Raychem Wire and Cable
501 Oakside Avenue, Redwood City, CA 94063-3800

WIRE AND CABLE, ELECTRIC, RADIATION-CROSSLINKED, EXTRUDED, MODIFIED, FLUOROPOLYER-INSULATED COPPER OR COPPER ALLOY

1. SCOPE

1.1 SCOPE

This specification covers radiation-crosslinked, extruded, modified, fluoropolymer-insulated wire and single- and multiple-conductor cables which may be shielded and jacketed. This insulation may be used alone or in combination with other insulation materials and is intended for use as a high-temperature, thin-wall insulation system in military, aerospace, and general purpose hookup wire applications.

1.2 CLASSIFICATION

Products in accordance with this specification shall be of the following types, as specified in the applicable specification sheet.

Finished Wire — A single conductor, insulated as specified in the applicable specification sheet.

Finished Cable — Any construction other than finished wire, utilizing a wire or wires with or without shielding, or with or without an outer jacket.

1.2.1 Temperature Rating

The maximum conductor temperature of the finished wire and cable for continuous use shall be as specified in the applicable specification sheet.

2. APPLICABLE DOCUMENTS

2.1 GOVERNMENT-FURNISHED DOCUMENTS

The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

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2.1.1 Department of Defense

SPECIFICATIONS

Federal

UU-T-450	Tissue, Facial

Military

AS22759	Wire, Electric, Fluoropolymer-Insulated, Copper or Copper Alloy
MIL-D-26937	Detergent, Synthetic, Anionic (Alkyl Benzene Sulfonate)

STANDARDS

Federal

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

Military

MIL-STD-104	Limits for Electrical Insulation Color
MIL-STD-109	Quality Assurance Terms and Definitions
MIL-STD-681	Identification Coding and Application of Hook Up and Lead Wire

(Copies of Department of Defense documents may be obtained from the Naval Publications and Forms Center, Standardization Documents Order Desk, Bldg. 4D, 700 Robbins Ave., Philadelphia, PA 19111-5094; or at https://quicksearch.dla.mil.)

2.1.2 Department of Transportation, Federal Aviation Administration

FEDERAL AVIATION REGULATIONS (FAR)

Part 25	Airworthiness Standards: Transport Category Airplanes

(Copies of Department of Transportation, Federal Aviation Administration documents may be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C. 20402; or at www.faa.gov.)

2.2 OTHER PUBLICATIONS

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

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2.2.1 American Society for Testing and Materials (ASTM)

E 104 Standard Recommended Practice for Maintaining Constant Relative Humidity by Means of Aqueous Solutions

(Copies of ASTM publications may be obtained from the American Society for Testing and Materials, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959; or at www.astm.org.)

2.2.2 American Society for Quality (ASQ)

ASQ Z1.4 DOD Preferred Methods for Acceptance of Product

(Copies of ASQ documents may be obtained from the American Society of Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203; or at www.asq.org.)

2.2.3 National Electrical Manufacturers Association (NEMA)

WC 27500 Standard for Aerospace and Industrial Electrical Cable

(Copies of NEMA publications may be obtained from the National Electrical Manufacturers Association, 1300 N. 17th Street, Rosslyn, VA 22209; or at www.nema.org .)

3. REQUIREMENTS

3.1 SPECIFICATION SHEETS

The requirements for the individual wires and cables furnished under this specification shall be as specified herein and in accordance with the applicable specification sheet. Specification sheet shall mean the Specification Control Drawing (SCD) or the Customer Specification Report (CSR) when used in conjunction with the SCD, with the SCD taking precedence over this specification and the CSR taking precedence over the SCD and this specification. An SCD or CSR may include (but not be limited to) requirements, changes in procedures, or Quality Assurance Inspection levels which take precedence over this specification.

3.2 QUALIFICATION

The wire and cable furnished under this specification shall be a product which has been tested and has passed the qualification tests specified herein (see 4.2).

3.3 MATERIALS

3.3.1 Conductor Materials

Conductor materials shall be in accordance with AS22759 and the applicable specification sheet.

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3.3.2 Shield Materials

Shield strands shall conform to the requirements for conductor materials (3.3.1). When specified, conforming strands shall be flattened and rectangular in cross section.

3.3.3 Wraps

Wrap tapes, where specified in the applicable specification sheet, shall be applied with an overlap of 25 percent, minimum, and shall meet the material and construction requirements of the applicable specification sheet. Overlap is defined as the percentage of tape width covered by successive turns of tape.

3.3.4 Insulation and Jacket Materials

Insulating materials, used for wire insulation or cable jackets, shall be radiation-crosslinked, extruded, modified fluoropolymer.

3.4 IN-PROCESS

3.4.1 Conductor Splices

Splices shall be in accordance with AS22759.

3.4.2 Insulation Flaws

One hundred percent of the wire shall pass the impulse dielectric test or the spark test of AS22759 at any designated point or points in the manufacturing process prior to completion of the finished wire using the voltage specified in the applicable specification sheet.

3.5 FINISHED WIRE AND CABLE

Finished wire and cable shall conform to the following requirements, as applicable, those of Table 1, and those of the applicable specification sheet (3.1).

3.5.1 Crosslinking Tests and Life Cycle

3.5.1.1 Finished Wire - Accelerated Aging (Crosslinking Proof) and Life Cycle

When finished wire is tested in accordance with 4.6.1, there shall be no cracking of the insulation and no dielectric breakdown.

3.5.1.2 Finished Cable - Accelerated Aging and Life Cycle

When finished cable is tested in accordance with 4.6.1, there shall be no cracking of the jacket and, when applicable, no dielectric breakdown of the jacket.

3.5.2 Color

Color shall be in accordance with MIL-STD-104, Class 1. White is preferred for both insulation and jacket. Colors specified other than white shall be selected in accordance with MIL-STD-681.

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3.5.3 Conductor and Shield Continuity

When finished cable is tested in accordance with WC 27500, there shall be no loss of continuity in the conductors or shield.

3.5.4 Identification of Product

When specified by the procuring activity, finished wire or cable shall be identified by a marking applied to the outer surface. The identification shall consist of the appropriate mark as specified by contract or the applicable specification sheet. The mark color shall be in accordance with MIL-STD-104, Class 1, and shall be contrasting to that of the marking surface. Identification shall be applied with the vertical axis of the printed characters parallel to the longitudinal axis of the wire or cable when the nominal diameter of the marking surface is 0.050 inch *(1.27 mm)* or smaller. The vertical axis of the printed characters may be either perpendicular or parallel to the longitudinal axis of the wire or cable when the nominal diameter of the marking surface exceeds 0.050 inch *(1.27 mm)*.

3.5.5 Immersion

When finished wire is tested in accordance with AS22759/32, the diameter increase shall be not more than 5 percent and there shall be no cracking of the insulation and no dielectric breakdown.

3.5.6 Insulation Flaws

One hundred percent of finished wire and unshielded, unjacketed cable shall pass the impulse dielectric test or the spark test of AS22759 using the voltage specified in the applicable specification sheet. The test shall be performed during the final winding of the wire or cable on shipment spools or reels.

3.5.7 Jacket Concentricity

When finished cable is tested in accordance with 4.6.8, the jacket concentricity shall be 70 percent, minimum.

3.5.8 Jacket Flaws

One hundred percent of finished shielded and jacketed cable shall pass the jacket flaws test in accordance with 4.6.9 using the voltage specified in the applicable specification sheet.

3.5.9 Wrap Test

When tested in accordance with 4.6.14, no cracking of the insulation is allowed. If the specification sheet does not specify a temperature, the test shall be performed at room temperature.

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TABLE 1.
REQUIREMENTS FOR FINISHED WIRE AND CABLE

Examination or Test	Requirement	Test Method	Quality Conformance Test and Group Number
Finished Wire			
Accelerated aging (Crosslinking proof)	Applicable specification sheet and 3.5.1.1	4.6.1	2
Blocking	Applicable specification sheet and AS22759	AS22759	
Color	Applicable specification sheet and 3.5.2	4.6.4	1
Concentricity	Applicable specification sheet	AS22759	2
Conductor diameter	Applicable specification sheet	4.6.4	1
Conductor elongation and breaking strength	Applicable specification sheet or AS22759	AS22759	1
Conductor material	Applicable specification sheet and 3.3.1	4.6.4	
Conductor resistance	Applicable specification sheet	AS22759	1
Conductor stranding	Applicable specification sheet	4.6.4	1
Finished wire diameter	Applicable specification sheet	4.6.4	1
Flammability	Applicable specification sheet	4.6.5	2
Fluoride Extraction	Applicable specification sheet	4.6.7	
Humidity resistance	Applicable specification sheet	AS22759	
Identification and color striping durability	Applicable specification sheet	AS22759	1
Identification of product	Applicable specification sheet and 3.5.4	4.6.4	1
Immersion	3.5.5.1	AS22759/32	
Insulation elongation and tensile strength	Applicable specification sheet	4.6.6	1
Insulation flaws	Applicable specification sheet and 3.5.6	AS22759	3
Insulation construction	Applicable specification sheet	4.6.4	1
Insulation material	Applicable specification sheet and 3.3.4	4.6.4	
Insulation resistance	Applicable specification sheet	AS22759	1
Insulation thickness	Applicable specification sheet	4.6.4	2
Life cycle	Applicable specification sheet and 3.5.1.1	4.6.1	
Low temperature-cold bend	Applicable specification sheet and AS22759	AS22759	2
Removability of insulation	AS22759	AS22759	1
Shrinkage	Applicable specification sheet	AS22759	2
Smoke test	Applicable specification sheet and AS22759	AS22759	
Solderability:			
Tin coated conductors only	Applicable specification sheet	AS22759	2
Silver coated conductors only	Applicable specification sheet	AS22759	
Surface resistance	Applicable specification sheet	4.6.10	
Thermal shock resistance	Applicable specification sheet	AS22759	2
Weight	Applicable specification sheet	AS22759	1
Wicking	Applicable specification sheet	4.6.13	2
Workmanship	AS22759	AS22759	1
Wrap test	Applicable specification sheet and 3.5.9	4.6.14	2

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TABLE 1. (Cont'd)
REQUIREMENTS FOR FINISHED WIRE AND CABLE

Examination or Test	Requirement	Test Method	Quality Conformance Test and Group Number	
			NON-CSR 1/	CSR 1/
Finished Cable				
Accelerated aging	Applicable specification sheet and 3.5.1.2	4.6.1	2	N/A
Blocking	Applicable specification sheet and WC 27500	WC 27500		2
Cabling	Applicable specification sheet and WC 27500	WC 27500	1	1
Conductor and shield continuity	3.5.3 and WC 27500	WC 27500	3	3
Crosslinked verification	WC 27500	WC 27500 and 4.6.11.1	N/A	2
Dielectric withstand	Applicable specification sheet and WC 27500	WC 27500	3	3
Dimensions	Applicable specification sheet	4.6.4	1	1
Flammability	Applicable specification sheet	4.6.5.1		2
Fluoride Extraction	Applicable specification sheet	4.6.7		
Insulation Flaws	Applicable specification sheet and 3.5.6	AS22759	3	3
Jacket color	Applicable specification sheet and 3.5.2	4.6.4	1	1
Jacket concentricity	3.5.7	4.6.8	2	2
Jacket elongation and tensile strength	Applicable specification sheet	4.6.6	1	2
Jacket flaws	Applicable specification sheet and 3.5.8	4.6.9	3	3
Jacket removability	WC 27500	WC 27500	1	1
Jacket material	Applicable specification sheet and 3.3.4	4.6.4		
Jacket thickness	Applicable specification sheet	4.6.4	2	1
Life cycle	Applicable specification sheet and 3.5.1.2	4.6.1		N/A
Low temperature-cold bend	Applicable specification sheet or WC 27500	WC 27500		2
Shield material and construction	Applicable specification sheet, 3.3.2 and WC 27500	WC 27500		
Shield coverage	Applicable specification sheet	WC 27500	1	1
Weight	Applicable specification sheet	4.6.12	1	1
Workmanship	WC 27500	WC 27500	1	1
Wraps	3.3.3	4.6.4	1	1

NOTE:
1/ A non-CSR cable is a cable that is ordered directly to a Raychem SCD.
A CSR cable is a cable that is ordered to a military or customer specification.

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4. QUALITY ASSURANCE PROVISIONS

4.1 RESPONSIBILITY FOR INSPECTION

The supplier is responsible for the performance of all the inspection tests specified herein. The supplier may utilize his own or any other inspection facility and services acceptable to the buyer. Inspection records of the examination and tests shall be kept complete and available to the buyer as required.

4.2 QUALIFICATION INSPECTION

Qualification inspection shall consist of all tests listed in Table 1, as applicable to finished wire or to finished cable.

4.2.1 Sampling for Qualification Inspection

Except as provided in 4.2.1.1, a finished wire or cable sample of the required length shall be tested for each range of wire or cable sizes for which qualification is desired. The sample may be any size of wire or cable within the size range specified below. Ten linear feet *(3 linear meters)* of the conductor or shield strand used in the manufacture of the finished wire or cable sample also shall be tested.

Wire Size Range		Required Length of Sample	
AWG	*mm2*	ft	*m*
30 through 26	*0.057 through 0.15*	200	*60*
24 through 16	*0.24 through 1.23*	200	*60*
14 through 10	*1.94 through 4.74*	200	*60*
8 through 0000	*8.60 through 106.9*	200	*60*

Cable Size Range (Overall Diameter)		Required Length of Sample	
in.	*mm*	ft	*m*
≤ 0.075	*≤ 1.91*	100	*30*
> 0.075 and ≤ 0.130	*> 1.91 and ≤ 3.30*	100	*30*
> 0.130 and ≤ 0.230	*> 3.30 and ≤ 5.84*	100	*30*
< 0.230	*< 5.84*	100	*30*

4.2.1.1 Optional Qualification Samples

In cases where two or more specification sheets cover finished wire or cable identical in materials and construction except for conductor (i.e., the specified conductor may be tin-coated copper, silver-coated high-strength copper alloy or as specified in the applicable specification sheet), the finished wire or cable sample and conductor or shield strand sample in accordance with 4.2.1 may qualify any one of the specification sheets. Approval of the qualification sample shall also qualify the same wire size range or ranges in each of the other specification sheets. (Note: For purposes of determining identity of construction in specification sheets under this provision, small differences in specified finished wire or cable diameter or weight which are due to differences in the specified conductor shall not be considered as constituting differences in construction of the wires or cables.)

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4.2.2 Qualification Test Reports

When requested by the procuring activity, qualification test reports shall be supplied plainly identified with the following information:

Qualification test report for
WIRE AND CABLE, ELECTRIC, RADIATION-CROSSLINKED, EXTRUDED, MODIFIED, FLUOROPOLYMER-INSULATED, COPPER OR COPPER ALLOY
Manufacturer's Name
Part number of qualification sample
Part numbers qualified
Specification 55A

4.3 QUALITY CONFORMANCE INSPECTION

Quality conformance inspection shall consist only of those examinations and tests listed in Table 1 and identified by a group number, as applicable to finished wire or to finished cable. Quality conformance inspection shall be performed on every lot of wire or cable procured under this specification.

Quality Control Plan QP-D-0006 specifies the inspection class for European manufactured products.

4.3.1 Sampling for Quality Conformance Inspection

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

4.3.1.1 Lot

The inspection lot shall include all wire and cable of one part number subjected to inspection at one time.

4.3.1.2 Unit of Product

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

4.3.1.3 Sample Unit (Groups 1 and 2 tests)

The sample unit for Groups 1 and 2 tests, except for the Group 1 insulation resistance test, shall consist of a single length of finished wire or cable chosen at random from the inspection lot and of sufficient length to permit all applicable examinations and tests. Unless otherwise specified, the length of the sample unit for Group 1 tests of Table 1 shall be 20 ft *(6 m)* and the length of the sample unit for Group 2 tests shall be 25 ft *(7.5 m)*. Not more than one sample unit for each group of tests shall be taken from a single unit of product.

4.3.1.3.1 *Sample Unit for Insulation Resistance Test (Group 1)*

The sample unit for the Group 1 insulation resistance test shall be a specimen 26 ft *(8 m)* in length selected at random from finished wire which has passed the insulation flaws test.

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4.3.1.4 Inspection Levels and Acceptable Quality Levels (AQL) (Groups 1 and 2 tests)

For Group 1, the inspection level shall be S-2 and the AQL shall be 6.5 percent in accordance with ASQ Z1.4; for Group 2, the inspection level shall be S-3 and the AQL shall be 1.5 percent.

4.3.1.5 Sampling and Acceptance Level for Group 3 Tests

Unless otherwise specified in the applicable specification sheet, the finished wire or cable sample for the Group 3 insulation flaws test or jacket flaws test shall be 100 percent of the finished wire or cable, and every length of the wire or cable shall be fully tested. Portions showing breakdown in these dielectric tests and ends or portions not subjected to the test shall be marked or removed. Unless otherwise specified in the applicable specification sheet, the finished cable sample for the Group 3 conductor and shield continuity and dielectric withstand tests shall be 100 percent of the finished cable. Portions showing breakdown in these dielectric tests shall be removed and the remaining lengths tested until no failure occurs.

4.3.1.6 Group N/A

Tests labeled as Group N/A are not to be tested unless they are required on the specification sheet. In such an event, and unless otherwise specified, they shall be considered a Group 2 test, except Life Cycle, Thermal Shock and Vacuum Stability which shall be considered as qualification.

4.3.2 Nonconforming Inspection Lots

Disposition of inspection lots found unacceptable under initial quality conformance inspection shall be in accordance with ASQ Z1.4.

4.4 PROCESS CONTROL INSPECTION

This inspection comprises tests and examinations (Table 2) of such a nature that they cannot be performed on the finished wire or cable and therefore must be performed at an appropriate stage of manufacture. Process control inspection shall be performed on every lot of wire or cable procured under this specification.

TABLE 2.
PROCESS CONTROL INSPECTION

Examination or test	Requirement	Test Method
Conductor material	3.3.1	4.6.4
Insulating material	3.3.4	4.6.4
Conductor splices	3.4.1	4.6.4
Insulation flaws (impulse dielectric test or spark test)	3.4.2	AS22759

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4.4.1 Sampling for Process Control Inspection

4.4.1.1 Conductor Material

Process control sample selection and inspection of uninsulated conductor shall be performed at receiving inspection. The conductor lot size, for purposes of sampling, shall consist of the number of reels of a given type and size of conductor received at one time from one supplier against a single purchase order. For lot sizes of 3 reels or less, one 15-ft *(4.5-m)* length of conductor shall be selected from each reel. For lot sizes of not less than 4 and not more than 25 reels, a minimum of three 15-ft *(4.5-m)* lengths of conductor shall be selected at random, in such a manner as to be representative of the material. For lot sizes in excess of 25 reels, the inspection level shall be Level 1 and the AQL shall be 4.0 percent in accordance with ASQ Z1.4.

4.4.1.2 Insulation Flaws (impulse dielectric test or spark test)

One hundred percent of the wire, after the application of the primary insulation, shall be tested in accordance with the applicable specification sheet and AS22759.

4.4.2 Rejection and Retest in Process Control Inspection

When a sample selected from an inspection lot fails to meet the specified test (Table 2), except the insulation flaws test (see 4.4.1.2), no items still on hand or later produced from that lot shall be accepted until the extent and cause of the failure has been determined.

4.4.2.1 Effect of Process Control Failure on Quality Conformance Testing

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

4.5 PERIODIC QUALIFICATION RE-EVALUATION

Materials from current production shall be evaluated periodically against the requirements of Table 1.

4.6 TEST METHODS

4.6.1 Crosslinking Tests and Life Cycle

For finished wire, 1 in. *(25 mm)* of insulation shall be removed from each end of a 24-in. *(600-mm)* specimen. The central portion of the specimen then shall be bent at least halfway around a horizontally positioned smooth stainless steel mandrel of the diameter specified in the applicable specification sheet. To prevent sticking of the specimen to the mandrel, the mandrel shall be covered with polytetrafluoroethylene in the form of either a dispersion coating or wrapped tape, provided that the diameter of the mandrel still conforms to the applicable specification sheet. Each end of the conductor shall be loaded with the weight specified in the applicable specification sheet so that the portion of the insulation between the

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conductor and mandrel is under compression while the conductor is under tension. This specimen, so prepared on the mandrel, shall be conditioned in an air-circulating oven for the time and at the temperature specified in the applicable specification sheet. For finished cable, 2 in. *(50 mm)* of the jacket shall be removed from each end of a 24-in. *(600-mm)* specimen. If applicable, the shield shall be pushed back and formed into a pigtail at each end of the specimen. One inch *(25 mm)* of the insulation of each of the primary wires then shall be removed from each end of the specimen. The cable specimen shall be conditioned hanging straight in the oven for the time and at the temperature specified in the applicable specification sheet. The velocity of air past the specimens (measured at room temperature) shall be between 100 and 200 ft *(30 and 60 m)* per minute. After conditioning, the oven shall be shut off, the door opened, and the specimens allowed to cool in the oven for at least 1 hour. When cool, the finished wire specimens shall be freed from tension, removed from the mandrel, and straightened. The finished wire and cable specimens then shall be subjected to the bend test (4.6.2). The voltage withstand test (4.6.11) shall then be conducted on finished wire specimens and shielded and jacketed cable specimens only.

4.6.2 Bend Test

At a temperature maintained between 20 and 25°C, one end of a finished wire specimen shall be secured to the mandrel and the other end to the weight specified in the applicable specification sheet. For finished cable specimens, the mandrel shall be as specified in Table 3 and sufficient weight shall be used to maintain contact with the mandrel. 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 turns in contact. The mandrel then shall be rotated in the reverse direction until the full length of the specimen 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 specimen. The specimen then shall be examined for cracking of the insulation or jacket, as applicable.

TABLE 3.
MANDREL DIAMETERS FOR CABLES FOR BEND TEST AFTER ACCELERATED AGING AND LIFE CYCLE

Finished Cable Diameter		Mandrel Diameter	
in.	***mm***	**in.**	***mm***
≤ 0.083	*≤ 2.11*	0.75	*19*
> 0.083 and ≤ 0.111	*> 2.11 and ≤ 2.82*	1.00	*25*
> 0.111 and ≤ 0.139	*> 2.82 and ≤ 3.53*	1.25	*32*
> 0.139 and ≤ 0.194	*> 3.53 and ≤ 4.93*	1.75	*44*
> 0.194 and ≤ 0.250	*> 4.93 and ≤ 6.35*	2.25	*57*
> 0.250 and ≤ 0.334	*> 6.35 and ≤ 8.48*	3.00	*76*
> 0.334 and ≤ 0.444	*> 8.48 and ≤ 11.3*	4.00	*102*
> 0.444 and ≤ 0.556	*> 11.3 and ≤ 14.1*	5.00	*127*
> 0.556 and ≤ 0.667	*> 14.1 and ≤ 16.9*	6.00	*152*
> 0.667 and ≤ 0.889	*> 16.9 and ≤ 22.6*	8.00	*203*
> 0.889 and ≤ 1.111	*> 22.6 and ≤ 28.2*	10.0	*254*
> 1.111 and ≤ 1.556	*> 28.2 and ≤ 39.5*	14.0	*356*
> 1.556 and ≤ 2.000	*> 39.5 and ≤ 50.8*	18.0	*457*

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4.6.3 Examination of Preparation for Delivery

Preparation for delivery of materials ready for shipment shall be examined to determine compliance with the requirements of Section 5.

4.6.4 Examination of Product

All samples of wire and cable shall be examined to determine conformance with this specification and the applicable specification sheet with regard to requirements not covered by specific test methods.

4.6.5 Flammability

4.6.5.1 Procedure 1

4.6.5.1.1 *Test Apparatus*

The test shall be performed within a test chamber approximately 1 ft *(0.3 m)* square by 2 ft *(0.6 m)* in height, open at the top and front to provide adequate ventilation for combustion but to prevent drafts. The specimen holder shall be so designed that the lower end of a 24-in. *(600-mm)* specimen is held by a clamp, while the upper end of the specimen passes over a pulley and can be suitably weighted to hold the specimen taut at an angle of 60 degrees with the horizontal, in a plane parallel to and approximately 6 in. *(150 mm)* from the back of the chamber. The test flame shall originate from a Bunsen type gas burner with an 0.250-in. *(6-mm)* inlet, a needle valve in the base for gas adjustment, a nominal bore of 0.375 in. *(9.5 mm)*, and a barrel length of approximately 4 in. *(100 mm)* above the air inlets. The burner shall be adjusted to furnish a 3-in. *(75-mm)* - high conical flame with an inner cone approximately 1 in. *(25 mm)* in length and a flame temperature not less than 954°C at its hottest point, as measured with an accurate thermocouple pyrometer. A sheet of facial tissue conforming to UU-T-450 shall be suspended taut and horizontal 9.5 in. *(240 mm)* below the point of application of the flame to the specimen and at least 0.50 in. *(13 mm)* from the chamber floor, so that any material dripping from the specimen shall fall upon the tissue.

4.6.5.1.2 *Test Procedure*

A 24-in. *(600-mm)* specimen shall be marked at a distance of 8 in. *(200 mm)* from its lower end to indicate the point for flame application and shall be placed in the specified 60-degree position in the test chamber. The lower end of the specimen shall be clamped in position in the specimen holder and the upper end shall be passed over the pulley of the holder and the applicable weight shall be attached. For wire, the weight shall be as specified for life cycle test of the same wire in the applicable specification sheet. For cable, the weight shall be sufficient to hold the specimen taut throughout the test. With the burner held perpendicular to the specimen and at an angle of 30 degrees from the vertical plane of the specimen (see Figure 1), the hottest portion of the flame shall be applied to the lower side of the specimen at the test mark. The period of test flame application shall be 30 seconds and the test flame shall be withdrawn immediately at the end of that period. The distance of flame travel upward along the specimen from the test mark and the time of burning after removal of the test flame shall be recorded; also the presence or absence of flame in the facial tissue due to incendiary dripping from the specimen. Charred holes or charred spots in the tissue shall be ignored in

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the absence of actual flame. Breaking of the wire specimens in size 24 or smaller shall not be considered as failure, provided the requirements for flame travel limits, duration of flame, and absence of incendiary dripping are met. The apparatus and procedure above conform to FAR, Part 25, Appendix F (g), except that the facial tissue is not required.

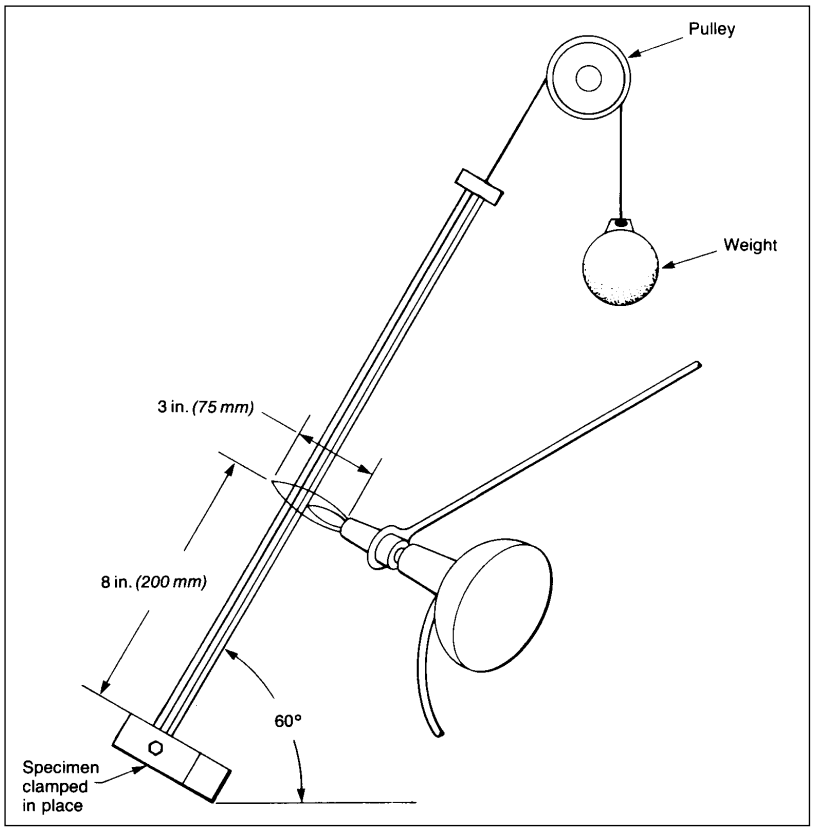


Figure 1. Flammability Test Apparatus, Procedure 1 (shown without chamber)

4.6.5.2 *Procedure 2*

Deleted.

4.6.6 Insulation Elongation and Tensile Strength

Specimens of the entire insulation shall be carefully removed from the conductor and tested for tensile strength and elongation in accordance with FED-STD-228, Methods 3021 and 3031, respectively, using 1-in. *(25-mm)* bench marks, a 1-in. *(25-mm)* initial jaw separation, and a jaw separation speed of 2 in. *(50 mm)* per minute. For dual wall insulations, where separate values are specified for the inner layer and for both layers together, the inner layer shall be carefully separated from the conductor and outer layer. For cables, the method shall be the same, but only the cable jacket shall be tested.

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4.6.7 Fluoride Extraction

Approximately 0.5 gram of insulation or jacket material shall be removed, cut into 3-inch *(76-mm)* lengths, and weighed to the nearest milligram. A polystyrene test tube (without its cap) shall also be weighed to the nearest 0.1 gram. After filling with approximately 14 ml of distilled water, the polystyrene test tube shall be reweighed. The insulation or jacket sample shall then be placed into the test tube, making sure that the sample is fully submerged, and the test tube cap is tightly attached. The test tube shall then be partially immersed in a 70 ± 2°C water bath so that the water levels of the bath and the test tube are equal. The test tube shall be so conditioned for 168 hours with the set-up being periodically checked to make sure that the sample is still submerged. After conditioning, the test tube shall be removed from the bath and allowed to cool. The cap shall then be removed from the test tube, and the tube, water and sample shall be weighed to determine the water weight loss. If the water loss is more than 0.5 gram, the test shall be rerun. Otherwise, 5 ml of the test tube water shall be analyzed for fluoride ion content using an Ion Chromatograph. The fluoride ion content shall be reported in ppm of water.

A blank test in accordance with 4.6.7.1 should also be conducted in case the result is needed for calculation purposes.

4.6.7.1 Blank Test

A blank test follows the same procedure as 4.6.7 except that a specimen is not included. What is tested is the distilled water and the sample tube. Ideally, there are no fluoride ions in either the test tube or the distilled water such that the result for the blank test would be zero. However, there may be a low non-zero result (i.e. 0.005 ppm). If this occurs, the ppm of fluoride for the blank test must be subtracted from the ppm of fluoride obtained from the specimen. A blank test also performs the same function as a calibration as it can indicate a problem with the test procedure. For example, should the blank test produce a result of 15 ppm of fluoride, this would be an indication that the ion chromatograph is not functioning correctly, tap water was used in place of distilled water, etc.

4.6.7.2 Calculation

If necessary, the blank test result shall be subtracted from the sample result to obtain the net fluoride ion content (ppm). The fluoride ion content, of the insulation or jacket weight, shall then be calculated as follows:

$$\text{F ion} = \text{Net F ion (ppm)} \times \text{Original water weight} / \text{Sample weight}$$

4.6.8 Jacket Concentricity

The concentricity of the cable jacket shall be determined by first locating and recording the minimum wall thickness measured on a cross section of the jacket. The maximum wall thickness of this same cross section of the jacket shall be measured and recorded. The ratio of the minimum wall thickness to the maximum wall thickness shall define the concentricity. All wall thickness measurements shall be made under suitable magnification. The wall thickness shall be the radial distance between the inner and outer rim of the jacket.

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4.6.9 Jacket Flaws

Finished cable shall be tested in accordance with the jacket flaws test of WC 27500, or the procedure of the impulse dielectric test of AS22759 with the shield grounded at one or both ends.

4.6.10 Surface Resistance

The surface resistance of the finished wire shall be measured using the procedure of FED-STD-228, Method 6041, except that the required humidity shall be maintained by ASTM E 104, Method A and without instrumentation of the chamber. All specimens, after having been provided with the required electrodes, but prior to testing, shall be cleaned by the procedure described in the test method. The specimens shall be positioned in the test chamber so that their ends are at least 1 in. *(25 mm)* from any wall of the chamber.

4.6.11 Voltage Withstand Test

The uninsulated ends of the specimen shall be attached to an electric lead. The specimen shall be immersed in a 5-percent, by weight, solution of sodium chloride in water at 20 to 25°C, except that the uninsulated ends and 1.5 in. *(38 mm)* of insulated wire or cable at each end of the specimen shall protrude above the surface of the solution. After immersion for 5 hours, the voltage specified in the applicable specification sheet at 60 Hz shall be applied between the conductor or the shield, as applicable and an electrode in contact with the liquid. The voltage shall be gradually increased at a uniform rate from zero to the specified voltage in 0.5 minute, maintained at that voltage for a period of 5 minutes for finished wire specimens and 1 minute for finished cable specimens, and gradually reduced to zero in 0.5 minute.

4.6.11.1 Cables Containing a Jacket Between Two Shields

For cables containing a jacket between two shields, the voltage withstand test of 4.6.11 or WC 27500, as applicable, shall additionally be conducted on the inner jacket with the voltage as specified in the applicable specification sheet being applied between the two shields.

4.6.12 Weight

The weight of each lot of finished cable shall be determined in accordance with the procedure for finished wire in AS22759.

4.6.13 Wicking

A specimen of each finished wire size to be tested shall be cut with square ends. The length of the specimen shall be 4 ± 1/16 in. *(100 ± 2 mm)*. The specimen shall be vertically immersed for 2 in. *(50 mm)* of its length in a fluorescent dye solution contained in an open test tube and shall be conditioned thus for 24 hours at room temperature in a draft-free room. The fluorescent dye solution shall be prepared by dissolving 0.02 g of Rhodamine B dye in 30 ml of ethyl alcohol and diluting with 2 liters of distilled water containing 3 ml of an anionic wetting agent conforming to MIL-D-26937. After conditioning, the specimen shall be removed from the fluorescent dye solution and excess solution on the surface shall be

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removed immediately by wiping gently with a clean, dry, lint-free cloth. The outer layer of insulation shall be removed from the specimen and the outside of the inner layer of insulation and the inside of the outer layer of insulation shall be examined under ultraviolet illumination for evidence of fluorescent dye. The distance that the dye has traveled from the end of the specimen between the outer and inner layers shall be recorded as the distance of wicking.

4.6.14 Wrap Test

A specimen of finished wire shall be tested in accordance with AS22759 "wrap back test" for extruded insulation, except 8 AWG and larger shall be wound around a mandrel with the diameter 3 times the outside diameter of the wire.

5. PREPARATION FOR DELIVERY

5.1 PACKAGING AND PACKING

5.1.1 Wire and cable shall be delivered wound on reels or spools in accordance with 5.1.2. Unless otherwise specified, the minimum acceptable finished wire lengths shall conform to Table 4. The wire and cable shall be wound on the reel or spool in such a manner that all ends are accessible.

TABLE 4.
FINISHED WIRE LENGTHS

Wire Size Range		Minimum percentage of total length in shipment with lengths greater than:			
AWG	*mm²*	1000 ft *(305 m)*	500 ft *(152 m)*	100 ft *(30.5 m)*	50 ft *(15.2 m)*
30 through 16	*0.057 through 1.23*	50	80	100	---
14 through 10	*1.94 through 4.74*	30	50	100	---
8 through 0000	*8.60 through 106.9*	--	50	80	100

5.1.2 Reels and Spools

Reels and spools shall be of a nonreturnable type. Each reel and spool shall have an appropriate diameter for the respective wire size. In no case shall the barrel of the reel or spool have a diameter less than 3.5 in. *(90 mm)*. Reels and spools shall be suitably finished to prevent corrosion under typical storage and handling conditions.

5.1.3 Containers

Unless otherwise specified (see 6.1), wire and cable shall be delivered in standard commercial containers so constructed as to ensure acceptance by common or other carrier for safe transportation at the lowest rate to the point of delivery.

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5.1.4 Marking of Shipments

All spools or reels and shipping container labels shall be identified with the following information:

Specification Part Number
Lot Number
Quantity in Feet *(or Meters)*
Name of Manufacturer

6. NOTES

6.1 ORDERING DATA

Procurement documents should specify the following:

a. Title, number, and date of this specification
b. Applicable specification sheet part number
c. Quantity
d. Special preparation for delivery requirements, if applicable.

6.2 METRIC UNITS

Unless otherwise specified, the metric units noted herein are for information only.

6.3 AS22759

Whatever AS22759 refers to “applicable specification sheet”, use the applicable TE Connectivity specification sheet (3.1).

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