AEROSPACE STANDARD

AS50861™	REV. C

Issued	1998-03
Reaffirmed	2004-06
Revised	2018-10
Stabilized	2024-11

Superseding AS50861B

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

(FSC 6145)

RATIONALE

AS50861C is being stabilized because the processes/product is considered mature and the committee does not anticipate future technical changes. Stabilization does not imply the process or product is unacceptable for applications for which it is designed. Any technical changes noted by a supplier or user which results in a product or requirement change will be addressed by a new revision. The components are no longer authorized for new aircraft applications (refer to AS50881). Qualified suppliers are still maintained.

STABILIZED NOTICE

This document has been declared “STABILIZED” by SAE AE-8D Wire and Cable Committee and will no longer be subjected to periodic reviews for currency. Users are responsible for verifying references and continued suitability of technical requirements. Newer technology may exist.

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1. SCOPE

1.1 Scope

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

1.2 Classification

The wires shall be as described in the applicable detail specification.

1.2.1 Part Numbers

Part numbers under this specification are coded as in the following example:

M5086/1	-	22	-	9
Applicable specifcation sheet		Wire size		Insulation color designator or designators (see 6.8)

1.2.2 Temperature Rating of Finished Wire

The maximum conductor temperature of the finished wire for continuous use shall be as specified in the applicable detail specification (see 6.1.1).

1.2.3 Voltage Rating of Finished Wire

Voltage rating of an insulation system is specified in the detail specification. Polyvinyl chloride insulation systems specified herein has been used in aerospace applications using 115 V (phase to neutral), 400 H AC, and 28 V DC. Verification of the suitability of this product for use in other electrical system configurations is the responsibility of the user.

2. APPLICABLE DOCUMENTS

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP9013	Statistical Product Acceptance Requirements
AS4373	Test Methods for Insulated Electric Wire
AS4461	Assembly and Soldering Criteria for High Quality/High Reliability Soldered Wire and Cable Termination in Aerospace Vehicles
AS5768	Tool, Stripper, Electrical Insulation, General Specification for
AS5768/1	Tool, Stripper, Manually Actuated, Electrical Insulation, Round Wire, Size 10 to 30
AS5768/2	Tool, Stripper, Manually Actuated, Small Grip, Electrical Insulation, Round Wire, Size 16 to 30
AS9003	Inspection and Test Quality Systems, Requirements for Aviation, Space, and Defense Organizations
AS29606	Wire, Electrical, Stranded, Uninsulated Copper, Copper Alloy, or Aluminum, or Thermocouple Extension, General Specification for
AS50861/1*	Wire, Electric, Polyvinyl Chloride Insulated, Nylon Jacket, Tin-Coated Copper Conductor, 600-Volt, 105 °C
AS50861/2*	Wire, Electric, Polyvinyl Chloride Insulated, PVC-Glass-Nylon, Tin-Coated Copper Conductor, 600-Volt, 105 °C
AS50861/3*	Wire, Electric, Polyvinyl Chloride Insulated, PVC-Glass-PVC-Nylon, Tin-Coated Copper Conductor, 600-Volt, 105 °C
AS50861/4*	Wire, Electric, Polyvinyl Chloride Insulated, Nylon Jacket, Tin-Coated Copper Conductor, 3000-Volt, 105 °C
AS50861/5*	Wire, Electric, Polyvinyl Chloride Insulated, Polyvinylidene Fluoride Jacket, Tin-Coated Copper Conductor, 600-Volt, 110 °C
AS50861/6*	Wire, Electric, Polyvinyl Chloride Insulated, Polyvinylidene Fluoride Jacket, Silver-Coated Copper Alloy Conductor, 600-Volt, 110 °C
AS50861/7*	Wire, Electric, Polyvinyl Chloride Insulated, Nylon Jacket, Tin-Coated Copper Conductor, Medium Weight, 600-Volt, 105 °C
AS50881	Wiring, Aerospace Vehicle

*SAE AS50861 detail specifications

2.2 European Committee for Standardization Publications

Available from European Parliament, Bât. Altiero Spinelli, 60 rue Wiertz/Wiertzstraat 60, B-1047 - Bruxelles/Brussels Belgium.

RoHS Restriction of Hazardous Substances Directive (RoHS) 2002/95/EC by January 1, 2015

2.3 U.S. Government Publications

Copies of these document are available online at http://quicksearch.dla.mil.

MIL-DTL-5624 Turbine Fuel, Aviation, Grades JP-4 and JP-5

MIL-DTL-12000 Cable, Cord, and Wire, Electric, Packaging of

MIL-DTL-83133 Turbine Fuel, Aviation, Kerosene Types, JP-8 (NATO F-34), NATO F-35, and JP-8+100 (NATO F-37)

MIL-STD-104 Limits for Electrical Insulation Color

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

MIL-PRF-572 Cords, Yarns and Monofilaments, Organic Synthetic Fiber

MIL-PRF-5606 Hydraulic Fluid, Petroleum Base, Aircraft, Missile, and Ordnance

MIL-PRF-23699 Lubricating Oil, Aircraft Turbine Engine, Synthetic Base, NATO O-152, O-154, and O-167

MIL-Y-1140 Yarn, Cord, Sleeving, Cloth, and Tape, Glass

SAM* System for Award Management

SD6 Provisions Governing Qualification

*Available from https://www.sam.gov/portal/public/SAM/

2.4 Other Publications

2.4.1 ASQ Publications

Available from American Society for Quality, 600 North Plankinton Avenue, Milwaukee, WI 53203, Tel: 800-248-1946 (United States or Canada), 001-800-514-1564 (Mexico) or +1-414-272-8575 (all other locations), www.asq.org.

ASQC Z1.4 Sampling Procedures and Tables for Inspection by Attributes

2.4.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D471 Rubber Property-Effects of Liquids

ASTM D1371 Recommended Practice for Cleaning Plastic Specimens for Insulation Resistance, Surface Resistance, and Volume Resistivity Testing

ASTM D4066-94B Nylon, Injection and Extrusion Materials (PA)

2.4.3 National Conference of Standards Laboratories (NCSL) Publications

Available from NCSL International, 2995 Wilderness Place, Suite 107, Boulder, CO 80301, Tel: 303-440-3339, www.ncsli.org.

NCSL Z540.3 Calibration of Measuring and Test Equipment, Requirements for

3. REQUIREMENTS

3.1 Detail Specifications

The requirements for the individual wires under this specification shall be as specified herein and in accordance with the applicable detail specification. In the event of discrepancy between this specification and the requirements of the applicable detail specification, the requirements of the detail specification shall govern.

3.2 Qualification

The wire furnished herein shall be a product that has been tested and has passed the qualification tests specified herein, and has been listed on or approved for listing on the applicable qualified products list (see 6.4).

3.2.1 Conformity to Qualified Sample

Except for changes approved by the purchase order, it is understood that wire supplied under the purchase order shall be the same material formulations, material sources, and manufacturing processes as approved by the qualifying activity. Any unapproved changes made after the qualification approval date, unless accepted by the qualifying activity, may constitute cause for rejection. All identified unapproved changes must be reported to the qualifying activity. Failure of a supplier to notify the qualifying activity of a change in design, material, manufacturing process (including quality conformance) or plant location shall be reason for adverse action or removal from the qualified products list.

3.3 Materials

Unless otherwise specified in the detail specification, the wire materials shall be as specified herein. The wire insulation shall contain no additives except those required as wetting agents in suspensoids, pigmentation for colors, and lubricants used in extrusion. Fillers shall be added only when required. The use of reclaimed or recycled insulation material is not prohibited, but if used, the recycled materials shall not have been degraded, shall be free of contaminants, and shall be identical with the original materials in performance. The wire shall comply with Restriction of Hazardous Substances Directive (RoHS).

3.3.1 Conductor Material

All conductors shall meet the material requirements of AS29606. The wire supplier is responsible for all quality assurance and compliance requirements imposed on the conductor per AS29606. Conductor material data shall be maintained for a minimum of 6 years (see 4.3.4 and 4.3.6).

3.3.2 Insulating Material

3.3.2.1 Primary and Secondary Insulation

The primary insulation and, when specified, secondary insulation for all wires under this specification shall be an extruded polyvinyl chloride composition. The properties of the extruded polyvinyl chloride in the finished wire shall be as specified in Table 1.

Table 1 - Properties of extruded polyvinyl chloride insulation and polyvinylidene fluoride jacket compounds

Property	Polyvinyl Chloride	Polyvinylidene Fluoride
Tensile strength Initial (psi) (min avg)	1800	4000
Elongation Initial (%) (min avg) After aging: Qualification procedure (% of initial) (min avg) Acceptance procedure (% of initial) (min avg)	100 70 90	250 ----- -----
Corrosive effect	To pass test (see 4.7.5.3)	-----

3.3.2.2 Glass Braid

When a glass braid is specified in the applicable detail specification, it shall be a tightly formed, uniformly surfaced braid composed of electrical-grade continuous filament glass yarn of MIL-Y-1140. For wire sizes 10 and larger, the yarn shall gage 13000 to 16000 yd/lb before treatment. For wire sizes 12 and smaller, the yarn shall gage 13000 to 24000 yd/lb before treatment. The braid shall be treated with suitable saturants to facilitate stripping and to cause the braid to adhere to the next outer layer of material.

3.3.2.3 Polyamide Extruded or Braided Jacket

When an extruded polyamide jacket is specified, it shall be made of clear ASTM D4066-94B Type PA0611, PA0612, PA0621, or equivalent material as approved by the qualifying activity (see 6.4). Certified test data shall be furnished by the wire supplier to establish conformity of the polyamide extruding material to the required type and grade. When a braided polyamide jacket is specified, the material shall conform to Type P of MIL-C-572 and shall be impregnated with polyamide finisher.

3.3.2.4 Polyvinylidene Fluoride Jacket

Jackets of this material shall be extruded clear polyvinylidene fluoride having the tensile and elongation properties shown in Table 1.

3.4 Construction

Construction of the wire shall be as specified herein and in the applicable detail specification.

3.4.1 Conductor Prior to Insulation Application

The conductor construction prior to the application of the insulation shall be in accordance with AS29606.

3.4.2 Insulated Conductor Splice

Insulated conductor splices shall meet the requirement of AS29606.

3.4.3 Insulated Conductor Geometric Characteristics

The insulated conductor diameter, strand count, and strand diameter shall be in accordance with AS29606 and listed in the detail specification.

3.4.4 Insulated Conductor Elongation and Tensile Strength

The wire conductor elongation and tensile break strength shall be in accordance with AS29606.

3.4.5 Insulated Conductor Insulation Removability

All insulation shall be readily removable by conventional wire stripping devices without damage to the conductor. The insulation of wire size 10 or smaller shall be removed in accordance with the required stripping tool specified in AS5768/1 or AS5768/2 and the wire shall be found “acceptable” as defined by AS5768.

3.4.6 Primary Insulated Conductor Flaws Test

100% of the wire shall be inspected for dielectric flaws after application of the primary insulation and prior to the application of any other material to the wire. At the option of the supplier, the inspection shall be made by either the chain electrode spark test, the impulse dielectric test, or high-frequency spark test using the test voltages specified for primary insulation herein or in the applicable detail specification.

3.5 Finished Wire

The insulation shall be constructed on the conductor as specified in the applicable detail specification. The finished wire shall conform to the requirements of Table 2 and those of the applicable detail specification. The requirements of 3.5.1 through 3.5.8 also apply.

3.5.1 Surface Smoothness

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

3.5.2 Impulse Dielectric or High-Frequency Spark Test

100% of the finished wire shall pass the impulse dielectric test of 4.7.5.4 or the high-frequency spark test of 4.7.5.5, which test shall be made during the final winding of the wire on shipment spools or reels.

Table 2 - Properties of finished wire

Examination or Test	Requirement	Method
Conductor stranding	3.4.3	4.7.1
Conductor diameter 1/	3.4.3	4.7.1
Finished wire diameter 1/	3.4.3	4.7.1
Construction of insulation	3.4.3	4.7.1
Tensile strength of insulation 1/ (primary and secondary) (initial)	Table 1	4.7.5.1
Elongation of insulation 1/ (primary and secondary) Initial After aging	 Table 1 Table 1	 4.7.5.2.1 4.7.5.2.2
Corrosive effect of insulation 1/ (primary and secondary)	Table 1	4.7.5.3
Tensile strength of extruded jacket (initial) (when applicable)	Table 1	4.7.5.1
Elongation of extruded jacket (initial) (when applicable)	Table 1	4.7.5.2.1
Removability of insulation	3.4.5	4.7.1
Wire surface smoothness	3.5.1	4.7.1
Impulse or high-frequency dielectric test	3.5.2	4.7.5.4
Insulation resistance	Detail specification	4.7.5.5
Color	3.5.3	4.7.1
Color striping or banding durability	3.5.3	4.7.5.6
Identification of product	3.5.4	4.7.1
Durability of identification 1/	3.5.4.1	4.7.5.6
Blocking	3.5.5	4.7.5.7
Workmanship	3.5.7	4.7.1
Finished wire weight	Detail specification	4.7.5.8
Conductor resistance	3.4.3	4.7.5.9
Insulated conductor elongation and tensile strength	3.4.4	4.7.5.10
Thermal shock resistance	Detail specification	4.7.5.11
Concentricity	70% (min) (see also 3.5.6)	4.7.5.12
Low temperature (cold bend) 1/	No cracking; no dielectric breakdown	4.7.5.13
Wrap test (extruded jackets only) 1/	No cracking	4.7.5.14
Flammability 1/	Detail specification	4.7.5.15
Shrinkage	Detail specification	4.7.5.16
Life cycle 1/	Air oven exposure No cracking in bend test No dielectric breakdown No pitting	4.7.5.17.1 4.7.5.17.2 4.7.5.17.3 4.7.5.17.1
Immersion tests	Diameter increase, 5% max No cracking in bend test No dielectric breakdown	4.7.5.18 4.7.5.17.2 4.7.5.17.3
Humidity resistance	Detail specification	4.7.5.19
Surface resistance	Detail specification	4.7.5.20
Smoke test 1/	Detail specification	4.7.5.21
Continuous lengths	3.5.8	4.7.5.22

1/ Test performed by the qualifying activity for qualification (see 6.4). The supplier is still required to perform the tests as part of quality conformance.

3.5.3 Color

The color of the finished wire shall be as specified in the procurement contract or order in accordance with this paragraph. The preferred colors are as indicated in the individual detail specifications. All solid colors and the colors of all striping or banding or of fibrous braid tracers shall be in accordance with MIL-STD-104, Class 1. Striping, banding, or braided tracers, if used, shall conform to MIL-STD-681, except that the background insulation color and the colors of the stripes or bands shall be as indicated in the part number of the wire and not necessarily in accordance with the preferred colors specified in MIL-STD-681. Striping or banding shall be capable of withstanding the striping durability test of 4.7.5.6 for the number of strokes and with the weight specified in the applicable detail specification. This test shall not be required if the striping or banding is under a clear jacket and shall not be required of braided tracers. Conformity to color requirements after the air oven test of 4.7.5.18.1 is not required.

3.5.4 Identification of Product

Except as otherwise specified in the procurement contract or in the applicable detail specification, the finished wire shall be identified by a printed marking applied to the outer surface of the wire or visible through the outer surface. When the wire is to be used in an end item for, omission of the identification of product shall be permissible only when so stated in the detail specification for the wire or the purchase order for the end item. The printed identification shall consist of the following, at intervals of 9 to 60 inches, as measured from the beginning of one complete marking to the beginning of the succeeding complete marking.

3.5.4.1 Detail Specification Part Number

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

3.5.4.2 Manufacturer Code

Manufacturer's code designation in accordance with SAM (see 2.7).

3.5.4.3 Print Color

The printing shall be green in color in accordance with MIL-STD-104, Class 1, except that when the wire is solid green or any other solid color against which green is difficult to distinguish, the printing shall be white. Identification printing shall be applied with the vertical axes of the printed characters lengthwise of the wire when the nominal diameter of the finished wire is 0.050 inch or smaller. The vertical axes of the printed characters may be either crosswise or lengthwise of the wire when the nominal diameter of the wire exceeds 0.050 inch. All printed characters shall be complete and legible.

3.5.4.4 Durability of Identification

Identification printing, when applied to the outer surface of the finished wire, shall be capable of withstanding the durability test specified in 4.7.5.6 for the number of cycles and with the weight specified in the applicable detail specification. This test shall not be required when the identification marking is under a clear jacket.

3.5.5 Blocking

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

3.5.6 Concentricity

The concentricity requirement (see Table 3) shall apply to the primary insulation, the secondary insulation when present, and the finished wire.

3.5.7 Workmanship

All details of workmanship shall be in accordance with high-grade aircraft wire manufacturing practice. The insulation shall be free of cracks, splits, irregularities, and imbedded foreign material.

3.5.8 Continuous Lengths

The individual continuous lengths of wire in each inspection lot shall be of such footage that, when inspected in accordance with 4.7.5.22, the inspection lot shall conform to the continuous length requirements of Table 4. Unless otherwise specified in the contract or order, the footage of the individual continuous lengths in each spool or reel shall be marked on the spool or reel in the sequence in which the lengths will be unwound by the user.

Table 4 - Minimum continuous wire lengths

Wire Size (Range)	Required Minimum Percent of the Total Inspection Lot Footage in Continuous Lengths of Not Less Than				
	500 feet	250 feet	100 feet	50 feet	25 feet
30-6	85%	-----	100%	-----	-----
4-1	-----	85%	-----	100%	-----
0-0000	-----	-----	85%	-----	100%

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

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

4.1.1 Responsibility for Compliance

All items must meet all technical requirements of the product standard. The inspection set forth in this standard shall become a part of the supplier's overall inspection system or quality program. The absence of any inspection requirements in the standard shall not relieve the supplier of the responsibility of assuring that all products comply with all requirements of the contract or purchase order. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the purchaser to acceptance of defective material.

4.1.2 Test Equipment and Inspection Facilities

Test and measuring equipment and inspection facilities of sufficient accuracy, quality, and quantity to permit performance of the required inspection shall be established and maintained by the supplier. The establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with NCSL Z540-3 or equivalent standards.

4.1.3 AS9003 Quality Assurance Compliance

The supplier's quality assurance program for wire production shall comply with the AS9003 Inspection and Test Quality System. Independent certification of the processes is not required. Other established and industry-recognized quality assurance standards that assure all products produced conform to the contract requirements are acceptable. However, if used, it is the responsibility of the supplier to provide evidence of compliance to AS9003. The qualifying activity (QA) authority reserves the right to monitor, measure, and validate compliance at their discretion.

4.2 Classification of Inspections

The examinations and tests of wires under this specification shall be divided into the following classifications:

Classification	Paragraph
Intial qualification inspection	4.3
Quality conformance inspection	4.4
Process control inspection	4.5
Retention of qualification inspections	4.6

4.2.1 Inspection Conditions

Unless otherwise specified herein or in the detail specification, all measurements and tests shall be made at temperatures of 15 to 35 °C (59 to 95 °F) at air pressure of 650 to 800 mm of mercury, and a relative humidity of 45 to 75%. Whenever these conditions must be closely controlled in order to obtain more reproducible results, the temperature, relative humidity, and atmospheric pressure conditions of 25 +0, -2 °C (77 + 0, -3.6 °F), 50% ± 12% relative humidity, and 650 to 800 mm of mercury shall be used.

4.3 Initial Qualification Inspection

Initial qualification inspection shall consist of all the tests of this specification. Only the qualifying activity is designated to perform or witness those tests specified in Tables 2 and 6 for initial qualification and retention of qualification. The qualifying activity shall provide the data package to the supplier. The supplier is not required to perform the tests. The supplier shall perform all remaining tests.

4.3.1 Initial Qualification Sample

For each wire tested the supplier shall use the same materials, manufacturing procedures, and methods of inspection as would be used to provide the wire to a purchaser. A wire length shall be obtained from the continuous length qualification lot (see 3.5.8).

4.3.2 Sampling for Initial Qualification Inspection

A finished wire sample consisting of 150 linear feet for size 10 or smaller, and 100 linear feet for size 8 or larger, shall be submitted to the qualification tests as specified for each wire size and part number for which qualification is desired, except that certain sizes will qualify additional sizes as follows:

Sample Wire	Will Qualify Sizes
Size 28	30 through 24
Any size, 26 through 22	20 through 22
Size 20, 18, or 16	22 through 16
Size 14, 12 or 10	14 through 10
Size 8, 6, or 4	8 through 4
Any size, 2 through 0000	2 through 0000

In addition to the finished wire sample, 10 linear feet of each size of coated conductor strand and 50 linear feet of each yarn used in the manufacture of the wire shall be submitted to qualification tests as specified.

4.3.3 Initial Qualification Inspection Qualifying Activity Sample

A duplicate group of qualification samples from the same lot as required for supplier tests shall be submitted to the qualifying activity for the qualifying activity tests. The samples shall be identified by securely attached durable tags marked with the information listed below. The tags must be stamped by the supplier's and/or qualifying activity designated quality assurance representative (QAR) inspector as representative samples of the supplier's normal production capability. Samples submitted without the stamp will not be accepted.

Sample for qualification test
WIRE, ELECTRIC POLYVINYL CHLORIDE INSULATED, COPPER, OR COPPER ALLOY
Detail specification part number
Supplier's name and code number (publication SAM)
Supplier's part number
Comprehensive description and prime supplier's name and formulation number of the base materials from which the product is made (this information will not be divulged)
Place and date of manufacture of sample
Submitted by (name) (date) for qualification tests in accordance with the requirements of AS50861 under authorization (reference authorizing letter)

4.3.4 Test Report

The supplier's test report shall be submitted with the test samples (see 4.3.3). The test report shall contain all required supplier certified tests and requirements specified in the authorization letter. Upon completion of the designated qualifying activity tests by the qualifying activity, the qualifying activity shall provide to the supplier a certified data package of the designated tests specified in Tables 2 and 6. The test report and data package will be returned to the supplier and retained for 6 years.

4.4 Quality Conformance Inspection

Quality conformance inspection shall consist of the examinations and tests listed in Table 4 and described under 4.7. Quality conformance inspection shall be performed on every lot of wire procured under this specification.

Table 4 - Quality conformance inspection

Examination or Test	Requirement	Method
Group I Characteristics		
Conductor stranding	3.4.1	4.7.1
Conductor diameter	3.4.1	4.7.1
Finished wire diameter	Detail specification	4.7.1
Construction of insulation	Detail specification	4.7.1
Tensile strength of insulation (primary and secondary)	Table 1	4.7.5.1
Elongation of insulation (primary and secondary)		
Initial	Table 1	4.7.5.2.1
After aging (acceptance procedure)	Table 1	4.7.5.2.2
Tensile strength of extruded jacket (initial) (when applicable)	Table 1	4.7.5.1
Elongation of extruded jacket (initial) (when applicable)	Table 1	4.7.5.2.1

Removability of insulation	3.4.5	4.7.1
Wire surface smoothness	3.5.1	4.7.1
Insulation resistance	Detail specification	4.7.5.5
Color	3.5.3	4.7.1
Color striping or banding durability	3.5.3	4.7.5.6
Identification of products	3.5.4	4.7.1
Durability of identification	3.5.4.1	4.7.5.6
Workmanship	3.5.7	4.7.1
Finished wire weight	Detail specification	4.7.5.8
Conductor resistance	AS29606	4.7.5.9
Insulated conductor elongation and tensile strength	3.4.4	4.7.5.10
Group II Characteristics		
Thermal shock resistance	Detail specification	4.7.5.11
Concentricity	70% (min) (see also 3.5.6)	4.7.5.12
Low temperature (cold bend)	No cracking; no dielectric breakdown	4.7.5.13
Wrap test (extruded jackets only)	No cracking	4.7.5.14
Flammability	Detail specification	4.7.5.15
Group III Characteristics		
Impulse dielectric high-frequency test	3.5.2	4.7.5.4
Group IV Characteristics		
Continuous lengths	3.5.8	4.7.5.22

4.4.1 Sampling for Quality Conformance Inspection

MIL-STD-109 shall apply for definitions of inspection terms used herein. For purposes of this specification, the following shall apply to Table 4:

4.4.1.1 Lot

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

4.4.1.2 Unit of Product

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

4.4.1.3 Sample Unit (Groups I and II Tests)

The sample unit for Groups I and II tests, except for the Group I insulation resistance test, shall consist of a single piece of finished wire chosen at random from the inspection lot and of sufficient length to permit all applicable examinations and tests. Unless otherwise specified, the length of the sample unit for Group I tests, other than insulation resistance, shall be 20 feet and the length of the sample unit for Group II tests shall be 25 feet. Not more than one sample unit for each group of tests shall be taken from a single unit of product.

4.4.1.3.1 Sample Unit for Insulation Resistance Test (Group I)

The sample unit for the Group I insulation resistance test shall be a specimen at least 26 feet in length selected at random from finished wire which has passed the Group III impulse dielectric test. It is optional whether the specimen is tested on the reel or removed from the reel for the test, provided the length of the specimen can be determined.

4.4.1.4 Inspection Levels and Acceptable Quality Levels (AQL) (Groups I and II Tests)

For Group I characteristics, including the insulation resistance test, the inspection level shall be S-2 and the AQL shall be 6.5% defective units in accordance with ASQC Z1.4. For Group II characteristics, the inspection level shall be S-3 and the AQL shall be 1.5% defective units. Major and minor defects shall be as defined herein (see 6.4).

4.4.1.5 Sampling and Acceptance for the Group III (Impulse Dielectric) Test

The sample for the Group III impulse dielectric test shall be 100% of the finished wire and every length of the wire shall be subjected fully to the test. Insulation breakdowns resulting from the test and ends or portions not subjected to the test shall be marked or cut out of the finished wire (see 4.5.1.4).

4.4.1.6 Sampling and Acceptability Levels for Group IV (Continuous Lengths) Examination

The inspection level and acceptable quality level for this examination shall be as required for the applicable procedure of 4.7.5.22.

4.4.2 Nonconforming Inspection Lots

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

4.4.3 Statistical Process Control

Suppliers demonstrating statistical product acceptance requirements (refer to ARP9013) may waive specific individual quality conformance inspection tests shown in Table 4 when justified and approved by the qualifying activity. For initial or retention of qualification, all tests have to be performed. In no case shall Groups 3 or 4 be waived for statistical process control. The qualifying activity authority reserves the right to monitor, measure, and validate compliance at their discretion.

4.4.3.1 Movement of Tests in Groups

When a qualified supplier can demonstrate to the qualifying activity consistent repeatable results for a specific quality conformance inspection property by tight process controls (statistical, etc.), the supplier can recommend and be approved by the qualifying activity to move tests from Group 2 to Group 1, or test from Group 1 to retention of qualification only. Consideration can also be given to reduced inspection times or sampling as well as alternative in-process inspections. For qualification submittal samples, all inspections shall be performed as required.

4.4.3.2 Product Failure of Statistical Process Control Approved Groups

The original specification test requirement shall be imposed until reapproved by the qualifying activity, if failure occurs during retention of qualification testing on an approved statistical process control test requirement changes.

4.5 Process Control Inspection

This inspection comprises tests and examinations of such a nature that they cannot be performed on the finished wire as submitted for inspection and, therefore, must be conducted at the most appropriate stage of the manufacturing operations. The process control tests shall consist of the tests listed in Table 5. Process control inspection shall be performed on every lot of wire procured under this specification.

Table 5 - Process control inspection

Examination or Test	Requirement	Method
Conductor material 1/	3.4.1	4.7.2
Insulated conductor splices	3.4.2	AS29606
Glass braid yarns	3.3.2.2	4.7.3
Polyamide braid yarns	3.3.2.3	4.7.3
Flaws test of primary insulation (as applicable)		
Spark test	3.4.6	4.7.4
Impulse dielectric test	3.4.6	4.7.5.4

1/ Not required if conductor is procured from an AS29606 qualified supplier.

4.5.1 Sampling for Process Control Inspection

4.5.1.1 Conductor Material

From each week's production of individual coated strands, or from every 1000 pounds of such strands, whichever is less, three 10-foot lengths of strand shall be selected in such a manner as to be representative of the material to be used in the finished wire.

4.5.1.2 Conductor Splices

The supplier's method of splicing individual strands and entire members shall be observed at the discretion of the qualifying activity representative.

4.5.1.3 Braid Yarns

When a glass braid or polyamide braid is specified in the wire construction, three representative 30-foot lengths of each type of component yarn before braiding shall be selected from each lot of wire.

4.5.1.4 Flaws Test of Primary Insulation

The sample for this test shall be 100% of the wire after application of the primary insulation and prior to the application of any other material. 100% of the wire shall be subjected to either the spark test or the impulse dielectric test at this stage in production. Portions showing dielectric breakdown shall be cut out or removed and testing of the balance of production shall be resumed.

4.5.2 Rejection and Retest in Process Control Inspection

When a sample selected from a production run fails to meet the specified tests (except flaws test of primary insulation, see 4.5.1.4), no items still on hand or later produced shall be accepted until the extent and cause of the failure have been determined. After investigation, the contractor shall advise the qualifying activity of the action taken and, after corrections have been made, shall repeat all the process control tests. Rejection after corrective action will require that the supplier advise the purchaser of the details surrounding the retest and cause for rejection. Nonconformities of primary insulation in the flaws test shall be handled as provided in 4.5.1.4.

4.5.2.1 Effect of Process Control Failure on Quality Conformance Testing

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

4.6 Retention of Qualification Inspection

Unless otherwise noted, retention of qualification inspection shall occur every 36 months after the initial qualification date, and shall consist of the qualifying activity and supplier tests specified in Table 6, in addition to the supplier's quality conformance requirements and process control requirements of Tables 4 and 5. Qualification cannot begin until an authorization letter for testing has been issued by the qualifying activity. The qualifying activity may shift the reporting date to accommodate testing schedules, but no later than 18 months from the retention of qualification due date. Failure of the supplier to submit retention of qualification test report or certification within 30 days after the end of the reporting period may result in the removal of the product or products from the qualified products list (QPL).

Table 6 - Tests applicable only to retention of qualification inspection

Test		Requirement	Method
Elongation of insulation after aging (qualification procedure)		Table 1	4.7.5.2.2
Corrosive effect of insulation 1/		Table 1	4.7.5.3
Blocking		3.5.5	4.7.5.7
Shrinkage		Detail specification	4.7.5.16
Life cycle 1/		Table 3	4.7.5.17
Immersion tests		Table 3	4.7.5.18
Humidity resistance		Detail specification	4.7.5.19
Surface resistance		Detail specification	4.7.5.20
Smoke test 1/		Detail specification	4.7.5.21

1/ Test performed by the qualifying activity for qualification (see 6.4). Supplier is still required to perform the tests as part of quality conformance.

4.6.1 Retention of Qualification No Production Certification

If no production of the qualified products has occurred for the entire reporting period, the supplier may provide a certification to the qualifying activity that no changes in the product materials, manufacturing processes, or site of production has occurred since the initial qualification inspection (see 4.3). Certification for more than one reporting period shall not be permitted. The supplier shall contact the qualifying activity to determine the conditions of the certification. The supplier may be required to submit the certification on a specified form provided by the qualifying activity.

4.6.2 Retention of Qualification Sample

One wire size from each initial qualification approved sampling for initial qualification inspection group (see 4.3.2) shall be tested. The sample shall be from a current production run. For each wire tested, the supplier shall use the same materials, manufacturing procedures, and methods of inspection as would be used to provide the wire to a purchaser. Unless otherwise specified, three wire specimens shall be tested for each required test.

4.6.3 Retention of Qualification Test Report

The supplier shall provide a test report to the qualifying activity for the tests specified in Tables 4, 5, and 6. The test report shall be signed by the manufacturing authority responsible for ensuring compliance with the specification requirements. The qualifying activity shall provide the supplier a data package of all designated tests performed in accordance with Table 6. The qualifying activity test method procedures shall be made available to the supplier upon request. The final test report and data package shall remain on file with the supplier for a minimum period of 6 years and be available to the qualifying activity upon request. The supplier test report shall contain as a minimum the following information:

4.6.3.1 A summary of quality conformance inspection pass or fail results for tests specified in Tables 4 and 5 and the authorization letter.

4.6.3.2 A certification of compliance to all requirements of AS50861.

4.6.3.3 Detail results of tests performed in Table 6.

4.6.4 Corrective Action Reports (as applicable)

If a failure occurs in the tests for retention of qualification, no wire represented by the sample, nor any other wire manufactured with the same materials and processes, which has not already been submitted for quality conformance inspection, shall be offered for acceptance until the cause for failure has been determined and concurred with by the qualifying activity as not affecting the ability of the wire to meet qualification inspection requirements.

4.6.5 Material and Process Changes During Retention of Qualification Intervals

Except for changes approved by the purchase order, the wire supplied under purchase order shall be the same material formulations, material sources, and manufacturing processes as approved by the qualifying activity. It is the responsibility of the wire manufacturer to notify the qualifying activity when materials, material formulations, and manufacturing processes need to be changed. The wire supplier is responsible for verifying and documenting all performance characteristics including quality conformance and qualification requirements. The changes are categorized as minor and major.

4.6.5.1 To address a minor change, the wire supplier will provide written notification of the change to the qualifying activity and maintain documentation of compliance. The qualifying activity may request results of product testing to confirm compliance and approve the change under the existing qualification. A minor change includes modification of processing additives, colorants, braids, finishers, coatings, and inks. It also includes manufacturing process parameters, integrating processes, and relocating equipment within the qualified manufacturing site.

4.6.5.2 To address a major change, a request for change will be submitted to the qualifying activity. The qualifying activity will provide authorization to proceed and define the qualification submittal and third-party testing in accordance with Table 13. All qualification tests identified shall be performed, either by the wire supplier, the qualifying activity, or an approved third-party laboratory at the discretion of the qualifying activity. A major change includes the conductor source and formulation and the modification of insulating material to include resin change, source change (new resin producer), or alternate production location for the resin.

4.7 Test Methods

4.7.1 Examination of Product

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

4.7.2 Conductor Material

Tin coated soft annealed copper conductor strands selected before stranding, in accordance with 4.5.1.1, shall be tested for conformity to AS29606 by the methods prescribed therein. Silver coated high-strength copper alloy conductor strands, similarly selected, shall be tested for coating thickness and continuity of coating in accordance with AS29606.

4.7.3 Braid Yarns

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

4.7.4 Spark Test of Primary Insulation (when applicable; see 3.5.2)

The spark test on the primary insulation shall be performed after the application of the primary insulation and prior to the application of any other material. The 60-Hz spark test shall be performed in accordance with AS4373, Methods 505 and 2, except it shall be performed as an in-process test.

4.7.5 Finished Wire

Methods of test of the finished wire (and of unfinished wire also, when so specified) shall be as follows:

4.7.5.1 Tensile Strength and Elongation of Insulation or Jacket (Finished Wire)

Specimens of the extruded primary insulation, secondary insulation, or jacket, as applicable, shall be removed carefully from the finished wire and tested for tensile strength in accordance with AS4373, Method 705. Dumbbell or straight specimens may be used as appears most feasible. The average of three specimens shall be recorded.

4.7.5.2 Elongation of Insulation or Jacket (Finished Wire)

4.7.5.2.1 Initial Elongation

Specimens of the extruded primary insulation, secondary insulation, or jacket, as applicable, prepared in accordance with 4.7.5.1 shall be tested by AS4373, Method 705. The average of three specimens shall be recorded.

4.7.5.2.2 Elongation After Aging

Specimens of the insulation or jacket shall be prepared in accordance with 4.7.5.2.1 and shall be subjected to accelerated aging in a circulating air atmosphere by in accordance Appendix A. The oven shall be adjusted to give a high rate of air circulation and air change in order to avoid a buildup of plasticizer in the oven atmosphere. Duration and temperature of aging shall be as follows:

a. For qualification - 60 days at 111 to 115 °C (232 to 239 °F)

b. For acceptance - 4 days at 133 to 137 °C (271.5 to 278.5 °F)

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

4.7.5.3 Corrosive Effect (Primary and Secondary Insulation)

A 6-inch specimen of wire (for fine gage wires, a longer specimen may be used) shall be stripped mechanically of all material exterior to the polyvinyl chloride insulation, primary or secondary, which is to be tested. (Alternatively, the supplier may furnish a wire sample taken before any material has been added exterior to the applicable layer of insulation.) The specimen and a 30-inch length of size 34 uncoated soft annealed copper wires conforming to AS29606 shall be cleaned in accordance with the procedure for Group I materials in ASTM D1371 and shall subsequently be handled with maximum care, preferably with clean gloves, to avoid even the slightest contamination, including direct contact with the fingers. The size 34 shall be passed to its midpoint through a small loop formed near one end of the insulated specimen and shall then be wrapped helically in an evenly spaced bifilar winding over the specimen. (In lieu of the loop in the specimen, a short length of AS29606 size 18 uncoated soft annealed copper wire, cleaned and handled as with the specimen and winding wire, may be twisted tightly around the specimen near one end and formed into a hook to anchor the midpoint of the winding wire.) The ends of the winding shall be welded to leads of an AS29606 size 18 copper wire and the specimen shall be placed in a test tube with the leads extending through the cork stopper. The end of the insulated specimen may conveniently be anchored in a hole drilled into the small end of the cork. Approximately 3/4 inch of distilled water shall be placed in the test tube (the specimen shall be above water level) to maintain a high relative humidity and the cork shall be coated with microcrystalline wax to produce a vapor-tight seal. The test assembly shall be placed in a vertical position in an oven at 70 °C ± 2 °C (158 °F ± 3.6 °F) for a period of 720 hours. The electrical resistance of the winding shall be determined when the test assembly has attained temperature equilibrium, periodically throughout the test period, and at the end of the test. A low voltage and a momentary contact switch should be used in order to avoid heating of the winding wire during the resistance determinations. An increase in resistance exceeding 2% over the 720-hour period shall constitute failure of the test. Absence of water in the test tube at the end of the test period shall invalidate the test.

4.7.5.4 Impulse Dielectric or High-Frequency Spark Test

4.7.5.4.1 The impulse dielectric test shall be performed in accordance with AS4373, Method 503, at the voltage specified in detail specification.

4.7.5.4.2 The high-frequency spark test shall be performed in accordance with AS4373, Methods 5.5 and 1. Unless otherwise specified in the detail specification, the voltage shall be 5.7 kV (rms).

4.7.5.5 Insulation Resistance

The insulation resistance test shall be performed in accordance with AS4373, Method 504.

4.7.5.6 Durability of Color Markings

The durability of product identification and color markings applied to the wire for coding shall be evaluated at 20 to 25 °C (68 to 77 °F) in accordance with AS4373, Method 710. The tolerance of the weight shall be ±0.01 pounds. If there is a continuous line of erasure or obliteration through the stripe, band, or printed identification marking exposing the insulation, the specimen shall be considered as having failed. Three specimens shall be tested from each sample unit and failure of any specimen shall constitute failure of the sample unit.

4.7.5.7 Blocking

Conductor strand blocking (adhesion) of a wire shall be performed in accordance with AS4373, Method 404.

4.7.5.8 Wire Weight

The weight of each lot of wire shall be determined by Procedure I of AS4373, Method 902, for qualification submittal and for lot inspection. Inspection lots failing to meet the wire weight requirement of the applicable detail specification when tested in accordance with Procedure I shall be subjected to Procedure II of AS4373, Method 902. All reels or spools failing to meet the requirements of the applicable detail specification shall be rejected. The quality conformance sampling plans are not applicable when Procedure II is used. For qualification the results of both methods, as applicable, shall be submitted to the qualifying activity including any required corrective action.

4.7.5.9 Conductor Resistance

The DC resistance of the conductor shall be measured in accordance with AS4373, Method 403.

4.7.5.10 Insulated Conductor Elongation and Tensile Strength

Insulated conductor elongation and tensile break strength shall be performed in accordance with AS4373, Method 402. Only elongation shall be performed on soft or annealed copper conductor. The results of three specimens shall be recorded and the average determined.

4.7.5.11 Thermal Shock Resistance

4.7.5.11.1 Preparation of Specimen

A specimen of wire, 5-feet long, shall be prepared by carefully removing 1 inch of insulation from each end of the wire. (For purposes of this test, insulation is defined as all layers of non-conducting material covering the electrical conductor, e.g., primary and secondary insulation, all tapes and braids, and the jacket.) A razor blade or equivalent, held perpendicular to the axis of the wire, shall be used to cut the insulation for the removal operation. The length of exposed conductor at each end of the specimen shall be measured to the nearest 0.01 inch. The specimen shall be formed into a loose coil not less than 1 foot in diameter and shall be laid on a wire screen for handling throughout the test.

4.7.5.11.2 Test Procedure

The specimen shall be placed for 30 minutes in a preheated air circulating oven at the temperature specified in the applicable detail specification. The specimen shall then be removed from the oven and, within 2 minutes, placed in a chamber which has been pre-cooled to -55 °C ± 2 °C (-67 °F ± 3.6 °F). It shall be exposed to this temperature for 30 minutes, after which it shall be removed and allowed a minimum of 30 minutes to return to room temperature, 20 to 25 °C (68 to 77 °F). At the conclusion of this cycle, the distance from the end of each layer of insulation to the end of the conductor shall be measured to the nearest 0.01 inch. This thermal shock cycle and the measurements shall be repeated for an additional three cycles (a total of four cycles). Any measurement varying from the original measurement by more than the amount specified in the applicable detail specification shall constitute failure. Any flaring of any layer shall also constitute failure.

4.7.5.12 Concentricity

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

4.7.5.12.1 Primary Insulation or Finished Wire (Procedure for Concentric-Lay Wires)

The concentricity of the primary insulation or of the finished wire shall be determined by first locating and recording the minimum wall thickness measured on a cross section of the primary insulation or finished wire. The maximum wall thickness of this same cross section of the primary insulation or finished wire shall also be located and recorded. 100 times the ratio of the minimum wall thickness to the maximum wall thickness shall define the percent concentricity.

4.7.5.12.2 Primary Insulation or Finished Wire (Procedure for Rope-Lay Wires)

The concentricity of the primary insulation or of the finished wire shall be determined by first locating and recording the minimum wall thickness measured on a cross section of the primary insulation or of the finished wire. From this point on, the outer rim of the primary insulation or finished wire at which the minimum wall thickness was measured, three more reference points 90 degrees apart on the outside rim of the primary insulation or finished wire shall be established. At each of these three reference points, the nearest member of the rope-lay conductor shall be selected and the minimum wall thickness between that member and the outer rim of the primary insulation or finished wire shall be measured. The average of the four readings shall be considered to be the average wall thickness. 100 times the ratio of the minimum wall thickness to the average wall thickness shall define the percent concentricity.

4.7.5.12.3 Secondary Insulation (All Wires)

The concentricity of the secondary insulation shall be determined by first locating and recording the minimum wall thickness measured on a cross section of the secondary insulation. The maximum wall thickness of this same cross section of the secondary insulation shall be measured and recorded. 100 times the ratio of the minimum wall thickness to the maximum wall thickness shall define the percent concentricity.

4.7.5.13 Low Temperature (Cold Bend)

The low-temperature mechanical resistance (cold bend) test shall be performed in accordance with AS4373, Method 702, followed by a wet dielectric test with the bend portion submerged.

4.7.5.14 Wrap Test (Extruded Jackets Only)

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

4.7.5.15 Flammability

Resistance to flame shall be determined by Method I or II, as specified in the applicable detail specification.

4.7.5.15.1 Method I

4.7.5.15.1.1 Apparatus

The test shall be performed within a test chamber approximately 1 ft^2 by 2 feet in height, open at top and front to provide adequate ventilation for combustion but to prevent drafts. Means shall be provided in the chamber to hold a 10-inch wire specimen taut in a horizontal position 10 to 12 inches above the floor of the chamber in a vertical plane parallel to and about 6 inches in front of the rear wall of the chamber. The test flame shall be from a Bunsen-type gas burner with a 1/4-inch inlet, a needle valve in the base for gas adjustment, a bore of 3/8-inch nominal, and a barrel length of approximately 4 inches above the air inlets. The burner shall be fitted with a wing top flame spreader having a 1/16-inch by 2-inch opening, and shall be adjusted to provide an all blue flame 2 inches high. A sheet of commercial facial tissue shall be suspended taut and horizontal 9-1/2 inches below the wire specimen and at least 1/2 inch from the chamber floor, so that any material dropping from the wire specimen shall fall upon the tissue.

4.7.5.15.1.2 Procedure

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

4.7.5.15.2 Method II

4.7.5.15.2.1 Apparatus

The test chamber shall be as in Method I, except that the specimen shall be positioned at an angle of 60 degrees with the horizontal, in a plane parallel to and approximately 6 inches from the back of the chamber. The burner shall be as specified in Method I, except that there shall be no wing top flame spreader and the burner shall be adjusted to furnish a 3-inch conical flame with an inner cone approximately 1 inch in length. The temperature of the hottest part of the flame, as measured with an accurate thermocouple pyrometer, shall be not less than 954 °C (1750 °F). A facial tissue shall be suspended, as in Method I, to receive drip, if any, from the specimen.

4.7.5.15.2.2 Procedure

A 24-inch specimen of wire shall be marked at a distance of 8 inches 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. With the burner held perpendicular to the specimen and at an angle of 30 degrees from the vertical plane of the specimen, the hottest portion of the flame shall be applied to the lower side of the wire at the test mark. The period of test flame application shall be 30 seconds for all sizes of wire 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 drip from the specimen. Charred holes or charred spots in the tissue shall be ignored in the absence of actual flame. Breaking of the wire specimens in sizes 24 and smaller shall not be considered as failure provided the requirements for flame travel limits, duration of flame, and absence of incendiary dripping are met.

4.7.5.16 Shrinkage

The shrinkage test shall be performed in accordance with AS4373, Method 104. The shrinkage of the insulation shall be measured as the greatest additional distance that any layer of the insulation, including jacket if present, has receded from either end of the conductor. Measuring expansion is not required

4.7.5.17 Life Cycle

4.7.5.17.1 Air Oven

1 inch of the insulation shall be removed from each end of a 24-inch sample of the finished wire. The central portion of the specimen shall then be bent over a horizontally placed mandrel of the diameter specified in the applicable detail specification. Each end of the conductor shall be loaded with the weight specified in the detail specification, so that the portion of the insulation between the conductor and mandrel is under compression and the conductor is under tension. This specimen so prepared on the mandrel shall be placed in an air-circulating oven and maintained for a period of 120 hours at the temperature specified in the detail specification. Change of insulation color due to the oven exposure shall not be cause for rejection of the wire (see 3.6.3). After completion of the air oven exposure, the specimen shall be cooled to between 20 and 25 °C (68 to 77 °F), within a period of 1 hour. 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 (see 4.7.5.17.2), followed by the wet dielectric test (see 4.7.5.17.3). After the dielectric test, the insulation shall be removed from the specimen and the conductor shall be examined for pitting.

4.7.5.17.2 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 the applicable detail specification. 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.

4.7.5.17.3 Wet Dielectric Test

The uninsulated ends of the specimen shall be attached to an electric lead. The specimen shall be immersed in a 5%, by weight, solution of sodium chloride in water at 20 to 25 °C (68 to 77 °F), except that the uninsulated ends and 1-1/2 inches of insulated wire at each end of the specimen shall protrude above the surface of the solution. The solution shall contain 0.5 to 1.0% of a suitable anionic wetting agent such as sodium dioctyl sulfosuccinate. After immersion for 4 hours, the voltage specified in the applicable detail specification at 60 Hz cps shall be applied between the conductor 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 1/2 minute, maintained at that voltage for a period of 5 minutes, and gradually reduced to zero in 1/2 minute.

4.7.5.18 Immersion Tests

Specimens of wire of sufficient length to perform the subsequent tests shall be gaged to determine their initial diameter and shall then be immersed to within 6 inches of their ends in each of the following fluids (using a separate specimen for each fluid) for 20 hours at a temperature of 48 to 50 °C (118.4 to 122 °F) for fluids (a) and (b) and at 20 to 25 °C (68 to 77 °F) for fluids (c) and (d).

a. Lubricating oil, aircraft, turbine engine, synthetic base, MIL-PRF-23699.

b. Hydraulic fluid, petroleum base, aircraft, missile, and ordnance, MIL-PRF-5606.

c. Isopropyl alcohol, ASTM D471.

d. Turbine fuel, aviation, Grade JP-4, MIL-DTL-5624, or turbine fuel JP-8 in MIL-DTL-83133.

During the immersion, the radius of bend of the wire shall be not less than 14 times the maximum specified diameter of the wire under test. Upon removal from the liquids, the specimen shall remain for 1 hour in free air at room temperature. The diameter shall be gaged and compared to the initial diameter. The insulation, braid, and protective coating shall be removed for a distance of 1/2 inch from each end of a 24-inch length of the specimen and this length shall be subjected to the bend test of 4.7.5.17.2 and the dielectric test of 4.7.5.17.3.

4.7.5.19 Humidity Resistance

A 52-foot specimen of wire shall be subjected to the following:

4.7.5.19.1 Apparatus

The apparatus shall consist of a test chamber capable of maintaining an internal temperature of 70 °C ± 2 °C (158 °F ± 3.6 °F) and an internal relative humidity of 95% ± 5%. The test chamber shall be capable of being so sealed as to retain the total moisture content in the test space. The heat loss from the chamber shall be sufficient to reduce the internal temperature from the above specified operating temperature to not more than 38 °C (100.4 °F) within a period of 16 hours from the time of removal of the source of heat. Distilled or demineralized water shall be used to obtain the required humidity.

4.7.5.19.2 Procedure

The specimen shall be placed in the test chamber and the temperature and relative humidity raised over a 2-hour period to the values specified in 4.7.5.20.1 and maintained at such for a period of 6 hours. At the end of the 6-hour period, the heat shall be shut off. During the following 16-hour period, the temperature must drop to 38 °C (100.4 °F) or lower. At the end of the 16-hour period, heat shall be again supplied for a 2-hour period to stabilize at 70 °C ± 2 °C (158 °F ± 3.6 °F). This cycle (2 hours heating, 6 hours at high temperature, 16 hours cooling) shall be repeated a sufficient number of times to extend the total time of the test to 360 hours (15 cycles). At the end of the 15th cycle, the 50-foot center section of the specimen shall be immersed in a 5%, by weight, solution of sodium chloride in water at room temperature. With the outer surface of the specimen grounded through an electrode in the electrolyte and with a potential of 250 to 500 V DC applied to the conductor of the specimen, the insulation resistance of the specimen shall be measured after 1 minute of electrification at this potential. The insulation resistance shall be converted to megohms for 1000 feet by the calculation shown in 4.7.5.5.

4.7.5.20 Surface Resistance

The surface resistance test shall be performed in accordance with AS4373, Method 506.