



AEROSPACE STANDARD

AS6324™

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Verification of New Conductor Alloys for AS29606 Conductors Qualification

RATIONALE

AS6324 provides the requirements for verifying the basic material properties needed to initiate final design and qualification of a copper alloy conductor in AS29606 for Aerospace applications.

FORWARD

This document recognizes that no specification can cover all possible requirements needed for a component to perform in every field application, and acknowledges that only applications applied over a period of time can completely verify an aerospace component's capability. For pragmatic reasons, existing component specifications have limited qualification requirements for approval of the component in Aerospace vehicles. To address this basic issue, the introduction of a new, but similar to already field proven, component requires comparative testing to verify that the new component will perform at the same or above level as the already approved component. This typically requires long term tests or unique tests, not practical to be included in a component specification, with qualification oversight and periodic review requirements.

AS6324 is established because there are no documents which fully list the requirements for copper conductor alloys or define a testing regimen for verification of new alloys for Aerospace vehicle electrical conductor applications. Existing documents defining various conductor classes such as high strength, extra-high strength and ultra-high strength alloys specify only a limited number of requirements for these conductors:

- ASTM B624 describes the properties of single end high strength bare uninsulated conductors. These properties are limited to tensile strength/break load, electrical conductivity/resistance and elongation.
- AS29606 describes specifications for copper as well as high strength, extra-high strength and ultra-high strength conductors for typical constructions used in aerospace applications. The specified conductor properties in AS29606 are also limited to break load, resistance and elongation.
- AS22759 and its detailed specification sheets describe the requirements for insulated wire. Additional requirements listed in these specifications in some cases refer to the conductor, such as flex life and softening resistance, and may be of great importance in certain applications.

AS6324 provides comparative test methods for new copper alloys to be tested against a well-established, field tested, benchmark alloy such as C18135 (Cu-0.4%Cr-0.4%Cd) or an accepted cadmium free (RoHS compliant) equivalent which is qualified to AS29606. AS6324 verifies the characteristics of the new alloy and develops comparative performance criteria versus the benchmark.

Verification of ultra-high strength copper alloy, used extensively in the Aerospace application, was the first test program using the AS6324 approach. A similar version of this approach was also used to qualify a new cadmium free alloy, Percon® 24. The AS6324 verification program shall be conducted under the supervision of a third party testing activity capable of conducting or monitoring the testing of the new copper alloy. The testing organization shall analyze results and compare performance to validate performance equivalency with existing alloys if justified (see 6.2).

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1. SCOPE

AS6324 specifies the requirements for comparative testing of new copper and copper alloy conductors to AS29606 qualified conductors. AS29606 approved conductors are used for the construction of insulated wire defined in SAE Aerospace wire standards (i.e., AS22759, AS81044, etc.). AS6324 defines testing which meets or exceeds the minimum test requirements of AS29606 and AS22759 and its detailed specification sheets.

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 qualification or the purchase order, as applicable. In the event of a 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.

AS4373	Test Methods for Insulated Electric Wires
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
AS22759	Wire, Electrical, Fluoropolymer-Insulated, Copper or Copper Alloy
AS22759/33	Wire, Electrical, Fluoropolymer-Insulated, Cross-linked Modified ETFE, Lightweight, Silver-Coated, High-Strength Copper Alloy, 200°C, 600 Volt
AS22759/44	Wire, Electrical, Fluoropolymer-Insulated, Cross-linked Modified ETFE, Lightweight, Silver-Coated Copper, 200°C, 600 Volt
AS22759/45	Wire, Electrical, Fluoropolymer-Insulated, Cross-linked Modified ETFE, Lightweight, Nickel-Coated Copper, 200°C, 600 Volt
AS22759/46	Wire, Electrical, Fluoropolymer-Insulated, Cross-linked Modified ETFE, Lightweight, Nickel-Coated High-Strength Copper Alloy, 200°C, 600 Volt
AS22759/82	Wire, Electrical, Polytetrafluoroethylene/Polyimide Insulated, Lightweight, Nickel-Coated High-Strength or Ultra-High Strength Copper Alloy, 260°C, 600 Volt
AS22750/92	Wire, Electrical, Polytetrafluoroethylene/Polyimide Insulated, Lightweight, Nickel-Coated Copper Conductor, 260°C, 600 Volt
AS22759/182	Wire, Electrical, Polytetrafluoroethylene/Polyimide Insulated, Smooth Surface, Lightweight, Nickel-Coated High-Strength or Ultra-High Strength Copper Alloy, 260°C, 600 Volt
AS22759/192	Wire, Electrical, Polytetrafluoroethylene/Polyimide Insulated, Smooth Surface, Lightweight, Nickel-Coated Copper Conductor, 260°C, 600 Volt
AS29606	Wire, Electrical, Stranded, Uninsulated Copper, Copper Alloy, or Aluminum, or Thermocouple Extension, General Specification For
AS39029	Contacts, Electrical Connector, General Specification For

2.2 U.S. Military Specifications and Standards

Copies of these documents are available at <http://quicksearch.dla.mil>.

MIL-STD-202 Test Method Standard Electronic and Electrical Components Parts

MIL-STD-2223 Test Methods for Insulated Electric Wire

2.3 American Society for Testing and Materials (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 B298 Silver-Coated Soft or Annealed Copper Wire

ASTM B355 Nickel-Coated Soft or Annealed Copper Wire

ASTM B470 Bonded Copper Conductors for Use in Hookup Wires for Electronic Equipment

ASTM B624 High-Strength, High-Conductivity Copper-Alloy Wire for Electronic Application

ASTM B961 Silver Coated Copper and Copper Alloy Stranded Conductors for Electronic Space Application

ASTM B965 High Performance Tin-Coated Annealed Copper Wire Intended for Electrical and Electronic Application for Solderability

2.4 Electronic Components Industry Association (ECIA) Publications

Available from Electronic Components Industry Association, 2214 Rock Hill Road, Suite 265, Herndon, VA 20170, Tel: 571-323-0294, www.ecianow.org.

ECIA EIA-364-28 Vibration Test Procedure for Electrical Connectors and Sockets

2.5 IPC-Association Connecting Electronics Industries

Available from IPC, 3000 Lakeside Drive, 309 S, Bannockburn, IL 60015, Tel: 847-615-7100, www.ipc.org.

J-STD-002 Component Leads, Terminations, Lugs, Wires, Solderability Test For

3. REQUIREMENT

In order for a new conductor to be considered for usage in AS29606 its test results shall exceed or be equivalent to those of the approved similar AS29606 conductor being used as the benchmark.

3.1 Requirement Deviations

In particular tests, new conductor values may be slightly lower than the benchmark conductor. The user requesting the new AS29606 conductor (see 6.4) may determine the result does significantly impact the conductor usage. The number of deviations shall be kept to a minimum and the conductor supplier with user guidance shall provide technical justification for the conductor acceptance in AS29606.

4. QUALITY CONFORMANCE

4.1 Independent Test Laboratory

When AS6324 is used to establish a new conductor for qualification in AS29606 and AS22759, all testing shall be performed by, or under the direction of the designated Qualifying Activity listed in AS29606 (see 6.3). Conductor suppliers shall contact the qualifying activity prior any testing (see 6.4).

4.1.1 Testing Procedure

A request for testing shall be made to the Qualifying Activity (see 6.2) prior to initiating testing. Testing cannot begin until the supplier has received an authorization letter. The supplier is recommended to provide the Qualifying Activity a test plan based on the authorization letter to ensure the supplier and Qualifying Activity maintain communication and document changes as needed. The Qualifying Activity shall not approve a new conductor that does not meet the requirements specified herein. The Qualifying Activity has the authority to impose specific specification test requirements to resolve test failures/discrepancies. Any change in the supplier's process control inspections, quality conformance inspections, or manufacturing control drawings (editorial changes are acceptable) without the express approval of the Qualifying Activity may result in non-acceptance of test results for that conductor.

4.1.2 Test Reports

The supplier shall provide the Qualifying Activity a data package of all tests performed (see 5.). The Qualifying Activity test method procedures shall be made available to the supplier upon request for any tests conducted by the Qualifying Activity. The supplier shall provide a test report to the Qualifying Activity for all tests conducted by the supplier. The test report shall be signed by the manufacturing authority responsible for ensuring compliance with the specification requirements. The supplier may combine the Qualifying Activity test data with the supplier's test data into one final test report. The final test report and/or 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.

- a. Copy of all certifications specified herein.
- b. The quantitative results for all tests conducted and the authorization letter.
- c. A tabulated comparison between the new conductor, AS29606 benchmark conductor and annealed copper.
- d. Corrective Action Reports (as applicable)

4.2 Test/Benchmark Conductor and Wire Configuration Sample

The conductor construction shall be size 24 with unilay or unidirectional concentric-lay stranding that is 19 strands of 36 copper alloy (19x36). If applicable, as approved by the Qualifying Activity, other conductor constructions such as size 26 (19x38) unilay or unidirectional concentric-lay may be used (see 6.4). Both nickel and silver coated products shall be tested. Relevant AS22759 fluoropolymer insulations shall be used to insulate each coating type. Testing shall be conducted on the un-insulated conductor as well as the insulated wire. AS29606 small diameter conductors shall be used as applicable. The benchmark conductor shall be one which is qualified to AS29606 and contain similar properties as the new conductor being evaluated.

4.2.1 Alternate Configurations

In a broader qualification program, other constructions may be required depending on the User need for listing in AS29606 (See 6.4). Tin coating may also need to be included if applicable.