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.

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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

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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)

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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.

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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)	100	250
After aging:		
Qualification procedure (% of initial) (min avg)	70	-----
Acceptance procedure (% of initial) (min avg)	90	-----
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.

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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.

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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.

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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.

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