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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5223D

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Superseding AMS 5223C

ALLOY STRIP
49Fe - 5.3Cr - 42Ni - 2.5Ti - 0.55Al
Solution Heat Treated, Cold Rolled, 10% Reduction

UNS N09902

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 x 10^{-6} per degree Fahrenheit from -50° to +150°F (-36 to +36 x 10^{-6} per degree Celsius from -46° to +66°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 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 2248 - Chemical Check Analysis Limits, Wrought Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
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 E8 - Tension Testing of Metallic Materials
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E112 - Determining Average Grain Size
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 conform to the following percentages by weight, Ø determined by wet chemical methods in accordance with ASTM E354, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	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 - 4x 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, cold rolled with approximately 10% reduction in thickness, and decaled.

3.3 Heat Treatment: Strip shall be solution heat treated by heating to Ø 1750°F ± 25 (954°C ± 14, holding at heat for a time commensurate with thickness, 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 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, determined in accordance with ASTM E112.

3.4.2 As Solution Heat Treated and Cold Rolled:

3.4.2.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM E8; these requirements apply to strip 0.020 to 0.250 inch (0.51 to 6.35 mm), incl, in nominal thickness:

Tensile Strength	90,000 - 110,000 psi (621 - 758 MPa)
Elongation in 2 inches (50.8 mm), minimum	15%

3.4.2.1.1 Tensile property requirements for strip under 0.020 inch (0.51 mm) or over 0.250 inch (6.35 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4.2.2 Hardness: Should be 83 - 98 HRB, or equivalent, determined in accordance with ASTM E18, but strip shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.2.1 are met.

3.4.3 After Precipitation Heat Treatment: Strip 0.020 to 0.250 inch (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°F ± 15 (704°C ± 8), holding at heat for 180 minutes ± 5, and cooling in air; properties of strip under 0.020 inch (0.51 mm) or over 0.250 inch (6.35 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

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

Tensile Strength, minimum	165,000 psi (1138 MPa)
Yield Strength at 0.2% Offset, minimum	120,000 psi (827 MPa)
Elongation in 2 inches (50.8 mm), minimum	10%

3.4.3.2 Hardness: Should be 34 - 41 HRC, or equivalent, determined in accordance with ASTM E18, but strip shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.3.1 are met.

3.5 Quality: Strip, 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 strip.

3.6 Tolerances: Shall conform to the following:

3.6.1 Thickness:

TABLE I

Nominal Thickness (T) Inch	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	0.0010	0.0010
Over 0.040	0.025T	0.025T

TABLE I (SI)

Nominal Thickness (T) Millimetres	Thickness Tolerance, Millimetre Plus and Minus Width Ranges, Millimetres	
	Up to 101.6, incl	Over 101.6 to 127.0 incl
Up to 0.38, incl	0.013	0.015
Over 0.38 to 0.64, incl	0.019	0.020
Over 0.64 to 1.02, incl	0.025	0.025
Over 1.02	0.025T	0.025T

3.6.1.1 When close tolerances for thickness are specified, strip shall conform to Table II.

TABLE II

Nominal Thickness (T) Inch	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, Millimetre Plus and Minus Width Ranges, Millimetres	
	Up to 101.6, incl	Over 101.6 to 127.0 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 Tolerance, Inch Thickness Ranges, Inch			
	Up to 0.010, incl	Over 0.010 to 0.040, incl	Over 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

TABLE III (SI)

Nominal Width Millimetres	Width Tolerance, Millimetre Thickness range, Millimetres			
	Up to 0.25, incl	Over 0.25 to 1.02, incl	Over 1.02 to 1.90, incl	Over 1.90
Up to 76.2, incl	+0.25 -0.00	+0.25 -0.00	+0.38 -0.00	+0.38 -0.00
Over 76.2 to 101.6, incl	+0.25 -0.00	+0.30 -0.00	+0.38 -0.00	+0.38 -0.00
Over 101.6 to 127.0, incl	+0.25 -0.00	+0.38 -0.00	+0.38 -0.13	+0.38 -0.38