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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 7727B

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Superseding AMS 7727A

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

UNS K94610

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 shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 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 E8 - Tension Testing of Metallic Materials
ASTM E228 - Linear Thermal Expansion of Solid Materials with a Vitrous Silica Dilatometer
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 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall be approximately 53% iron, 29% nickel, and 17% cobalt by Ø weight with residual elements not exceeding the following percentages by weight; composition shall be determined by wet chemical methods in accordance with ASTM E354 or by spectrochemical methods or other analytical methods acceptable to purchaser:

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

3.3.2 Coefficient of Thermal Expansion: Shall be as specified in Table I, Ø determined in accordance with ASTM E228 on specimens annealed by heating in a hydrogen atmosphere to 900°C ± 15 (1652°F ± 27), holding at heat for 60 minutes + 5, followed by heating in a hydrogen atmosphere to 1100°C ± 15 (2012°F ± 27), holding at heat for not less than 15 minutes, and cooling in the hydrogen atmosphere to 200°C (392°F) or lower at a rate not exceeding 5 C (9 F) degrees/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/Degree 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 Inches/Inch/Degree 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 Ø gamma to alpha phase shall be not higher than -78°C (-108°F), determined by metallographic examination on specimens annealed as in 3.3.2. Some localized transformation acceptable to the purchaser may be permissible on product 7/8 inch (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 Ø and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.5 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 under 0.030 inch (0.76 mm) or over 4.000 inches (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 any confirmatory testing deemed 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 heat or lot as applicable.