



AEROSPACE MATERIAL SPECIFICATION

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

AMS 5221B
Superseding AMS 5221A

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ALLOY STRIP
49Fe - 5.3Cr - 42Ni - 2.5Ti - 0.55Al
Solution Heat Treated

1. SCOPE:

1.1 Form: This specification covers an iron-nickel alloy in the form of strip.

1.2 Application: Primarily for diaphragms, leaf springs and helical springs, requiring a precipitation-hardenable alloy with a coefficient of modulus of elasticity of -20 to $+20 \times 10^{-6}$ per degree Fahrenheit from -50° to $+150^{\circ}$ F (-36 to $+36 \times 10^{-6}$ per degree Celsius from -46° to $+66^{\circ}$ C) after suitable heat treatment.

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 2248 - Chemical Check Analysis Limits, Wrought Heat and Corrosion Resistant Steels and Alloys

AMS 2350 - Standards and Test Methods

AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Alloys, Wrought Products Except 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 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-Base Alloys

2.3 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 conform to the following percentages by weight, 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 approved analytical methods:

	min	max
Carbon	--	0.06
Manganese	--	0.80
Silicon	--	1.00
Phosphorus	--	0.04
Sulfur	--	0.04
Chromium	4.90 -	5.75
Nickel + Cobalt	41.00 -	43.50
Titanium	2.20 -	2.75
Aluminum	0.30 -	0.80
Chromium + (Titanium - 4 x Carbon)	7.10 -	8.10
Cobalt (3.1.1)	--	1.00
Iron		remainder

- 3.1.1 Determination not required for routine acceptance.

- 3.1.2 Check Analysis: Composition variations shall meet the requirements of AMS 2248.

- 3.2 Condition: Solution heat treated.

- 3.3 Heat Treatment: Strip shall be solution heat treated by heating to $1750^{\circ}\text{F} \pm 25$ ($954.4^{\circ}\text{C} \pm 14$), holding at heat for a time commensurate with section thickness but not more than 30 min., and cooling as required.

- 3.4 Properties: Strip shall conform to the following requirements:

- 3.4.1 As Solution Heat Treated:

- 3.4.1.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM E8, on strip 0.020 to 0.250 in. (0.51 to 6.35 mm), incl; in nominal thickness; properties of strip less than 0.020 in. (0.51 mm) or over 0.250 in. (6.35 mm) in nominal thickness shall be as agreed upon by purchaser and vendor:

Tensile Strength, max	95,000 psi (655 MPa)
Elongation in 2 in. (50.8 mm), min	35%

- 3.4.1.2 Hardness: Shall be not higher than 80 HRB or equivalent, determined in accordance with ASTM E18.

- 3.4.1.3 Grain Size: Shall be 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.

3.4.2 After Precipitation Heat Treatment: Strip 0.020 to 0.250 in. (0.51 to 6.35 mm), incl, in nominal thickness shall conform to the following requirements after being precipitation heat treated by heating to $1300^{\circ}\text{F} \pm 15$ ($704.5^{\circ}\text{C} \pm 8.3$), holding at heat for 180 min. ± 5 , and cooling in air; properties of strip less than 0.020 in. (0.51 mm) or over 0.250 in. (6.35 mm) in nominal thickness shall be as agreed upon by purchaser and vendor:

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

$\emptyset$	Tensile Strength, min	150,000 psi (1034 MPa)
	Yield Strength at 0.2% Offset, min	90,000 psi (621 MPa)
	Elongation in 2 in. (50.8 mm), min	5%

3.4.2.2 Hardness: Shall be 27 - 35 HRC or equivalent, determined in accordance with ASTM E18.

3.5 Quality: Strip, as received by the 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 strip.

3.6 Tolerances: Unless otherwise specified, the following tolerances shall apply:

3.6.1 Thickness:

TABLE I

Nominal Thickness (T) Inches	Thickness Tolerance, Inch plus and minus	
	Width Ranges, Inches	
	Up to 4.00, incl	Over 4.00 to 5.00, incl
Up to 0.015, incl	0.0005	0.0006
Over 0.015 to 0.025, incl	0.00075	0.0008
Over 0.025 to 0.040, incl	0.001	0.001
Over 0.040	0.025T	0.025T

TABLE I (SI)

Nominal Thickness (T) Millimetres	Thickness Tolerance, Millimetres plus and minus	
	Width Range, Millimetres	
	Up to 101.6, incl	Over 101.6 to 127, incl
Up to 0.38, incl	0.013	0.015
Over 0.38 to 0.64, incl	0.0190	0.020
Over 0.64 to 1.02, incl	0.03	0.03
Over 1.02	0.025T	0.025T

3.6.1.1 When premium tolerances for thickness are specified, product shall conform to Table II.

TABLE II

Nominal Thickness (T) Inches	Thickness Tolerance, Inch plus and minus	
	Width Ranges, Inches	
	Up to 4.00, incl	Over 4.00 to 5.00, incl
Up to 0.005, incl	0.0002	0.0003
Over 0.005 to 0.010, incl	0.0003	0.0004
Over 0.010 to 0.015, incl	0.0004	0.0005
Over 0.015 to 0.025, incl	0.0005	0.0005
Over 0.025	0.02T	0.02T

TABLE II (SI)

Nominal Thickness (T) Millimetres	Thickness Tolerance, Millimetres plus and minus	
	Width Range, Millimetres	
	Up to 101.6 incl	Over 101.6 to 127, incl
Up to 0.13, incl	0.005	0.008
Over 0.13 to 0.25, incl	0.008	0.010
Over 0.25 to 0.38, incl	0.010	0.013
Over 0.38 to 0.64, incl	0.013	0.013
Over 0.64	0.02T	0.02T

3.6.2 Width:

TABLE III

Nominal Width Inches	Width Tolerances, Inch Thickness Ranges, Inch			
	Up to	Over	Over	Over
	0.010, incl	0.010 to 0.040, incl	0.040 to 0.075, incl	Over 0.075
Up to 3.00, incl	+0.010 -0.000	+0.010 -0.000	+0.015 -0.000	+0.015 -0.000
Over 3.00 to 4.00, incl	+0.010 -0.000	+0.012 -0.000	+0.015 -0.000	+0.015 -0.000
Over 4.00 to 5.00, incl	+0.010 -0.000	+0.015 -0.000	+0.015 -0.005	+0.015 -0.015