



400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard



AMS 7726E

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Superseding AMS 7726D

IRON-NICKEL-COBALT ALLOY, WIRE
53Fe - 29Ni - 17Co
Low Expansion, Glass Sealing, Annealed

UNS K94610

1. SCOPE:

1.1 Form:

This specification covers a low-expansion iron-nickel-cobalt alloy in the form of wire.

1.2 Application:

This wire has been used typically for the fabrication of lead wires and other electronic elements to be sealed to hard glasses during the assembly of electronic components, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification 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.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2371 Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steels and Alloys, Wrought Products and Forging Stock

AMS 2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat Resistant Steels and Alloys

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2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM E 18 Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials

ASTM E 112 Determining the Average Grain Size

ASTM E 228 Linear Thermal Expansion of Solid Materials with a Vitreous Silica Dilatometer

ASTM E 354 Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

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Shall be approximately 53% iron, 29% nickel, and 17% cobalt by weight with residual elements not exceeding the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 354, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition, Residual Elements

Element	min	max
Carbon	--	0.04
Manganese	--	0.50
Silicon	--	0.20
Chromium	--	0.20
Molybdenum	--	0.20
Copper	--	0.20
Titanium	--	0.10
Aluminum	--	0.10
Magnesium	--	0.10
Zirconium	--	0.10
Sum of Ti + Al + Mg + Zr	--	0.20

3.2 Condition:

Cold drawn and bright annealed.

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3.3 Properties:

Wire shall conform to the following requirements:

3.3.1 As Received:

3.3.1.1 Average Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with (R) ASTM E 112 (See 8.2).

3.3.1.2 Hardness: Shall be not higher than 82 HRB, or equivalent (See 8.3), determined in accordance with ASTM E 18.

3.3.2 After Reannealing: Specimens to determine conformance to the following requirements shall be reannealed by heating in hydrogen atmosphere to $900\text{ }^{\circ}\text{C} \pm 15$ ($1652\text{ }^{\circ}\text{F} \pm 27$), holding at heat for 60 minutes ± 5 , further heating to $1100\text{ }^{\circ}\text{C} \pm 15$ ($2012\text{ }^{\circ}\text{F} \pm 27$), holding at heat for 15 minutes ± 3 , cooling from $1100\text{ }^{\circ}\text{C} \pm 15$ ($2012\text{ }^{\circ}\text{F} \pm 27$) to $200\text{ }^{\circ}\text{C}$ ($392\text{ }^{\circ}\text{F}$) or below in the hydrogen atmosphere at a rate not greater than 5 C (9 F) degrees per minute, and air cooling to room temperature; specimens may be cooled to room temperature between the $900\text{ }^{\circ}\text{C}$ ($1652\text{ }^{\circ}\text{F}$) and $1100\text{ }^{\circ}\text{C}$ ($2012\text{ }^{\circ}\text{F}$) heating periods.

3.3.2.1 Coefficient of Thermal Expansion: Shall be as shown in Table 2, determined in accordance with ASTM E 228.

TABLE 2A - Linear Coefficient of Thermal Expansion, Inch/Pound Units

Temperature Range	Average Linear Coefficient of Thermal Expansion
	Inch/Inch/ per Degree Fahrenheit
86 to 752 $^{\circ}\text{F}$	$2.56 \text{ to } 2.89 \times 10^{-6}$
86 to 842 $^{\circ}\text{F}$	$2.83 \text{ to } 3.06 \times 10^{-6}$

TABLE 2B - Linear Coefficient of Thermal Expansion, SI Units

Temperature Range	Average Linear Coefficient of Thermal Expansion
	mm/mm per Degree Celsius
30 to 400 $^{\circ}\text{C}$	$4.60 \text{ to } 5.20 \times 10^{-6}$
30 to 450 $^{\circ}\text{C}$	$5.10 \text{ to } 5.50 \times 10^{-6}$

3.3.3 Temperature of Transformation: The temperature of transformation from gamma to alpha (R) phase shall be not higher than $-78\text{ }^{\circ}\text{C}$ ($-108\text{ }^{\circ}\text{F}$), determined by metallographic examination after cold soaking for not less than four hours.

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3.3.4 Glass Seal Test: Wire shall produce, with Corning Glass 7052 or equivalent, a glass-to-metal seal free from bubbles at the interface. The interface shall be free from cracks after immersion in a mixture of dry ice and acetone maintained at $-80\text{ }^{\circ}\text{C} \pm 2$ ($-112\text{ }^{\circ}\text{F} \pm 4$). Annealing of the glass to relieve stresses after the sealing operation is permissible.

3.4 Quality:

Wire, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the wire.

3.5 Tolerances:

Shall conform to the following:

3.5.1 Diameter or Thickness: Shall be as shown in Table 3.

TABLE 3A - Diameter or Thickness Tolerances, Inch/Pound Units

Nominal Diameter or Distance Between Parallel Sides Inch	Tolerance, Inch Plus and Minus
0.002 to 0.0043, incl	0.0002
Over 0.0043 to 0.0079, incl	0.00025
Over 0.0079 to 0.0149, incl	0.0003
Over 0.0149 to 0.0199, incl	0.0004
Over 0.0199 to 0.0309, incl	0.0005
Over 0.0309 to 0.0409, incl	0.0006
Over 0.0409 to 0.0609, incl	0.0007
Over 0.0609 to 0.0809, incl	0.0008
Over 0.0809 to 0.1259, incl	0.0010
Over 0.1259 to 0.1569, incl	0.0015
Over 0.1569 to 0.250, incl	0.0020

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TABLE 3B - Diameter or Thickness Tolerances SI Units

Nominal Diameter or Distance Between Parallel Sides Millimeters	Tolerance Millimeter Plus and Minus
0.05 to 0.109, incl	0.005
Over 0.109 to 0.201, incl	0.0064
Over 0.201 to 0.378, incl	0.008
Over 0.378 to 0.505, incl	0.010
Over 0.505 to 0.785, incl	0.013
Over 0.785 to 1.039, incl	0.015
Over 1.039 to 1.547, incl	0.018
Over 1.547 to 2.055, incl	0.020
Over 2.055 to 3.198, incl	0.025
Over 3.198 to 3.985, incl	0.038
Over 3.985 to 6.35, incl	0.051

3.5.2 Roundness: Round wire shall not be out-of-round by more than one-half the total tolerance specified in Table 3 for the nominal diameter.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

The vendor of wire shall supply all samples for vendor's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the wire conforms to specified requirements.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Composition (3.1), average grain size (3.3.1.1), hardness (3.3.1.2), coefficient of thermal expansion (3.3.2.1), temperature of transformation (3.3.3), quality (3.4), and tolerances (3.5) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Glass sealing (3.3.4) is a periodic test and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

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Shall be in accordance with AMS 2371 and the following:

4.3.1 One sample from each heat or lot as applicable for coefficient of thermal expansion (3.3.2.1), temperature of transformation (3.3.3), and glass sealing tests (3.3.4).

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