INCH-POUND

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DETAIL SPECIFICATION

CABLE, RADIO FREQUENCY, COAXIAL, SEMIRIGID, CORRUGATED OUTER CONDUCTOR, GENERAL SPECIFICATION FOR

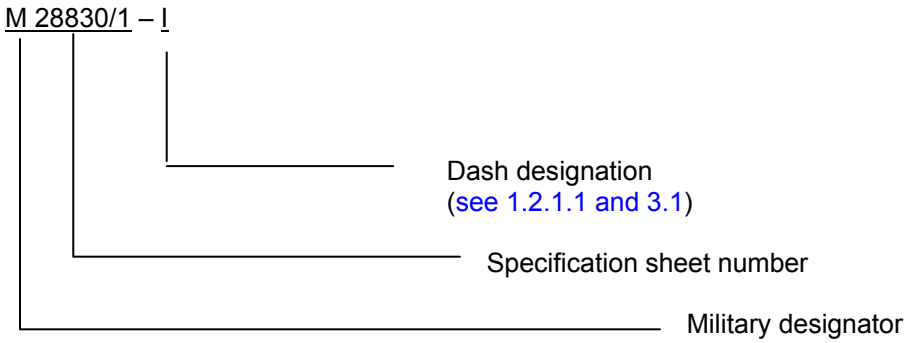
This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the general requirements for coaxial, semirigid, radio frequency cable with corrugated outer copper conductors (see 6.1).

1.2 Classification.

1.2.1 Part or Identifying Number (PIN). The term PIN is equivalent to the term part number which was previously used in this specification. The PIN (when applicable) consists of the letter "M", the basic number of the specification sheet, and an assigned dash number (see 3.1), as shown in the following example:



Comments, suggestions, or questions on this document should be addressed to: Defense Supply Center Columbus, ATTN: VAI, P. O. Box 3990, Columbus OH 43218-3990 or by email to RFConnectors@dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at http://assist.daps.dla.mil.

1.2.1.1 Jacket material. Jacket material is as specified in the specification sheet (see 3.1) and as follows:

Type I – Unjacketed.

Type II – Jacketed (polyethylene).

Type IV – Jacketed (non-halogenated fire-retardant compound).

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3, 4, or 5 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements cited in sections 3, 4, or 5 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL STANDARDS

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

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-C-17 - Cables, Radio Frequency, Flexible and Semirigid, General Specification for.

(See supplement 1 for list of associated specifications.)

(Copies of these documents are available online at http://assist.daps.dla.mil/quicksearch/ or http://assist.daps.dla.mil or from the Standardization Documents Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

NAVAL ENGINEERING STANDARDS (NES)

NES 711 - Determination of the Smoke Index of the Products of Combustion from Small Specimens of Materials.
NES 713 - Determination of the Toxicity Index of the Products of Combustion from Small Specimens of Materials.

(Copies of these documents should be addressed to the Procurement Executive, Ministry of Defense, Ship Department, Section TE112, Block G, Foxhill, Bath 5AB, England.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

ASTM INTERNATIONAL

ASTM B152 - Copper Sheet, Strip, Plate, and Rolled Bar, Standard Specification for.
ASTM B566 - Copper-Clad Aluminum Wire, Standard Specification for
ASTM D638 - Tensile Properties of Plastic.
ASTM D1248 - Polyethylene Plastics Extrusion Materials for Wire and Cable.
ASTM D1505 - Density of Plastics by the Density-Gradient Technique, Standard Test Method for.
ASTM D2863 - Measuring the Minimum Oxygen Concentration to Support Candle-Like Combustion of Plastics (Oxygen Index), Standard Test Method for.

(Copies of these documents are available from http://www.astm.org or ASTM International, P.O. Box C700, 100 Barr Harbor Dr., West Conshohocken, PA 19428-2959.)

INTERNATIONAL STANDARDS ORGANIZATION (ISO)

ISO 9000 - Quality Management Systems-Fundamentals and Vocabulary.

(Copies of these documents are available from http://www.iso.ch or International Organization for Standardization American National Standards Institute, 11 West 42nd Street, 13th floor, New York, NY 10036.)

2.4 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related specification sheets), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheet. In the event of any conflict between the requirements of this specification and the specification sheet, the latter shall govern.

3.2 Qualification. Cables furnished under this specification shall be products which are authorized by the qualifying activity for listing on the applicable qualified products lists before contract award (see 4.6 and 6.3).

3.3 Material. Unless otherwise specified (see 3.1), materials for the principle components of the cable shall be as specified herein. Prior approval to use substitute material must be obtained from the qualifying activity. However, when a definite material is not specified, a material shall be used which will enable the finished product to meet the performance requirements of this specification. Acceptance or approval of any constituent material shall not be construed as a guarantee of the acceptance of the finished product.

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

3.3.2 Copper-clad aluminum. Copper-clad aluminum wire shall be in accordance with ASTM B566 (see 4.2).

3.3.3 Copper. Copper strip shall be UNS C12000 in accordance with ASTM B152 (see 4.2).

3.3.4 Foam polyethylene. Foam polyethylene shall be in accordance with ASTM D1248, type I, class A or B (see 4.2). Vendor blends are acceptable if their dissipation factor is less than 0.0003.

3.3.5 Polyethylene. Polyethylene shall be in accordance with ASTM D1248, type I, W4 (see 4.2).

3.3.6 Non-halogenated fire-retardant compound. The property values of the non-halogenated fire-retardant compound shall be as specified in the applicable specification sheet (see 3.1), when tested as specified in accordance with the corresponding testing method of table I.

TABLE I. Non-halogenated fire retardant compound properties.

Property	Test method
Density	ASTM D1505
Tensile strength	ASTM D638
Ultimate elongation	ASTM D638
Oxygen index	ASTM D2863
Temperature index	ASTM D2863
Smoke index	NES 711
Toxicity index	NES 713
Halogen content	MIL-C-17
Acid gas generation	MIL-C-17

3.4 Design and construction. The cables shall be of the design, construction, and physical dimensions specified (see 3.1).

3.4.1 Splices. Each specified length of cable (see 6.2) shall be electrically and mechanically continuous. No cable splices shall be allowed after fabrication of the cable.

3.4.2 Dimensional errors and tolerances. The cumulative dimensional errors shall not result in the cables failing the voltage standing wave ratio (VSWR) test.

3.5 Performance.

3.5.1 Continuity. When tested as specified in 4.7.2, each conductor in each reel of cable shall be electrically continuous between ends.

3.5.2 Dielectric withstanding voltage. When tested as specified in 4.7.3, the completed cable shall withstand the voltage specified (see 3.1) without breakdown.

3.5.3 Spark test (jacketed cable only). When tested as specified in 4.7.4, jacketed cable shall have a continuous jacket without cracks, breaks, or holes. A puncture of the jacket by the applied voltage shall constitute a point of failure (see 3.1).

3.5.4 Insulation resistance. When tested as specified in 4.7.5, the insulation resistance shall be not less than 100,000 megohms per 1,000 feet (305 meters).

3.5.5 Leak test (type 1). When tested as specified in 4.7.6, the cable shall not increase in capacitance by more than 5 percent of the initial capacitance.

3.5.6 Attenuation. When tested as specified in 4.7.7, the attenuation in decibels (dB) per 100 feet (30 meters) shall not exceed the maximum values specified (see 3.1).

3.5.7 Velocity of propagation. When tested as specified in 4.7.8, the velocity of propagation shall be as specified (see 3.1).

3.5.8 Capacitance. When tested as specified in 4.7.9 , the cable capacitance shall be as specified (see 3.1).

3.5.9 Impedance. When tested as specified in 4.7.10, the impedance of the cable shall be as specified (see 3.1).

3.5.10 VSWR. When tested as specified in 4.7.11, the cable shall have a maximum VSWR as specified, with respect to a 50 $\pm$ 2 ohm termination, over the frequency range specified (see 3.1).

3.5.11 Cold bend (jacketed cable only). When tested as specified in 4.7.12, the cable jackets shall show no evidence of cracking or splitting.

3.5.12 Flexibility. When tested as specified in 4.7.13, the finished cable shall not exhibit kinking, wrinkling, or cracking. The cable shall then meet the requirements of 3.5.5 and 3.5.10 (see 3.1).

3.5.13 Temperature cycling. When tested as specified in 4.7.14, the cable shall exhibit no evidence of mechanical damage.

3.5.14 Thermal shock. When tested as specified in 4.7.15, there shall be no physical damage to any dielectric material and the change in dimensions from the original shall be .062 inch (1.57 mm) maximum for the center conductor and .125 inch (3.18 mm) maximum for the dielectric material.

3.5.15 Flame propagation (type IV jacketed cable only) (see 3.1). When tested as specified in 4.7.17, samples of completed cable shall be self-extinguishing and shall not burn to the top of the tray.

3.5.16 Acid gas generation (type IV jacketed cable only). When cables are tested as specified in 4.7.18, the acid equivalent shall not exceed the percentage, by weight of the sample, specified (see 3.1).

3.5.17 Halogen content (type IV jacketed cable only). When cables are tested as specified in 4.7.19, the halogen content shall not be greater than the value specified (see 3.1).

3.5.18 Smoke index (type IV jacketed cable only). When cables are tested as specified in 4.7.20, the smoke index shall not be greater than the value specified (see 3.1).

3.5.19 Toxicity index (type IV jacketed cable only). When cables are tested as specified in 4.7.21, the toxicity index shall not be greater than the value specified (see 3.1).

3.5.20 Tensile strength and elongation (unaged). When tested as specified in 4.7.22, the cable jacket shall have a tensile strength and elongation not less than the value specified (see 3.1)

3.6 Marking. Unless otherwise specified (see 3.1), marking shall consist of the PIN, manufacturer's CAGE code in accordance with publication H4/H8 (see 1.2.1), and the date of manufacture. Lettering shall be Futura or Gothic capitals and numerals shall be Arabic. Marking shall be on the outermost insulation (or cable) surface and shall be at intervals of every 3.3 feet (1 meter) measured from the beginning of one complete marking to the beginning of the succeeding complete marking. Marking of the unjacketed cable shall be specified by the procuring activity (see 6.2).

3.7 Workmanship. Cables shall be processed in such a manner as to be uniform in quality and shall be free from any burrs, die marks, chatter marks, foreign material, or other defects that will adversely affect life, serviceability, or appearance.

3.8 Continuous lengths (see 4.7.16). Unless otherwise specified in the contract or order, the footage of the individual continuous lengths in each spool or reel shall be marked on the spool or reel in the sequence in which the lengths will be unwound by the user. The minimum footage of each continuous length of cable in the inspection lot (see 4.6.1.1) shall conform to table II, which specifies the total number of inspection lot cable lengths which may be provided by cable lengths of various minimum footages, in terms of percentage.

3.9 Recycled, recovered, or environmentally preferable materials. Recycled, recovered, or environmentally preferable materials should be used to the maximum extent possible, provided that the material meets or exceeds the operational and maintenance requirements, and promotes economically advantageous life cycle costs.

TABLE II. Continuous lengths.

Minimum footage	Minimum percentage
100 feet (30.5 meters)	50 percent
75 feet (23 meters)	80 percent
50 feet (15 meters)	100 percent

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows:

a. Materials inspection (see 4.2).
b. Qualification inspection (see 4.5).
c. Conformance inspections (see 4.6).

4.2 Materials inspection. Materials inspection shall consist of certification supported by verifying data that the materials listed in table III, used in fabricating, are in accordance with the applicable referenced specifications or requirements prior to such fabrication.

TABLE III. Materials inspection.

Material	Requirement paragraph	Applicable specification
Copper-clad aluminum	3.3.2	ASTM B566
Phosphor reduced copper	3.3.3	ASTM B152
Polyethylene foam	3.3.4	ASTM D1248 or vendor blend with dissipation factor < 0.0003
Polyethylene	3.3.5	ASTM D1248
Non-halogenated fire-retardant compound	3.3.6	In accordance with 3.3.6

4.3 Inspection conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in section 6 of FED-STD-228.

4.4 Inspection terms and definitions. Inspection terms and definitions shall conform to ISO 9000 with the following additions.

4.4.1 Specimen. A specimen is an individual piece of cable taken from a sample unit.

4.4.2 Sample unit. The sample unit shall be as specified.

4.4.3 Defective unit. A defective unit shall be a sample unit which failed to meet the requirements of the specification.

4.5 Qualification inspection. Qualification inspection shall be performed at a laboratory acceptable to the Government (see 6.3) on sample units produced with equipment and procedures normally used in production and shall consist of the tests shown in table IV.

4.5.1 Sample size. Five hundred feet (152 meters) of cable of the type and size to be qualified shall be subjected to qualification inspection.

4.5.2 Failures. One or more failures shall be cause for refusal to grant qualification approval.

TABLE IV. Qualification inspection.

Inspection	Requirement paragraph	Test method paragraph
Leak test (type I only)	3.5.5	4.7.6
Attenuation	3.5.6	4.7.7
VSWR	3.5.10	4.7.11
Impedance	3.5.9	4.7.10
Velocity of propagation (when specified, see 3.1)	3.5.7	4.7.8
Capacitance (when specified, see 3.1)	3.5.8	4.7.9
Cold bend (jacketed cable only)	3.5.11	4.7.12
Flexibility	3.5.12	4.7.13
Temperature cycling	3.5.13	4.7.14
Thermal shock	3.5.14	4.7.15
Flame propagation (type IV jacketed cable only)	3.5.15	4.7.17
Acid gas generation (type IV jacketed cable only)	3.5.16	4.7.18
Halogen content (type IV jacketed cable only)	3.5.17	4.7.19
Smoke index (type IV jacketed cable only)	3.5.18	4.7.20
Toxicity index (type IV jacketed cable only)	3.5.19	4.7.21
Tensile strength and elongation (unaged) (types II and IV only)	3.5.20	4.7.22

4.5.3 Retention of qualification. To retain qualification, the contractor shall forward a report at 12 month intervals to the qualifying activity. The qualifying activity shall establish the reporting date. The report shall consist of the following:

a. A summary of the results of the test performed for inspection of product for delivery, groups A and B, indicating, as a minimum, the number of lots that have passed and the number that have failed. The results of tests of all reworked lots shall be identified and accounted for.
b. The results of tests performed for periodic inspection, group C, including the number and mode of failures. The report shall include results of all periodic inspection tests performed and completed during the 12-month period. If the test results indicate nonconformance with specification requirements, and corrective action acceptable to the qualifying activity has not been taken, action may be taken to remove the failing product from the qualified products list.

Failure to submit the report within 60 days after the end of the 12-month period may result in loss of qualification for the product. In addition to the periodic submission of inspection data, the contractor shall immediately notify the qualifying activity at any time during the 12-month period that the inspection data indicates failure of the qualified product to meet the requirements of this specification.

In the event that no production occurred during the reporting period, a report shall be submitted certifying that the company still has capabilities and facilities necessary to produce the item. If during two consecutive reporting periods there has been no production, the manufacturer may be required, at the discretion of the qualifying activity, to submit group C test results covering a representative product from each group as defined by 4.6.

4.6 Conformance inspections.

4.6.1 Inspection of product for delivery. Inspection of product for delivery shall consist of groups A and B inspections.

4.6.1.1 Inspection lot. An inspection lot shall consist of all cable covered by a single specification sheet, produced under essentially the same conditions, and offered for inspection at one time.

4.6.1.2 Group A inspection. Group A inspection shall consist of the inspections specified in table V, in the order shown.

TABLE V. Group A inspection.

Inspection	Requirement paragraph	Test paragraph	Sampling plan
Subgroup I			
Visual and mechanical inspection	3.1, 3.3, 3.4, 3.6, and 3.7	4.7.1	See 4.6.1.2.1
Subgroup II			
Continuity	3.5.1	4.7.2	100% of reels shall be inspected
Dielectric withstanding voltage	3.5.2	4.7.3	
Spark test (jacketed cable only)	3.5.3	4.7.4	
Insulation resistance	3.5.4	4.7.5	
Leak test (type I)	3.5.5	4.7.6	

4.6.1.2.1 Group A sampling plan. Sampling and inspection for subgroup I shall be in accordance with table VI except that the number of sample units shall not be more than two times the number of reels in the inspection lot. No more than two sample units shall be selected from each reel of cable. When two sample units are required from one reel, they shall be cut from each end of the reel. For subgroup II, each reel in the inspection lot shall be tested. If one or more defects are found, the lot shall be screened for that particular defect(s) and the defect(s) removed. A new sample shall be selected in accordance with table VI and all group A tests again performed. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

4.6.1.2.2 Sample unit. For subgroup I, a sample unit is a piece of cable three feet in length and cut from the reel of cable. For subgroup II, the complete length of cable on each reel shall be tested.

TABLE VI. Sampling plan for Group A inspection.

Inspection lot size cable length (in feet)	Metric equivalents for cable length (in meters)	Number of sample units for group A
0 to 5,000	0 to 1,524	1
5,001 to 15,000	1,524.30 to 4,572	5
15,001 to 25,000	4,572.30 to 7,620	8
25,001 to 65,000	7,620.30 to 19,812	13
65,001 to 160,000	19,812.30 to 48,768	20
160,001 to 440,000	48,768.30 to 134,112	32
440,001 to 2,200,000	134,112.30 to 670,560	50
2,200,001 and over	670,560.30 and over	80

4.6.1.3 Group B inspection. Group B inspection shall consist of the inspections specified in table VII in the order shown. The samples shall be selected from inspection lots that have passed the group A inspection.

4.6.1.3.1 Group B sampling plan. The sampling plan shall be in accordance with table VIII. If one or more defects are found, the lot shall be screened for that particular defect (s) and the defects removed. After screening and removal of defects, a new sample shall be randomly selected and subjected to all tests in accordance with table VII. If one or more defects are found in the second sample, the lot shall be rejected and shall not be supplied to this specification.

TABLE VII. Group B inspection.

Inspection	Requirement paragraph	Test paragraph	Number of samples
Attenuation VSWR	3.5.63.5.10	4.7.7 4.7.11	See table VIII

TABLE VIII. Sampling plan for group B inspection.

Inspection lot size cable length (in feet)	Metric equivalents for cable length (in meters)	Number of sample units for group B
0 to 15,000	0 to 4,572	1
15,001 to 65,000	4,752.30 to 19,812	2
65,001 to 160,000	19,812.30 to 48,768	3
160,001 to 440,000	48,768.30 to 134,112	5
440,001 and over	134,112.30 and over	8

4.6.1.3.2 Sample unit. A sample unit is a piece of cable from the reel of cable and the length specified for the applicable test method.

4.6.1.3.3 Disposition of sample units. Sample units which have passed all of group B inspections may be delivered on the contract or purchase order if the lot is accepted and if the sample units are undamaged and within specifications. Reworking of defective samples is not allowed.

4.6.2 Periodic inspection. Periodic inspection shall consist of group C inspections and shall be made after 36 months of qualifying initially and every 36 months thereafter. Except where the results of this inspection show noncompliance with the applicable requirements (see 4.6.2.1.4), delivery of products which have passed groups A and B inspections shall not be delayed pending the results of these periodic inspections.

4.6.2.1 Group C inspection. Group C inspection shall consist of the inspections specified in table IX in the order shown. Group C inspection shall be made on sample units selected from inspection lots which have passed groups A and B inspections.

4.6.2.1.1 Sample size. Five hundred feet (152.4 meters) of cable of the type and size specified (see 3.1) shall be subjected to group C inspection.

4.6.2.1.2 Failures. One or more failures shall be cause for rejection of the entire lot.

4.6.2.1.3 Disposition of sample units. Sample units which have been subjected to group C inspection shall not be delivered on the contract.

TABLE IX. Group C inspection.

Inspection	Requirement paragraph	Test method paragraph
Velocity of propagation (when specified, see 3.1)	3.5.7	4.7.8
Capacitance (when specified, see 3.1)	3.5.8	4.7.9
Impedance	3.5.9	4.7.10
Cold bend	3.5.11	4.7.12
Flexibility	3.5.12	4.7.13
Temperature cycling	3.5.13	4.7.14
Thermal shock	3.5.14	4.7.15

4.6.2.1.4 Noncompliance. If a sample fails to pass group C inspection, the manufacturer shall notify the qualifying activity and the cognizant inspection activity of such failure and take corrective action on the materials or processes or both, as warranted, and on all units of product which can be corrected and which were manufactured under essentially the same conditions with essentially the same materials and processes, and which are considered subject to the same failure. Acceptance and shipment of the product shall be discontinued until corrective action acceptable to the qualifying activity has been taken. After the corrective action has been taken, group C inspection shall be repeated on additional sample units (all inspections, or the inspection which the original sample failed, at the option of the qualifying activity). Groups A and B inspections may be reinstituted; however, final acceptance and shipment shall be withheld until the group C reinspection has shown that the corrective action was successful. In the event of failure after reinspection, information concerning the failure shall be furnished to the cognizant inspection activity and the qualifying activity.

4.7 Methods of inspection.

4.7.1 Visual and mechanical examination. The cables shall be examined to verify that the design, construction, physical dimensions, marking, and workmanship are in accordance with the applicable requirements (see 3.1, 3.3, 3.4, 3.6, and 3.7). A micrometer caliper or an instrument of equal accuracy shall be used to determine the proper dimensions.

4.7.2 Continuity (see 3.5.1). A direct current (dc) potential of 6 volts maximum shall be applied, through an appropriate indicator, to the inner and outer conductors of the reel of cable. The voltage may be applied to the conductors individually or in series.

4.7.3 Dielectric withstanding voltage (see 3.5.2). The cable shall be tested in accordance with method 6111 of FED-STD-228 (100% of cable shall be tested) with the following exceptions:

a. The cable shall not be immersed in water.
b. Direct current voltage is acceptable.
c. The test shall be performed on finished cable only.
d. The high potential shall be applied to the inner conductor and the outer conductor shall be grounded.
e. Test voltage shall be applied for 1 minute, minimum.

4.7.4 Spark test (jacketed cable only) (see 3.5.3). Jacketed cables shall be tested in accordance with method 6211 of FED-STD-228 (100% of cable shall be tested). The following details shall apply:

a. Unless otherwise specified (see 3.1), the test voltage shall be 60 hertz (Hz) root-mean-square (rms) voltage as indicated in table X.
b. The potential shall be applied between the outer conductor and the outer surface of the jacket.

TABLE X. Voltage for spark test.

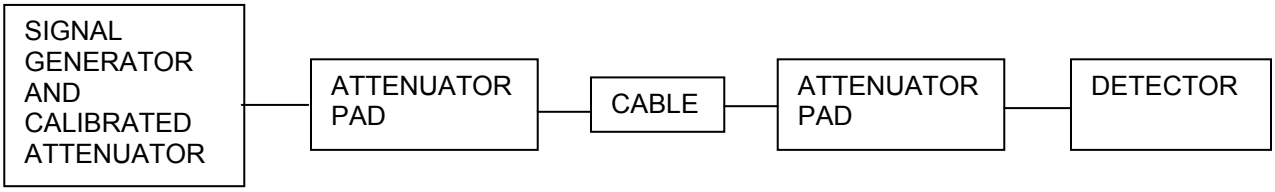
Jacket thickness (minimum in inches)	Jacket thickness (equivalents in millimeters)	Voltage (rms)
.035	0.89	7,000
.060	1.52	9,000
.065	1.65	10,000

4.7.5 Insulation resistance (see 3.5.4). The cable shall be tested in accordance with method 6031 of FED-STD-228 except that the cable shall not be immersed in water. The following details shall apply:

a. The test shall be performed on each length of complete cable.
b. The test voltage shall not be less than 200 volts.
c. The potential shall be applied to the inner conductor with the outer conductor grounded.

4.7.6 Leak test (type I) (see 3.5.5). The capacitance of a 7-foot (2.1 meters) specimen shall be measured and then the specimen shall be placed in a pressure tank filled with water so that at least 5 feet (1.5 meters) of the cable is immersed and both ends are exposed to air. The water shall then be pressurized to 25 pounds per square inch gauge (psi) for at least 8 hours. The cable shall then be removed and within 1 hour the capacitance shall again be measured. The capacitance measuring system shall be accurate to within ± 1%.

4.7.7 Attenuation (see 3.5.6). The attenuation, expressed in dB per 100 feet (30.5 meters), shall be measured at a sufficiently low-power level such that the resulting temperature rise will be negligible. An acceptable method for measuring attenuation is as follows:



In the block diagram, a suitable length of cable with an attenuation within the measurement range accuracy of the equipment is inserted between the connector. The signal generator and calibrated attenuator are adjusted to produce a reasonable indication at the detector, when the detector is tuned. The detector reading is noted, and the calibrated attenuator output level is recorded. The cable under test is then withdrawn and the circuit completed with the connectors (or a very short length of cable). With the detector tuned, the calibrated attenuator is readjusted to reproduce the original reading at the detector and the attenuator output level is again recorded. Attenuation is then computed as follows:

$$A = \frac{100}{L} \text{ (Difference in calibrated attenuator reading in dB)}$$

Where:
A = Attenuation in dB per 100 feet (30.5 meters).
L = Length of cable under test (in feet).

For measurements at frequencies of 400 megahertz (MHz), or less, the characteristic impedance of the attenuator pads and connectors shall preferably be the same as that of the cable under test. For measurement at frequencies of 1,000 MHz or above, the attenuator pads, connectors, and test cable shall be mated to the same characteristic impedance. Both pads shall be high enough in attenuation value to minimize the error caused by any mismatch of the signal generator and detector. For the majority of measurements, it is recommended that the attenuation of each pad be approximately 10 dB. Tuning stubs may be used in the circuit for impedance matching purposes. Any other method approved by the procuring activity may be used in lieu of that described herein. When the attenuation of the cable under test is less than 1 dB at the test frequency, the attenuation may be measured by the short circuit method. An alternate method may be used upon approval by the Government.

4.7.8 Velocity of propagation (when specified, see 3.1) (see 3.5.7). The velocity of propagation is determined in terms of the percentage of velocity of wave propagation along the cable to the velocity of an electromagnetic wave in free space. The velocity of propagation in the cable shall be found by resonating a length of cable at a frequency between 10 MHz and 200 MHz with one end short-circuited or open-circuited or by equivalent method subject to the approval of the procuring activity. The same sample may be used for velocity and capacitance measurements.

$$\text{Percent velocity} = \frac{\text{fr x length (ft)}}{2.46\ N}$$

Where:
fr = Resonant frequency in MHz.
N = Number of quarter wavelengths in the cable.

4.7.9 Capacitance (when specified, see 3.1) (see 3.5.8). The capacitance of the cable shall be measured to three significant figures, at any one frequency between 1 kilohertz (kHz) and 1 MHz reported in picofarads (pf) per foot. An electrically short piece, that is less than 1/40 of a wavelength of cable, shall be used for this test.

4.7.10 Impedance (see 3.5.9).

4.7.10.1 Specimen. The specimen shall be 10 feet (3.05 meters) minimum or 2 dB maximum at 3 GHz whichever is shorter.

4.7.10.2 Procedure. The specimen shall be prepared for testing by assembling appropriate connections to the cable ends. The equipment shall include a time domain reflectometer (TDR). The rise time of the TDR shall be 150 picoseconds or less, and the vertical sensitivity of the system shall provide for a minimum resolution of 0.5 ohm per centimeter (cm). A precision 30-cm air line of the same nominal characteristic impedance as the specimen shall be connected between the TDR and the connector-cable assembly. The characteristic impedance of the specimen shall then be measured compared to the precision air-line. The connector-cable assembly shall then be turned end-to-end and the measurement repeated. For cables of other than 50 and 75 ohms characteristic impedance, where precision air-lines, loads, or proper impedance measuring equipment are not available, the characteristic impedance may be determined by calculation from the capacitance measurement determined (see 4.7.9) and the velocity of propagation measurement determined (see 4.7.8), using the following formula:

$$Zo = \frac{101{,}670}{\text{Velocity of propagation (\%)} * \text{Capacitance (pf/ft)}}$$

4.7.11 VSWR (see 3.5.10). The VSWR of 500 foot (152 meters) minimum length of cable shall be measured over a frequency range as specified (see 3.1). A swept frequency technique capable of measuring a VSWR of 1.06 or less shall be used. The measuring system may be in the form of directional couplers, a hybrid, or a slotted line and shall have a directivity of at least 30 dB at the highest frequency of measurement.

4.7.12 Cold bend (jacketed cable only) (see 3.5.11). A straight section of finished cable, whose length shall be sufficient to make one revolution around a mandrel with a diameter as specified (see 3.1), in the case of 1.625 inch diameter cable, it shall be one-half revolution, shall be placed in a chamber and subjected to a temperature of -30°C $\pm$ 2°C for at least 48 hours. After this period, the cable shall be removed and within 30 seconds subjected to a 180° bend around the mandrel specified.

4.7.13 Flexibility (see 3.5.12). The length of cable to be flexed shall be sufficient to provide three complete coils around the mandrel with a diameter as specified (see 3.1). One end of the cable shall be clamped circumferentially to the mandrel at any two points, approximately 45° apart. The specimen shall then be coiled around the mandrel for not less than one complete revolution – and then uncoiled and straightened by pulling on the free cable end – a total of 20 times. (The mandrel shall be rotated not less than 20 times, 720°, to accomplish this.) Coiling and uncoiling shall be performed at a rate of not less than one revolution per minute (rpm) nor more than 5 rpm; that portion of the cable which is coiled about the mandrel shall be kept snug about the mandrel at all times (by maintaining tension in the cable). Although no special tools shall be used during the bending of the cable, a mechanism may be provided to guide the cable on the mandrel. After the twentieth cycle, the sample shall be tested as specified in 4.7.6 and 4.7.11. VSWR may be measured on the sample while coiled.

4.7.14 Temperature cycling (see 3.5.13). A length of cable with connectors properly attached shall be coiled on a mandrel with a diameter as specified (see 3.1). The cable shall be sufficiently long to make one complete revolution (360º) around the mandrel (in the case of 1.625 (41.27mm) inch diameter cable, it shall be one-half revolution (180º). The mandrel, with cable attached, shall be placed in a chamber and subjected to the temperature cycling specified in table XI. After the cycling has been completed, the cable shall be tested as specified in 4.7.11.

TABLE XI. Temperature cycling.

Step	Temperature (ºC)	Time (hours)	Number of cycles
1	80	48 minimum	10
2	25	48 minimum	10

4.7.15 Thermal shock (see 3.5.14). A piece of cable, length as specified (see 3.1), shall be prepared at both ends by exposing one inch of center conductor and one inch of dielectric (see figure 1). Removal of each layer shall be accomplished by an even cut perpendicular to the longitudinal axis of the cable. A razor blade, or equivalent, shall be used to cut the insulation. The specimen shall be formed into a loose coil with the largest convenient radius, and shall be laid on a screen for handling throughout the test. The length of exposed conductors and dielectric at each end of the specimen shall be measured to the nearest .031 inch (0.79 mm).

The screen (with cable) shall be placed for a minimum of 4 hours in a preheated, air-circulating oven at a temperature of 80ºC ± 2ºC. It shall then be removed from the oven and within 2 minutes be placed into a chamber maintained at -55ºC ± 2ºC. The specimen shall remain there for a minimum of 4 hours. It shall then be removed from the chamber and allowed to warm to room temperature. At the conclusion of this cycle, the length of the dielectric and of the inner conductor at each end of the cable shall be measured to the nearest .031 inch (0.79 mm). This thermal shock and the measurements shall be repeated for an additional three cycles (a total of four cycles). Cables shall be examined for changes in length of their various exposed areas at both ends.

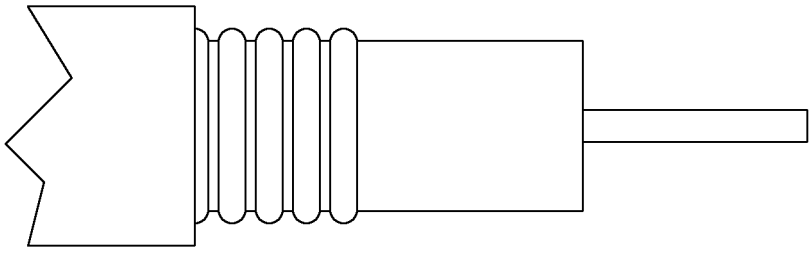


FIGURE 1. End view of test cable.

4.7.16 Continuous lengths (see 3.8). Unless otherwise specified in the acquisition requirements (see 6.2) the inspection requirements for continuous cable lengths shall be satisfied by the contractor's certificate of conformity and the presence of the required piece length markings on the spools or reels. However, the Government reserves the right to examine such certified lot if deemed necessary to assure that the length actually conforms to the requirements. When the acquisition requirements (see 6.2) specifies examination of cable lengths, the Government representative shall examine the cable at his own discretion to determine conformity to this requirement. In measuring continuous cable lengths where marking or stripping of jacket has been used in lieu of cutting the cable to identify dielectric test failures or areas not properly tested, such marking or stripping shall be considered equivalent to severance of the cable at the two ends of each marked or stripped area.

4.7.17 Flame propagation (see 3.5.15). Flame propagation shall be tested in accordance with MIL-C-17.

4.7.18 Acid gas generation (see 3.5.16). Acid gas generation shall be tested in accordance with MIL-C-17.

4.7.19 Halogen content (see 3.5.17). The halogen content shall be determined as specified in MIL-C-17.

4.7.20 Smoke index (see 3.5.18). The smoke index shall be measured as specified in MIL-C-17.

4.7.21 Toxicity index (see 3.5.19). The toxicity index shall be determined as specified in MIL-C-17.

4.7.22 Tensile strength and elongation (see 3.5.20). Tensile strength and elongation shall be tested in accordance with MIL-C-17.

5. PACKAGING

5.1 Packaging (see 6.2) For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When actual packaging of materiel is to be performed by DoD or in- house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the Military Service System Commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Cables covered by this specification are intended for use in radio frequency applications.

6.2 Acquisition requirements. Acquisition documents must specify the following:

a. Title, number, and date of this specification.
b. Title, number, and date of the applicable specification sheet.
c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual document referenced (see 2.1).
d. PIN (see 1.2.1).
e. Packaging (see 5.1).
f. Total footage of cable.

6.3 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time of award of contract, qualified for inclusion in the Qualified Products List QPL No. 28830 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or purchase orders for the products covered by this specification. The activity responsible for the qualified products list is the Defense Supply Center Columbus, P.O. Box 3990, Columbus, Ohio 43218-3990, attention VQ and information pertaining to qualification of products may be obtained from that activity.

6.4 Environmentally preferable material. Environmentally preferable materials should be used to the maximum extent possible to meet the requirements of this specification. Table XII lists the Environmental Protection Agency (EPA) top seventeen hazardous materials targeted for major usage reduction. Use of these materials should be minimized or eliminated unless needed to meet the requirements specified herein (see 3.3).

TABLE XII. EPA top seventeen hazardous materials.

Benzene	Dichloromethane	Tetrachloroethylene
Cadmium and Compounds	Lead and Compounds	Toluene
Carbon Tetrachloride	Mercury and Compounds	1,1,1 - Trichoroethane
Chloroform	Methyl Ethyl Ketone	Trichloroethylene
Chromium and Compounds	Methyl Isobutyl Ketone	Xylenes
Cyanide and Compounds	Nickel and Compounds	

6.5 Subject term (key word) listing.

Copper
Polyethylene

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

CONCLUDING MATERIAL

Custodians:
Army – CR
Navy – EC
Air Force – 11
DLA - CC

Preparing activity:
DLA – CC

(Project 6145-2380-000)

Review activities:
Navy – AS, MC, SH
Air Force – 19, 99

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at http://assist.daps.dla.mil .