



AEROSPACE STANDARD

AS4372™**REV. C**

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Superseding AS4372B

Performance Requirements for Wire, Electric, Insulated Copper or Copper Alloy

RATIONALE

AS4372C has been reaffirmed to comply with the SAE five-year review policy.

FOREWORD

This SAE Aerospace Standard (AS) contains performance-oriented requirements intended to evaluate electric wire for aerospace applications. The results of testing wires to the requirements of this standard should aid designers in selecting suitable wires for their particular applications.

The requirements of this standard are classified as follows:

- a. Design Evaluation: Specific requirements are given.
- b. Information Only: No specific requirements, but test results shall be reported.

These classifications are based on the existence of specific general performance levels for these requirements and not on the importance of the particular requirement. Requirements for process control and quality conformance are not included in this document since this is not a purchase specification.

This document provides baseline criteria and some minimum performance levels for aerospace wire. These requirements may need to be supplemented or revised by the designer to meet the particular application.

Sound engineering judgment must be the overriding criteria for test selection, interpretation of test results, and resulting aerospace wire application. Results from all tests may not be required for every wire application selection problem. A number of the performance requirements documented in this standard are long term procedures and/or are costly in terms of time and/or equipment.

NOTE: The requirements of this document were collected from a number of aerospace vehicle manufacturers. Therefore, some common requirements have established minimum performance levels while other requirements are more user-specific and are classified as information only.

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1. SCOPE

- 1.1 This document covers the requirements for insulated, single-conductor, electric wires with tin-coated, silver-coated, or nickel-coated conductors of copper or copper alloy as specified in an applicable generated performance sheet (see Appendix A for sample). It provides general performance requirements, ratings, and information for various characteristics of insulated wire systems used in aerospace applications. Numerical test requirements, or parameters, were originally developed using either English or metric units. The original, primary, units are shown first with the secondary (converted) units in parentheses. Secondary units are listed for information only and are not to be considered requirements.

Wire will be assigned a level of performance for many requirements set forth in this standard. These performance levels, in addition to numerical test results, shall be listed in the applicable performance sheet. This standard contains some tests and referenced AS4373 Test Methods that have not been rigorously confirmed as reproducible. Such methods are identified under the Precision and Bias Statements in the individual AS4373 Test Methods. Many requirements have multiple levels of performance. The wire with base level of performance is acceptable for general use; however, there may be special applications that will require wire with higher performance levels.

1.2 Construction

The wires shall be constructed as described in the applicable performance sheet.

1.2.1 Performance Sheet Identification

Each performance sheet will have an identifying number as shown in Figure 1.

ABCDEFG	-	01234
Manufacturer or User Code		Manufacturer I.D.

FIGURE 1

The manufacturer/user code can be the part number used by either one. The manufacturer identification should be the Commercial and Government Entity (CAGE) Code per publication H4-1 and H4-2.

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 724-776-4970 (outside USA), www.sae.org.

AS4373	Test Methods for Insulated Electric Wire
AS50881	Wiring, Aerospace Vehicle

2.2 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 B 33	Wire, Copper, Tinned Soft or Annealed, for Electrical Purposes
ASTM B 298	Wire, Copper, Silver Coated Soft or Annealed
ASTM B 355	Wire, Copper, Nickel Coated Soft or Annealed
ASTM B 624	Copper, High Strength, High Conductivity
ASTM E 29	Standard Practice for Using Significant Digits in Test Data to Determine Conformance with Specifications

2.3 U.S. Government Publications

Available from the Document Automation and Production Service (DAPS), Building 4/D, 700 Robbins Avenue, Philadelphia, PA 19111-5094, Tel: 215-697-6257, <http://assist.daps.dla.mil/quicksearch/>.

H4-1	Commercial and Government Entity (CAGE) for Manufacturers Part 1, Name to Code
H4-2	Commercial and Government Entity (CAGE) for Manufacturers Part 2, Code to Name

3. REQUIREMENTS

3.1 General

3.1.1 Performance Sheets

The requirements for the individual wires under this standard shall be as listed herein and as described in the applicable performance sheet. The format of the performance sheet shall be in accordance with the sample provided in Appendix A.

3.1.2 Design Evaluation

Some paragraphs in this document are specifically included to provide the design engineer with information needed in evaluating a new wire construction. These design evaluation requirements and paragraphs are listed below:

3.4.1	Conductor Diameter
3.4.2	Conductor Elongation and Tensile Breaking Strength
3.4.3	Conductor Material
3.4.4	Conductor Resistance
3.4.7	Conductor Stranding
3.5.5	Voltage Rating
3.6.1	Fluid Immersion
3.6.7	Wicking
3.7.1	Abrasion

- 3.7.2 Cold Bend
- 3.7.3 Dynamic Cut Through
- 3.7.4 Flex Life
- 3.7.6 Notch Propagation
- 3.7.7 Stiffness and Springback
- 3.8.1 Flammability
- 3.8.4 Temperature Index
- 3.9.1 Finished Wire Diameter
- 3.9.2 Finished Wire Weight
- 3.1.3 "Information Only"

Some paragraphs in this document require that test values be measured and recorded but do not establish a minimum performance level. This data is for information only and is intended to provide the designer with data without imposing minimum acceptable results. The "Information Only" paragraphs are listed below:

- 3.2.1 Solderability
- 3.2.2 Thermal/Mechanical Resistance
- 3.2.3 Solder Pot Test for Insulation Shrinkage
- 3.2.4 Insulation Bonding to Potting Compounds
- 3.2.5 Percent Overlap of Insulating Materials
- 3.3 Chemical, Biological, Radiological/Nuclear, Biological, Chemical (CBR/NBC)
- 3.4.5 Conductor Splices
- 3.4.6 Conductor Strand Blocking
- 3.5.1 Dielectric Constant
- 3.5.2 Corona Inception and Extinction Voltages
- 3.5.3 Surface Resistance
- 3.5.4 Time/Current to Smoke
- 3.5.6 Dry Arc Propagation Resistance
- 3.5.7 Wet Arc Propagation Resistance
- 3.5.8 Wire Fusing Time
- 3.6.2 Forced Hydrolysis
- 3.6.3 Humidity Resistance

- 3.6.4 Weight Loss Under Temperature and Vacuum
- 3.6.5 Propellant Resistance
- 3.6.6 Weathering Resistance
- 3.7.5 Insulation Impact Resistance
- 3.7.9 Durability and Legibility of Wire Installer's Identification
- 3.8.2 High Pressure/High Temperature Air Impingement
- 3.8.3 Smoke Quantity
- 3.8.6 Property Retention After Thermal Aging
- 3.8.7 Flame Resistance
- 3.8.8 Insulation State of Sinter
- 3.10.1 Wire Marking Contrast
- 3.1.4 Workmanship

All details of workmanship shall be in accordance with high quality aerospace manufacturing practices. The insulation shall be free of foreign materials and irregularities such as cracks, splits, and bubbles. Color shall be uniform (free of mottling and streaking).

3.1.5 Finished Wire

The finished wire shall conform to the requirements of this document and those of the applicable performance sheet.

3.1.6 Insulation Construction

Insulation shall be constructed as specified in the applicable performance sheet.

3.2 Assembly, Handling, and Repair

3.2.1 Solderability (Tin Coated Copper Wire Only)

When tested in accordance with Method 105 of AS4373, tin coated copper wire specimens shall have 95% of the termination covered by continuous new solder. Pinholes and voids shall not be concentrated and shall be less than 5% of the total termination area. Three specimens of each wire size shall be tested to one of the conditions listed in Table 1 and the results averaged.

TABLE 1

Condition	Hours of Steam Aging	Flux
A	8	Type R
B	1	Type R
C	0	Type R

3.2.2 Thermal/Mechanical Resistance

When tested in accordance with Method 106 of AS4373 for single wire and Method 107 for wire in a bundle, size 22 specimens shall exhibit their ability to resist damage from a soldering iron heated to 550 °F (288 °C), 650 °F (343 °C), and 750 °F (399 °C). The average time to penetrate at each temperature shall be recorded on the performance sheet. If penetration does not occur within the maximum time limit, "no penetration" shall be recorded on the performance sheet.

3.2.3 Solder Pot Test for Insulation Shrinkage

When tested in accordance with Method 108 of AS4373, three size 22 wire specimens shall have the insulation shrinkage measured. The average shrinkage shall be recorded in the performance sheet.

3.2.4 Insulation Bonding to Potting Compounds

When tested in accordance with Method 102 of AS4373, five size 22 AWG wire specimens shall have the pull-out strength measured. The average pull-out strength shall be recorded on the performance sheet.

3.2.5 Percent Overlap of Insulating Tapes

When tested in accordance with Method 109 of AS4373, the degree of rotation shall be measured on each tape layer. Using the formula provided, the degrees of overlap shall be converted to percentage overlap. Both the degrees of rotation and percent overlap shall be recorded on the performance sheet.

3.3 Chemical, Biological, Radiological/Nuclear, Biological Chemical [CBR(NBC)]

When required by a user, specimens of insulation material shall be tested to CBR/NBC. Note that the Air Force has established an extensive data base on the chemical compatibility of materials for use in aerospace vehicles. While this data base as a whole is classified information, it has been made available to prime aerospace contractors. Current contact for this data base is at WL/MSLA, Wright Patterson AFB, Ohio. In addition, the Army has done extensive testing of a number of materials and should be consulted before testing to determine if a candidate insulation material has already been tested. Contact for this is NBC Survivability Office, Army CR&D, Edgewood, MD.

The intent of this material testing is to assure inertness of a material to the CBR/NBC exposure. Because of this, Test Methods Group 200 of AS4373 gives no procedure. The Air Force and the Army have established over a dozen qualified laboratories to do this type of CBR/NBC testing. These laboratories are not empowered to determine the suitability of an item such as a wire after exposure, only to determine if there is an effect on the materials used for insulation. It is not recommended that handling of items after exposure be done outside of these qualified labs due to personnel safety considerations.

3.4 Conductor

3.4.1 Conductor Diameter

When tested in accordance with Method 401 of AS4373, conductor diameter shall meet the dimensions of Table 2. The average conductor diameter for applicable sizes shall be listed in the performance sheet.