



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 7727A

Superseding AMS 7727

Issued 1-31-64

Revised 1-15-81

UNS K94610

ALLOY BARS AND FORGINGS, LOW EXPANSION, GLASS SEALING
53Fe - 29Ni - 17Co

1. SCOPE:

1.1 Form: This specification covers a low-expansion iron-nickel-cobalt alloy in the form of bars and forgings.

1.2 Application: Primarily for electronic elements to be sealed to hard glasses during assembly of electronic components.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods

AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Wrought Products Except Forgings and Forging Stock

AMS 2374 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Forgings and Forging Stock

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

AMS 2808 - Identification, Forgings

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B95 - Linear Expansion of Metals

ASTM E8 - Tension Testing of Metallic Materials

ASTM E354 - Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

2.3 U. S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

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

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3. TECHNICAL REQUIREMENTS:

3.1 **Composition:** Shall be approximately 53% iron, 29% nickel, and 17% cobalt by weight with residual elements not exceeding the following percentages by weight; composition shall be determined by wet chemical methods in accordance with ASTM E354, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	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

3.2 **Condition:** The product shall be supplied in the following condition:

3.2.1 **Bars:** Centerless ground.

3.2.2 **Forgings:** As ordered.

3.3 **Properties:** The product shall conform to the following requirements:

3.3.1 **Tensile Properties:** Shall be as follows, determined in accordance with ASTM E8:

∅	Tensile Strength, min	70,000 psi (483 MPa)
	Yield Strength at 0.2% Offset, min	55,000 psi (379 MPa)
	Elongation in 4D, min	30%

3.3.2 **Coefficient of Thermal Expansion:** Shall be as specified in Table I, determined in accordance with ASTM B95 on specimens annealed by heating in a hydrogen atmosphere to 900°C ± 15 (1650°F ± 25), holding at heat for 60 min ± 5, followed by heating in a hydrogen atmosphere to 1100°C ± 15 (2010°F ± 25), holding at heat for not less than 15 min., and cooling in the hydrogen atmosphere to 200°C (390°F) or lower at a rate not exceeding 5 C (9 F) deg per minute. The specimens may be cooled to room temperature between the 900°C and the 1100°C heat treatment cycles.

TABLE I

Temperature Range	Average Linear Coefficient of Thermal Expansion (mm/mm)/Deg Celsius
30°C to 400°C	4.60 to 5.20 x 10 ⁻⁶
30°C to 450°C	5.10 to 5.50 x 10 ⁻⁶

TABLE I (IP)

Temperature Range	Average Linear Coefficient of Thermal Expansion In. per In. per Deg Fahrenheit
86°F to 752°F	2.56 to 2.89 x 10 ⁻⁶
86°F to 842°F	2.83 to 3.06 x 10 ⁻⁶

- 3.3.3 Temperature of Transformation: The temperature of transformation from gamma to alpha phase shall be not higher than -78°C (-109°F), determined on specimens annealed as in 3.3.2 by expansion measurements in accordance with ASTM B95 or by metallographic examination. Some localized transformation acceptable to the purchaser may be permissible on product 7/8 in. (22 mm) and under in nominal diameter or distance between parallel sides.
- 3.4 Quality: The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.
- 3.5 Tolerances: Unless otherwise specified, tolerances shall conform to the following:
 - 3.5.1 Diameter of Centerless-Ground Bars: Shall be as specified in Table II.

TABLE II

Nominal Diameter Inches	Tolerance, Inch plus and minus
0.030 to 0.055, incl	0.0005
Over 0.055 to 0.125, incl	0.001
Over 0.125 to 0.500, incl	0.0015
Over 0.500 to 1.000, incl	0.002
Over 1.000 to 1.625, incl	0.0025
Over 1.625 to 1.750, incl	0.003
Over 1.750 to 2.000, incl	0.004
Over 2.000 to 4.000, incl	0.005

TABLE II (SI)

Nominal Diameter Millimetres	Tolerance, Millimetre plus and minus
0.76 to 1.40, incl	0.013
Over 1.40 to 3.18, incl	0.03
Over 3.18 to 12.70, incl	0.038
Over 12.70 to 25.40, incl	0.05
Over 25.40 to 41.28, incl	0.064
Over 41.28 to 44.45, incl	0.08
Over 44.45 to 50.80, incl	0.10
Over 50.80 to 101.60, incl	0.13

- 3.5.1.1 Tolerances for centerless-ground bars less than 0.030 in. (0.76 mm) or over 4.000 in. (101.60 mm) in nominal diameter shall be as agreed upon by purchaser and vendor.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of the product shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), coefficient of thermal expansion (3.3.2), temperature of transformation (3.3.3), quality (3.4), and tolerances
∅ for bars (3.5) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for tensile properties (3.3.1) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless
∅ frequency of testing is specified by purchaser.

4.3 Sampling: Shall be in accordance with the following; a lot shall be all product of the same nominal size,
∅ configuration, or part number from the same heat of alloy processed at the same time:

4.3.1 For Acceptance Tests:

∅ 4.3.1.1 Bars: AMS 2371.

∅ 4.3.1.2 Forgings: AMS 2374.

4.3.1.3 Sampling for coefficient of thermal expansion (3.3.2) and temperature of transformation (3.3.3)
∅ shall be as agreed upon by purchaser and vendor.

∅ 4.3.2 For Periodic Tests: As agreed upon by purchaser and vendor.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of each heat and the results of tests on each lot to determine
∅ conformance to the other acceptance test requirements of this specification. This report shall include the purchase order number, lot number, AMS 7727A, size, and quantity from each lot. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 7727A, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: Shall be in accordance with the following:

∅ 4.5.1 Bars: AMS 2371.

∅ 4.5.2 Forgings: AMS 2374.

5. PREPARATION FOR DELIVERY:

5.1 Identification: The product shall be identified as follows:

∅ 5.1.1 Bars: In accordance with AMS 2806.

5.1.2 Forgings: In accordance with AMS 2808.