759/12	RE	MIL-W-81381/10	MV
ME	MIL-W-81044/6	TE	MIL-W-22759/16	MIL-W-22759/13	CA	MIL-W-81381/11	MW
MF	MIL-W-81044/7	TF	MIL-W-22759/17	MIL-W-22759/14	CB	MIL-W-81381/12	MY
MG	MIL-W-81044/8 2/	TG	MIL-W-22759/18	MIL-W-22759/15	CC	MIL-W-81381/13	NA
MH	MIL-W-81044/9	TH	MIL-W-22759/19	MIL-W-22759/16	TE	MIL-W-81381/14	NB
MJ	MIL-W-81044/10	TK	MIL-W-22759/20	MIL-W-22759/17	TF	MIL-W-81381/17	NE
MK	MIL-W-81044/11 2/	TL	MIL-W-22759/21	MIL-W-22759/18	TG	MIL-W-81381/18	NF
ML	MIL-W-81044/12	TM	MIL-W-22759/22	MIL-W-22759/19	TH	MIL-W-81381/19	NG
MM	MIL-W-81044/13	TN	MIL-W-22759/23	MIL-W-22759/20	TK	MIL-W-81381/20	NH
MR	MIL-W-81381/7	VA	MIL-W-22759/5	MIL-W-22759/21	TL	MIL-W-81381/21	NK
MS	MIL-W-81381/8	WA	MIL-W-22759/6	MIL-W-22759/22	TM	MIL-W-81381/22	NL
MT	MIL-W-81381/9			MIL-W-22759/23	TN		
MV	MIL-W-81381/10			MIL-W-22759/28	JB		
MW	MIL-W-81381/11			MIL-W-22759/29	JC		
MY	MIL-W-81381/12			MIL-W-22759/30	JD		
NA	MIL-W-81381/13			MIL-W-22759/31	JE		

1/ Not for use in aerospace applications.
2/ In active for new design.

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TABLE II. Recommended shield and jacket materials for each basic type wire.

Basic wire specification	Cable type					
	Shielded		Jacketed		Shielded and Jacketed	
	Shield style and material	Jacket material	Shield style and material	Jacket material	Shield style and material	Jacket material
MIL-W-5086	T	00	U	01, 02, 03, 10	T	01, 02, 03, 10
MIL-W-8777	S	00	U	04	S	04
MIL-W-22759	T, S, N	00	U	05, 06, 07, 09, 10, 14 thru 18, 20, 21, and 23	T, N or S	05, 06, 07, 09, 10, 14 thru 18, 20, 21, and 23
MIL-W-25038/1	F, C	00	U	06, 07	F, C	06, 07
MIL-W-81044	T, S	00	U	08, 09, 14, 16	T, S	08, 09, 14, 16
MIL-W-81381	T, S, N	00	U	05, 09, 10, 11, 12, 22	T, N, S	05, 09, 10, 11, 12, 22

TABLE IIIA. 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.

Number of wires in cable	Identification colors for respective wires in cable (see 3.2.1.1.1. or 3.2.1.1.2)						
	Wire number						
	1	2	3	4	5	6	7
1	Basic (White)						
2	White 1/	Blue					
3	White 1/	Blue	Orange				
4	White 1/	Blue	Orange	Green			
5	White 1/	Blue	Orange	Green	Red		
6	White 1/	Blue	Orange	Green	Red	Black	
7	White 1/	Blue	Orange	Green	Red	Black	Yellow 2/

1/ Except where preferred color on basic wire specification sheet is not white.
2/ Where basic wire is MIL-W-81381, a brown helical stripe shall be used.

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TABLE IIIB. Circuit identification colors for basic wires in accordance with MIL-W-5086. 1/

Number of wires in cable	Identification colors for respective wires in cable (see 3.2.1.1.1. or 3.2.1.1.2)
1	Basic (White)
2	Red, blue
3	Red, blue, yellow
4	Red, blue, yellow, green
5	Red, blue, yellow, green, basic
6	Red, blue, yellow, green, basic, black
7	Red, blue, yellow, green, basic, black, brown

1/ Inactive for new design.

TABLE IIIC. Color of insulation for identification of wire sizes (see 3.2.1.1.3), in accordance with MIL-STD-686.

Wire size 1/	Insulation color (solid)
26	Black
24	Blue
22	Green
20	Red
18	White
16	Blue
14	Green
12	Yellow
10	Brown
8	Red
6	Blue
4	Yellow
2	Red
1	White
0	Blue
00	Green

1/ 26 AWG is inactive for new design.

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TABLE IIID. Circumferential band configuration for wire number identification (see 3.2.1.1.3).

WIRE NUMBER 1/	BAND GROUP CONFIGURATION	NUMBER OF BANDS
1	NO MARKING	NONE
2		2
3		3
4		4
5		5
6		6
7		7

1/ 26 AWG IS INACTIVE FOR NEW DESIGN

TABLE IV. Jacket minimum wall thickness. 1/

Diameter of cable beneath jacket (inches)	Jacket material						
	01	02, 23	06	05, 09, 14, 15, 17, 18, 20, 21	08, 10	11, 22	12
Up to 0.150	0.010	0.005	0.010	0.007	0.005	0.0035	.003
0.151 to 0.200	0.015	0.006	0.010	0.010	0.006	0.0035	.003
0.201 to 0.250	0.020	0.007	0.010	0.010	0.007	0.0035	.003
0.251 to 0.300	0.025	0.007	0.010	0.010	0.007	0.0035	.003
0.301 to 0.400	0.030	0.008	0.015	0.013	0.007	0.006	.0045
0.401 to 0.500	0.040	0.009	0.015	0.013		0.006	.0045
0.501 to 0.600	0.050	0.010	0.020	0.020		0.0095	.007
0.601 to 0.700	0.060	0.012	0.020	0.020		0.0095	.007
0.701 to 0.750	0.070	0.014	0.020	0.020		0.0095	.007
0.751 to 0.800	0.075	0.014	0.020	0.020		0.0095	.007
0.801 to 1.000	0.080	0.016	0.020	0.020		0.0095	.007
Over 1.000	10%	0.020	0.020	0.020			

1/ Jacket materials not shown shall have a minimum wall thickness of .010.

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TABLE V. Thermal shock and aging stability.

Jacket materials	Thermal shock and aging stability temperature
01	136°C
05, 09	230°C
04, 10	150°C
11, 12, 22	230°C
14, 15	200°C
17, 18	180°C
20, 21	285°C

TABLE VI. Sampling tests.

Group	Test	Requirement	Test method
I	Shield coverage	3.2.3.4	4.5.5
	Braid angle	3.2.3.3	4.5.5
	Identification of product	3.4	4.5.1
	Jacket wall thickness	3.2.4	4.5.11
	Cable jacket removability (styles 11, 12 and 22 only)	3.2.4	4.5.17
	Cable diameter	3.6	4.6
	Cable weight	3.7	4.7
II	Cold bend	3.3.4	4.5.6
	Thermal shock	3.3.5	4.5.9
	Aging stability	3.3.5.1	4.5.9.2
	Heat resistance	3.3.6	4.5.10
	Blocking	3.3.7	4.5.15
	Flammability	3.3.8	4.8

TABLE VII. Process control tests.

Test	Requirement	Test
Copper shield round strand material	3.1.1	4.5.2
Stainless steel shield material	3.1.2	4.5.2
High-strength copper alloy shield round strand	3.1.3	4.5.2
Thickness of coating	3.2.3.1.3	4.5.2.2.1
Continuity of coating	3.2.3.1.3	4.5.2.2.2
Strand elongation	3.2.3.1.1	4.5.2.1
Adhesion of nickel coating	3.2.3.1.3.3	4.5.2.2.3
Jacket flaws	3.3.2	4.5.4
Dielectric withstand	3.3.1	4.5.3 or 4.5.3.1 (if applicable)
Conductor continuity	3.3.3	4.5.8
Basic wire acceptance	3.2.1	Basic wire specification

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TABLE VIII. Cable and geometry factors.

Number of conductors	A	B	G
1	1.0	1.0	1.00
2	2.0	1.8	1.64
3	2.2	2.1	1.95
4	2.4	2.4	2.27
5	2.7	2.7	2.59
6	3.0	3.0	2.87
7	3.0	3.0	2.91

TABLE IX. Test mandrel diameters.

Finished cable diameter (inches)	Cold bend (4.5.6); Thermal shock (4.5.9.1 and 4.5.9.3); Blocking (4.6.15); Immersion (4.5.12) (inches)	Finished cable diameter (inches)	Jacket material 02 only; Heat resistance (4.5.10) (inches)	Finished cable diameter (inches)	Thermal shock (4.5.9 only); Aging Stability (4.5.9.2 only) (inches)
0 to 0.125	3	0 to 0.083	1/4	0 to 0.083	3/4
		0.084 to 0.167	1/2	0.084 to 0.111	1
0.126 to 0.250	6	0.168 to 0.250	3/4	0.112 to 0.139	1-1/4
				0.140 to 0.194	1-3/4
0.251 to 0.360	10			0.195 to 0.250	2-1/4
				0.251 to 0.334	3
0.361 to 0.750	18			0.335 to 0.444	4
				0.445 to 0.556	5
0.751 to 1.200	30			0.557 to 0.667	6
				0.668 to 0.889	6
1.201 to 2.000	48			0.890 to 1.111	10
				1.112 to 1.556	14
				1.557 to 2.000	18

TABLE X. Specific densities for jacketing materials.

Jacket style	Specific density
01, 02, 03, 04, 22,	1.4
05, 06, 07, 09, 16, 20, 21	2.2
08, 10, 14, 15, 17, 18	1.8
11, 12	1.6
23	1.7

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6.6 Changes from previous issue. Asterisks are not used in this revision to identify changes with respect to the previous issue due to the extensiveness of the changes.

Custodians:
Army - CR
Navy - AS
Air Force - 85

Review activities:
Army - AR, MI
Navy - AS
Air Force - 11, 99
DLA - IS

Agent:
DLA - ES

Preparing activity:
Air Force - 85

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