AEROSPACE STANDARD

AS50881™ REV. G

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Superseding AS50881F

(R) Wiring Aerospace Vehicle

RATIONALE

This document was revised to incorporate comments (editorial and technical) received and coordinated by the SAE AE-8A System Installation Committee since 2015. Specification reference data was also updated.

FOREWORD

This specification has been developed by the SAE AE-8A System Installation Subcommittee as an industry replacement for MIL-W-5088L. Conformance with the provisions of this document is intended to provide wiring system safety, performance, reliability, maintainability, service life, and life cycle cost equivalent to that achieved when conforming to the provisions of MIL-W-5088. When practicable, paragraph numbers of this specification have been arranged to agree with their counterparts in MIL-W-5088. It is recommended that this overall set of requirements be used as a part of an aerospace vehicle specification in order to provide an overall set of requirements for wiring system provision.

1. SCOPE

1.1 Purpose

This specification covers all aspects in Electrical Wiring Interconnection Systems (EWIS) from the selection through installation of wiring and wiring devices and optical cabling and termination devices used in aerospace vehicles. Aerospace vehicles include manned and unmanned airplanes, helicopters, lighter-than-air vehicles, missiles, and external pods.

1.1.1 Application

This specification establishes design requirements guidance for wiring and optical cable installation in aerospace vehicles. Although many of the requirements are written as mandatory and shall be considered as such, there is also considerable material which is intended to denote optional, preferential or guidance type requirements. In interpreting the material contained herein, it is intended that the philosophy of the entire document be considered for the wiring of each new type of vehicle. This philosophy is safety of the personnel, safety of the vehicle, satisfactory performance and reliability of the vehicle and ease of maintenance, and service life all at the least cost to the operator. The intent of this document will be fulfilled by tailoring the requirements in each new type or class of aerospace vehicle designed, to the proper application. ARP/AIR documents listed in this specification are for reference only. Any reference in this document to Military, Air Force, Navy, Army, or Coast Guard refers to systems managed or procured by the U.S. Department of Defense (DOD) or the U.S. Department of Homeland Security (DHS).

1.1.1.1 This document does not apply to wiring inside of airborne electronic equipment, but shall apply to wiring externally attached to such equipment.

2. REFERENCES

2.1 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.

2.1.1 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.

AMS-STD-595	Colors Used in Government Procurement
AIR65	Thermoelectric Circuits and the Performance of Several Aircraft Engine Thermocouples
AIR1329	Electrical Connectors and Wiring, Compatibility of
AIR4465	Design and Handling Guide Radio Frequency Absorptive Type Wire and Cables (Filter Line, MIL-C-85485)
AIR5558	Ultraviolet (UV) Laser Marking Performance of Aerospace Wire Constructions
AIR6151	Torque, Threaded Application, Electrical Connector, Accessory and Terminal Board Installation
ARP6807	Guide for Identification of Terminal Lugs in Electrical Wiring Interconnect Systems (EWIS)
ARP6881	Guidelines for the Use and Installation of Bonded Cable Harness Supports
ARP1350	Procedure for Installation and Mounting of Single Hole Mount, Cylindrical, Electrical Connectors (for Pressure Differential Applications)
ARP1870	Aerospace Systems Electrical Bonding and Grounding for Electromagnetic Compatibility and Safety
ARP5614	Guidelines for Harness Critical Clamp Locator Marker Installation on Electrical Cable Assemblies
ARP6400	Recommended Practice for Processing and Handling Wire and Cable with Silver Plated Conductors and Shields
ARP6903	Guide for Achieving Plating/Finish Compatibility with Connectors and Accessories Used in Electrical Wiring Interconnect Systems (EWIS)
ARP81490	Transmission Lines, Transverse Electromagnetic Mode
AS567	Safety Cable, Safety Wire, Key Washers, and Cotter Pins for Propulsion Systems, General Practices for Use of
AS3509	Cable, Safety, Kit, Nickel Alloy, UNS N0660
AS4461	Assembly and Soldering Criteria for High Quality/High Reliability Soldering Wire and Cable Termination in Aerospace Vehicles
AS4536	Safety Cable Kit Procurement Specification and Requirement for Use
AS5117	Clip, Spring Retention - Electrical Cable

AS5419	Cable, Thermocouple Extension, Shielded and Unshielded
AS5768	Tool, Stripper, Electrical Insulation, General Specification for
AS5942	Marking of Electrical Insulating Materials
AS6070	Aerospace Cable, High Speed Data, Copper
AS6136	Conduit, Electrical, Flexible, Shielded, Aluminum Alloy for Aircraft Installations
AS7351	Clamp, Loop Type Bonding
AS7928	Terminals, Lug: Splices, Conductor: Crimp Style, Copper, General Specification for
AS7928/14	Terminal, Electrical, Permanent, Crimp Style, Tin-Coated Copper, Insulated, Environment Resistant, Class 1, 150 °C, Heatless Sealing
AS7974	Cable Assemblies and Attachable Plugs, External Electrical Power, Aircraft, General Specification for
AS8700	Installation and Test of Electronic Equipment in Aircraft, General Specification for
AS10380	Coupling Installations, Standard Conduit, Electrical
AS18029	Cover Assembly, Electrical, for MS27212 Terminal Board Assembly
AS21980	Ferrule, Outer, Uninsulated Shield Terminating, Type I, Two Piece, Class I, for Shielded Cables
AS21981	Ferrule, Inner, Uninsulated, Shield Terminating, Type I, Two Piece, Class I , for Shielded Cables
AS21919	Clamp, Loop Type, Cushioned Support
AS22520	Crimping Tools, Wire Termination, General Specification for
AS22759	Wire, Electrical, Fluoropolymer-Insulated, Copper or Copper Alloy
AS23053	Insulation Sleeving, Electrical, Heat Shrinkable, General Specification for
AS23053/5	Insulation Sleeving, Electrical, Heat Shrinkable, Polyolefin, Flexible, Crosslinked
AS23053/8	Insulation Sleeving, Electrical, Heat Shrinkable, Polyvinylidene Fluoride, Semi-Rigid, Crosslinked
AS23053/11	Insulation Sleeving, Electrical, Heat Shrinkable, Fluorinated Ethylene Propylene, Non-Crosslinked
AS23053/12	Insulation Sleeving, Electrical, Heat Shrinkable, Polytetrafluoroethylene
AS23053/18	Insulation Sleeving, Electrical, Heat Shrinkable, Modified Fluoropolymer, Crosslinked
AS23190	Wiring, Positioning, and Support Accessories
AS25274	Cap, Electrical (Wire End, Crimp Style, Type II, Class 1), for 105 °C Total Conductor Temperature
AS25435	Terminal, Lug, Crimp Style, Straight Type, for Aluminum Aircraft Wire, Class 1
AS25436	Terminal, Lug, Crimp Style, 90° Upright Type, for Aluminum Aircraft Wire, Class 1
AS25438	Terminal, Lug, Crimp Style, Right Angle Type, for Aluminum Aircraft Wire, Class 1
AS25439	Splice, Permanent, Crimp Style, Two Way Type for Aluminum Aircraft Wire, Class 1

AS27212	Terminal Board Assembly, Molded-in-Stud, Electric
AS33681	Strap, Tiedown, Electrical Components, Identification, Adjustable, Self-Clinching, Plastic, Type II, Class 1
AS33731	Strip, Mounting, Nut Insulating, for AS27212 Terminal Board
AS39029	Contacts, Electrical Connector, General Specification for
AS39029/112	Contact Bushing, Electrical Connector Contact, Wire Barrel
AS70991	Terminals: Lug and Splice, Crimp Style, Aluminum, for Aluminum Aircraft Wire
AS81044	Wire, Electrical, Crosslinked Polyalkene, Crosslinked Alkane-Imide Polymer, or Polyarylene Insulated, Copper or Copper Alloy
AS81714	Terminal Junction System (TJS), Environment Resistant, General Specification for
AS81714/11	Terminal Junction System, Terminal Junction Blocks, Sectional, Wire In-Line Junctions, Single, Series I
AS81714/12	Terminal Junction System, Terminal Junction Blocks, Sectional, Wire In-Line Junctions, Double, Series I
AS81714/27	Terminal Junction System, Terminal Junction Blocks, Sectional, Grounding Modules, Stud Type Mounting, Series I
AS81714/28	Terminal Junction System, Terminal Junction Blocks, Sectional, Grounding Modules, Integral, Bracket Mounting Series I
AS81714/63	Terminal Junction System, Terminal Junction Blocks, Sectional, Grounding Modules, Stud and Flange Type Mounting, Series II
AS81790	Connectors, Receptacle, External Electric Power, Aircraft, General Specification for
AS81824	Splices, Electric, Crimp, Copper, Environment Resistant
AS81824/1	Splice, In-Line, Electric, Crimp, SN/CU, Environmental, Heat-Shrinkable Sleeve (150 °C), 1 x 1 Sealant Opening
AS81824/13	Splice, Stub, Electrical, Permanent, Crimp Style, Nickel/Copper, Insulated, Environment Resistant, 175 °C Max
AS81914	Tubing, Plastic, Flexible, Convoluted, Conduit, General Specification for
AS83519	Shield Termination, Solder Style, Insulated, Heat-Shrinkable, Environment Resistant, General Specification for
AS85049	Connector Accessories, Electrical, General Specification for
AS85049/80	Connector Accessories, Electrical, Dummy Contact, Sizes 16, 12, and 8, Category 7 (for MIL-DTL-38999 Connectors)
AS85049/93	Connector Accessories, Electrical, Termination, Shield Split Support Ring, Composite, Nonenvironmental, Straight, Category 7
AS85049/103	Connectors, Accessories, Composite, RFI/EMI, Electrical, Strain Relief, Straight, Self-Locking, Category 3C (for MIL-DTL-38999 Series III and IV Connectors)

AS85049/104 Connectors, Accessories, Composite, RFI/EMI, Electrical, Strain Relief, 45°, Self-Locking, Category 3C (for MIL-DTL-38999 Series III and IV Connectors)

AS85049/105 Connectors, Accessories, Composite, RFI/EMI, Electrical, Strain Relief, 90°, Self-Locking, Category 3C (for MIL-DTL-38999 Series III and IV Connectors)

AS85049/128 Shield Band, Connector Accessories, Electrical Backshell, Category 7 (for AS85049/82 - /90, /93, /109 - /117 Accessories)

AS85049/138 Connector Accessories, Electrical, Cap, Dust, Plastic, Category 9

AS85485 Cable, Electric, Filter Line, Radio Frequency Absorptive

AS85485/8 Cable, Electric, Filter Line, Shielded, Jacketed, Radio Frequency Absorptive, 150 °C, 600-Volt

AS85485/12 Cable, Electric, Filter Line, Small Diameter Wire, Shielded, Jacketed, Radio Frequency Absorptive, 150 °C, 600-Volt

AS90387 Wiring Installation Tools for Plastic and Metal Tiedown Straps

2.1.2 U.S. Government Publications

Copies of these documents are available online at https://quicksearch.dla.mil.

2.1.3 Specifications, Standards, and Handbooks

Unless otherwise specified, the following specifications, standards and handbooks of the issue listed in that issue of the Acquisition Streaming and Standardization Information System (ASSIST) specified in the solicitation form a part of this specification to the extent specified herein.

2.1.3.1 Specifications

2.1.3.1.1 Military

MIL-A-46146 Adhesives-Sealants, Silicone, RTV, Noncorrosive (For Use With Sensitive Metals and Equipment)

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

MIL-DTL-3607 Connector, Coaxial, Radio Frequency, Series

MIL-DTL-3650 Connectors, Coaxial, Radio Frequency, Series LC

MIL-DTL-3655 Connector, Plug and Receptacle, Electrical (Coaxial, Series Twin), and Associated Fittings, General Specification for

MIL-DTL-5541 Chemical Conversion Coatings on Aluminum and Aluminum Alloys

MIL-DTL-5846 Chromel and Alumel Thermocouple Electrical Wire

MIL-DTL-24308 Connectors, Electrical, Rectangular, Nonenvironmental, Minature, Polarized Shell, Rack and Panel, General Specification for

MIL-DTL-25038 Wire, Electrical, High Temperature and Fire Resistant, and Flight Critical, General Specification for

MIL-DTL-25516 Connectors, Electrical, Miniature, Coaxial, Environment-resistant Type, General Specification for

MIL-DTL-81381 Wire, Electric, Polyimide-Insulated, Copper or Copper Alloy

MIL-DTL-83413/8 Connectors and Assemblies, Electrical, Aircraft Grounding: Type IV Jumper Cable Assembly, Lead, Electrical

MIL-DTL-83517 Connector, Coaxial, Radio Frequency for Coaxial, Strip or Microstrip Transmission Line, General Specification for

MIL-I-631 Insulation, Electrical, Synthetic-Resin Composition, Nonrigid

MIL-I-3190 Insulation Sleeving, Electrical, Flexible, Coated, General Specification for

MIL-M-24041 Molding and Potting Compound, Chemically Cured Polyurethane

MIL-PRF-8516 Sealing Compound, Polysulfide Rubber, Electric Connectors and Electric Systems, Chemically Cured

MIL-PRF-23586 Sealing Compound, Electrical, Silicone Rubber, Accelerator Required

MIL-PRF-29504 Termini, Fiber Optic Connector, Removable, General Specification for

MIL-PRF-39012 Connectors, Coaxial, Radio Frequency, General Specification for

MIL-PRF-46846 Rubber, Synthetic, Heat-Shrinkable

MIL-PRF-49142 Connector, Plug and Receptacle, Electrical, Triaxial, Radio Frequency, General Specification for

MIL-PRF-55339 Adapter, Connector, Coaxial, Radio Frequency, (Between Series and Within Series), General Specification for

MIL-T-81490 Transmission Lines, Transverse Electromagnetic Mode

2.1.3.2 Standards

2.1.3.2.1 Military

MIL-STD-196 Joint Electronics Type Designation System

MIL-STD-464 Department of Defense Interface Standard for Electromagnetic Environmental Effects Requirements for Systems

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

MIL-STD-704 Aircraft Electric Power Characteristics

MIL-STD-889 Dissimilar Metals

MIL-STD-1553 Digital Time Division Command/Response, Multiplex Data Bus

MIL-STD-7080 Electric Equipment, Aircraft, Selection and Installation of

MIL-STD-7179 Finishes, Coatings, and Sealings for the Protection of Aerospace Weapons Systems, General Specification for

MS27488 Plug, End Seal, Electrical Connector

2.1.3.3 Handbooks

2.1.3.3.1 Military

MIL-HDBK-502 Product Support Analysis

MIL-HDBK-516 Airworthiness Certification Criteria

MIL-HDBK-522 Guidelines for Inspection of Aircraft Electrical Wiring Interconnect Systems

MIL-HDBK-525 Electrical Wiring Interconnect System (EWIS) Integrity Program

MIL-HDBK-863 Wiring Data and System Schematic Diagrams, Preparation of

MIL-HDBK-1646 Selection of Electrical Contacts, Connectors and Associated Servicing Tools

2.1.3.4 Technical Manuals

Documents can be obtained at the NATEC technical data website: https://mynatec.navair.navy.mil/natechome.htm.

NAVAIR 01-1A-505-1, T.O. 1-1A-14, and ARMY TM 1-1500-323-24-1: Installation and Repair Practices Volume I Aircraft Electric and Electronic Wiring

NAVAIR 01-1A-505-2, T.O. 1-1A-14-2, and TM 1-1500-323-24-2: Installation and Repair Practices Volume II Aircraft Circular Electrical Connectors and Accessories

NAVAIR 01-1A-505-3, T.O. 1-1A-14-3, and TM 1-1500-323-24-3: Installation and Repair Practices Volume III Aircraft Rectangular Electrical Connectors and Accessories

NAVAIR 01-1A-505-4, T.O. 1-1A-14-4, and TM 1-1500-323-24-4: Installation and Repair Practices Volume IV Aircraft Fiber Optic Cabling

2.1.3.5 Commercial Item Descriptions (CID)

A-A-52080 Tape, Lacing and Tying, Nylon (Type I), -67 °F (-55 °C) to 250 °F (121 °C)

A-A-52081 Tape, Lacing and Tying, Polyester (Type II), -100 °F (-73 °C) to 280 °F (138 °C)

A-A-52082 Tape, Lacing and Tying, TFE-Fluorocarbon (Type III), -100 °F (-73 °C) to 450 °F (232 °C)

A-A-52083 Tape, Lacing and Tying, Glass (Type IV), -100 °F (-73 °C) to 800 °F (427 °C)

A-A-52084 Tape, Lacing and Tying, Aramid (Nomex), (Type V), -100 °F (-73 °C) to 500 °F (260 °C)

A-A-59163 Insulation Tape, Electrical, Self Adhering Unsupported Silicone Rubber

A-A-59178 Nipple, Electrical Terminal

A-A-59474 Insulation Tape, Electrical, High Temperature, Polytetrafluoroethylene, Pressure-sensitive

2.1.3.6 Additional Documents

Additional documents pertaining to the selection of wire and electrical cables are listed in Appendix A.

2.1.4 Non-Government Publications

The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of the ASSIST cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the ASSIST are the issues of the documents cited in the solicitation (see 6.2).

2.1.5 AIA Publications

Available from Aerospace Industries Association, 1000 Wilson Boulevard, Suite 1700, Arlington, VA 22209-3928, Tel: 703-358-1000, www.aia-aerospace.org.

NAS831 Cap - Protective Electrical Connector

NAS837 Plug - Protective Electrical Connector

NASM3036 Grommet, Rubber Hot-oil and Coolant Resistant

NASM20995 Wire, Safety or Lock

NASM21266 Grommet, Plastic, Edging

NASM22529/2 Grommet, Cushion Composite Edging

NASM25440 Washer, for Use with Aircraft Aluminum Terminals

NASM33540 Safety Wiring and Cotter Pinning, General Practice for

2.1.6 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME Y14.100 Engineering Drawing Practices

ASME Y14.24 Types and Applications of Engineering Drawings

ASME Y14.34M Associated Lists

2.1.7 ECA Publications

EIA standards are available from Electronic Components Industry Association (ECIA), 310 Maxwell Road, STE 200, Alpharetta, GA 30009, Tel: 678-393-9990. Copies of these documents are available online at https://www.ecianow.org.

EIA/ECA-364-26 Salt Spray Test Procedure for Electrical Connectors, Contacts and Sockets

2.1.8 IEEE Publications

Available from IEEE Operations Center, 445 and 501 Hoes Lane, Piscataway, NJ 08854-4141, Tel: 732-981-0060, www.ieee.org.

IEEE Std. 315-1975 Graphic Symbols for Electrical and Electronics Diagrams (Including Reference Designation Letters)

2.1.9 RTCA Publications

Available from RTCA, Inc., 1150 18th Street, NW, Suite 910, Washington, DC 20036, Tel: 202-833-9339, www.rtca.org.

RTCA DO-160 Environmental Conditions and Test Procedures for Airborne Equipment

2.2 Order of Precedence

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

2.3 Definitions

2.3.1 AIRCRAFT

An airplane, helicopter, or lighter-than-air vehicle.

2.3.2 BRANCH

A section of harness that divides off and extends to a point of termination.

2.3.3 BUNDLE

Any number of harnesses or branches routed and supported together along some distance within the aircraft.

2.3.4 CHAFING

Repeated relative motion between wiring system components, or between a wiring system component and structure or equipment, which results in a rubbing action that causes wear which will likely result in mechanical or electrical failure during the aerospace vehicle's specified service life.

2.3.5 CONNECTOR PLUG

The connector containing the coupling ring or active retention device of the mating pair.

2.3.6 CONNECTOR RECEPTACLE

The connector containing the static retention device of the mating pair.

2.3.7 ELECTRICAL CABLE

Two or more insulated conductors, solid or stranded, contained in a common covering, or two or more insulated conductors twisted or molded together without common covering, or one insulated conductor with a metallic covering shield or outer conductor.

2.3.8 END FACE

The end portion of a fiber optic terminus that is intended to transmit light to an adjoining end of a mated terminus. End faces are either cleaved or cleaved and polished so as to optimize their light transmission characteristics.

2.3.9 FIBER OPTIC CABLE

A cable designed to transmit light waves between a light transmission source and a receiver. In signal applications, the transmitter and receiver include devices that are used to convert between optical and electronic pulses. Typical cables include a glass or plastic core, a layer of cladding having a lower refractor index to refract or totally reflect light inward at the core/cladding boundary, a buffer, strength members, and jacketing to protect the inner cable from environmental damage.

2.3.10 FIREPROOF

The capability of a material or component to withstand a 2000 °F flame (±150 °F) for 15 minutes minimum, while still fulfilling its design purpose.

Clarification:

The term “fireproof” when applied to a connector, backshell, or accessory hardware mounted and secured to a structure used to confine fires within designated fire zones means that the connector system will perform this function (conduct electrical power and prevent flame/heat penetration) under conditions likely to occur in such zones and will withstand a 2000 °F flame (±150 °F) for 15 minutes minimum. A connector system consists of mated connectors, fully wired, backshells, or conduit assemblies, and mounting hardware installed on a structural panel (firewall).

2.3.11 FIRE RESISTANT

The capability of a connector system (as defined in “fireproof”) to perform its intended function in designated fire zone areas under heat and other abnormal conditions, as encountered in powerplants and auxiliary power unit (APU) installations, that are likely to occur at the particular location or area and to withstand a 2000 °F flame (±150 °F) for 5 minutes minimum.

2.3.12 FIREWALL

A structural panel designed to prevent a hazardous quantity of air, fluid, or flame from exiting a designated fire zone in which a fire may erupt and cause additional hazard to the aircraft. This structural panel permits penetration of fluid carrying lines (fuel and hydraulics), ducts, electrical power, and control cables/rods through the use of suitable fireproof components or fittings. The firewall and the attached components or fittings shall withstand flame penetration and shall not exhibit backside ignition for the required test time (15 minutes). The backside temperature should not exceed 450 °F maximum and the structural panel should have fireproof insulating material installed to limit the backside temperature.

2.3.13 FIRE ZONE

A designated area or enclosure generally considered to be within certain selected areas within engine nacelles and APU installations that under abnormal operating conditions can experience temperatures approaching 2000 °F. These conditions are generally the results of fuel or hydraulic line failures, heat duct failures, or engine case burn through, allowing high pressure and high temperature gas to escape from the engine, and similar types of failures. Some typical fire zones are the engine nacelles, (APU) compartment, fuel burning heaters, weapon exhaust areas, and other combustion equipment installations. Other areas such as wheel wells may also be considered a fire zone area due to the heat generated from the brakes.

2.3.14 FLAMMABLE

Capable of bursting into flame when a spark or open flame is passed sufficiently near, as with fumes and vapors from hot oils or volatile combustible liquids, and with finely powdered, combustible solids.

2.3.15 GROUP

A number of wires and/or electrical/optical cables and their terminations secured together within the structure of a bundle or harness. Groups normally contain wire and/or electrical/optical cables pertaining to a single circuit or routed to a single item of equipment.

2.3.16 HARNESS

An assembly of any number of wires, electrical/optical cables and/or groups and their terminations which is designed and fabricated so as to allow for installation and removal as a unit. A harness may be an open harness or a protected harness.

2.3.16.1 HIGH DENSITY HARNESS

A protected harness designed to save weight and space which has a majority of wire types selected from Appendix A, Table A2.