



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
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AMS 7728D

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ALLOY SHEET, STRIP, AND PLATE, 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 sheet, strip, and plate.
- 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
- 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 E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
 - ASTM E112 - Estimating the Average Grain Size of Metals
 - 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 impurities 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:

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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: Cold rolled and bright annealed.

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

3.3.1 As Received:

- 3.3.1.1 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, determined by comparison of a polished and etched specimen with the chart in ASTM E112.

- 3.3.1.2 Hardness: Not higher than 82 HRB or equivalent for product 0.100 in. (2.54 mm) and under in nominal thickness and not higher than 85 HRB for product over 0.100 in. (2.54 mm) in nominal thickness, determined in accordance with ASTM E18.

- 3.3.2 After Reannealing: Specimens to determine conformance to the following requirements shall be reannealed by heating in a hydrogen atmosphere to $900^{\circ}\text{C} \pm 15$ ($1650^{\circ}\text{F} \pm 25$), holding at heat for 60 min. ± 5 , further heating to $1100^{\circ}\text{C} \pm 15$ ($2010^{\circ}\text{F} \pm 25$), holding at heat for 15 min. ± 3 , cooling from $1100^{\circ}\text{C} \pm 15$ ($2010^{\circ}\text{F} \pm 25$) to 200°C (390°F) or below in the hydrogen atmosphere at a rate not greater than 5 C (9 F) deg per min., and air cooling to room temperature; specimens may be cooled to room temperature between the 900°C (1650°F) and 1100°C (2010°F) heating periods.

- 3.3.2.1 Coefficient of Thermal Expansion: Shall be as specified in Table I, determined in accordance with ASTM B95.

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	

3.3.2.2 Temperature of Transformation: The temperature of transformation from gamma to alpha phase shall be not higher than -78°C (-109°F), determined by expansion measurements in accordance with ASTM B95 or by metallographic examination.

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 Thickness: Product over 1 in. (25 mm) wide shall be measured at least 3/8 in. (9.5 mm) from the edge.

TABLE II

Nominal Thickness Inches	Tolerance, Inch Plus and Minus Except As Shown Width Ranges, Inches			
	Up to 3.0, excl	3.0 to 6.0, incl	Over 6.0 to 12.0, incl	Over 12.0 to 16.0, incl
Up to 0.006, excl	0.0005	0.0005	--	--
0.006 to 0.009, incl	0.00075	0.00075	--	--
Over 0.009 to 0.010, incl	0.001	0.001	0.001	0.001
Over 0.010 to 0.011, incl	0.001	0.001	0.001	0.0015
Over 0.011 to 0.016, incl	0.001	0.001	0.0015	0.0015
Over 0.016 to 0.019, incl	0.001	0.001	0.0015	0.002
Over 0.019 to 0.025, incl	0.001	0.0015	0.002	0.002
Over 0.025 to 0.028, incl	0.0015	0.0015	0.002	0.002
Over 0.028 to 0.034, incl	0.0015	0.002	0.0025	0.0025
Over 0.034 to 0.049, incl	0.002	0.0025	0.003	0.003
Over 0.049 to 0.068, incl	0.0025	0.003	0.003	0.003
Over 0.068 to 0.099, incl	0.003	0.003	0.003	0.004
Over 0.099 to 0.160, incl	0.004	0.004	0.004	0.004
Over 0.160 to 0.189, incl	0.005	0.005	+0.020	+0.020
Over 0.189 to 0.250, incl	--	--	+0.046	+0.046
Over 0.250 to 0.375, incl	--	--	+0.046	+0.046
Over 0.375 to 0.500, incl	--	--	+0.054	+0.054
Over 0.500 to 0.750, incl	--	--	+0.054	+0.054
Over 0.750 to 1.000, incl	--	--	+0.060	+0.060

TABLE II (SI)

			Tolerance, Millimetres Plus and Minus Except As Shown Width Ranges, Millimetres			
Nominal Thickness Millimetres			Up to 76, excl	76 to 152, incl	Over 152 to 305, incl	Over 305 to 406, incl
Up to 0.15, excl			0.013	0.013	--	--
0.15 to 0.23, incl			0.0190	0.0190	--	--
Over	0.23 to	0.25, incl	0.03	0.03	0.03	0.03
Over	0.25 to	0.28, incl	0.03	0.03	0.03	0.038
Over	0.28 to	0.41, incl	0.03	0.03	0.038	0.038
Over	0.41 to	0.48, incl	0.03	0.03	0.038	0.05
Over	0.48 to	0.64, incl	0.03	0.038	0.05	0.05
Over	0.64 to	0.71, incl	0.038	0.038	0.05	0.05
Over	0.71 to	0.86, incl	0.038	0.05	0.064	0.064
Over	0.86 to	1.24, incl	0.05	0.064	0.08	0.08
Over	1.24 to	1.73, incl	0.064	0.08	0.08	0.08
Over	1.73 to	2.51, incl	0.08	0.08	0.08	0.10
Over	2.51 to	4.06, incl	0.10	0.10	0.10	0.10
Over	4.06 to	4.80, incl	0.13	0.13	+0.51	+0.51
Over	4.80 to	6.35, incl	--	--	+1.17	+1.17
Over	6.35 to	9.52, incl	--	--	+1.17	+1.17
Over	9.52 to	12.70, incl	--	--	+1.37	+1.37
Over	12.70 to	19.05, incl	--	--	+1.37	+1.37
Over	19.05 to	25.40, incl	--	--	+1.52	+1.52

- 3.5.1.1 For widths over 6.00 in. (152 mm) to 16.00 in. (406 mm), incl, the minus tolerance for nominal thicknesses over 0.160 in. (4.06 mm) to 0.189 in. (4.80 mm), incl, shall be 0.000 and for nominal thicknesses over 0.189 in. (4.80 mm) shall be -0.010 in. (-0.25 mm).

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: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each lot.
- 4.3 Sampling: Shall be in accordance with AMS 2371 and the following; a lot shall be all product of the same nominal size from the same heat of alloy processed at the same time:
- 4.3.1 Composition: One sample from each heat.
- 4.3.2 Hardness: The number, location, and orientation of samples from each lot shall be as agreed upon by purchaser and vendor.
- 4.3.3 Sampling for coefficient of thermal expansion (3.3.2.1) and temperature of transformation (3.3.2.2) shall be as agreed upon by purchaser and vendor.

4.4 Reports: