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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 5598A
Superseding AMS 5598

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ALLOY SHEET, STRIP, AND PLATE, CORROSION AND HEAT RESISTANT
72Ni - 15.5Cr - 0.95(Cb + Ta) - 2.5Ti - 0.70Al - 7.0Fe
Consumable Electrode or Vacuum Induction Melted
Solution Heat Treated

UNS N07750

1. SCOPE:

1.1 Form: This specification covers a corrosion and heat resistant nickel alloy in the form of sheet, strip, and plate.

1.2 Application: Primarily for parts requiring high strength up to 1500°F (815°C) and oxidation resistance up to 1800°F (980°C), and for bellows and flat springs requiring optimum resistance to relaxation up to 1000°F (540°C) with moderate or relatively low stresses, particularly where welding is involved. Parts may be formed, welded if required, and then heat treated to improve strength at elevated temperatures.

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 SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2262 - Tolerances, Nickel, Nickel-Base, and Cobalt-Base Alloy Sheet, Strip, and Plate
AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel Alloys and Cobalt 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 - Estimating the Average Grain Size of Metals
ASTM E290 - Semi-Guided Bend Test for Ductility 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

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 spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Carbon	--	0.08
Manganese	--	0.35
Silicon	--	0.35
Phosphorus (3.1.1)	--	0.015
Sulfur	--	0.010
Chromium	14.00	17.00
Nickel + Cobalt	70.00	--
Columbium + Tantalum	0.70	1.20
Titanium	2.25	2.75
Aluminum	0.40	1.00
Iron	5.00	9.00
Cobalt (3.1.1)	--	1.00
Copper	--	0.50

3.1.1 Determination not required for routine acceptance.

3.1.2 Check Analysis: Composition variations shall meet the requirements of AMS 2269.

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

3.2.1 Sheet: Hot rolled or cold rolled, solution heat treated, and descaled unless solution heat treatment is performed in an atmosphere yielding a bright finish, having a surface appearance comparable to a commercial corrosion-resistant steel No. 2 Finish.

3.2.2 Strip: Cold rolled and solution heat treated. Strip need not be bright and may have an oxidized surface.

3.2.3 Plate: Hot rolled, solution heat treated, and descaled.

3.3 Solution Heat Treatment: No specific heat treating instructions are specified but it is recommended that the product be solution heat treated by heating in a suitable protective atmosphere to 1800°F ± 25 (980°C ± 15), holding at heat for a time commensurate with product thickness, and cooling at a rate equivalent to air cool or faster.

3.4 Properties: The product 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:

3.4.1.1.1 Strip:

TABLE I

Nominal Thickness Inch	Tensile Strength psi, max	Elongation in 2 in. or 4D %, min
Up to 0.010, excl	140,000	--
0.010 to 0.025, excl	135,000	18

TABLE I (SI)

Nominal Thickness Millimetre	Tensile Strength MPa, max	Elongation in 50 mm or 4D %, min
Up to 0.25, excl	965	--
0.25 to 0.64, excl	930	18

3.4.1.1.2 Sheet:

TABLE II

Nominal Thickness Inch	Tensile Strength psi, max	Yield Strength at 0.2% Offset psi, max	Elongation in 2 in. or 4D %, min
0.010 to 0.024, incl	135,000	75,000	30
Over 0.024 to 0.250, incl	135,000	75,000	35

TABLE II (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, max	Yield Strength at 0.2% Offset MPa, max	Elongation in 50 mm or 4D %, min
0.25 to 0.61, incl	930	515	30
Over 0.61 to 6.35, incl	930	515	35

3.4.1.1.3 Tensile property requirements for strip 0.025 in. (0.64 mm) and over in nominal thickness and for plate in all thicknesses shall be as agreed upon by purchaser and vendor.

3.4.1.2 Bending: Product 0.250 in. (6.25 mm) and under in nominal thickness shall withstand, without cracking, bending in accordance with ASTM E290 at room Ø temperature through an angle of 180 deg around a diameter equal to the bend factor times the nominal thickness of the product with axis of bend parallel to the direction of rolling.

Nominal Thickness Inch	Nominal Thickness (Millimetres)	Bend Factor
Up to 0.050, incl	(Up to 1.25, incl)	1
Over 0.050 to 0.250, incl	(Over 1.25 to 6.25, incl)	2

3.4.1.2.1 Bending requirements for plate over 0.250 in. (6.25 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4.1.3 Grain Size: Sheet and strip 0.010 in. (0.25 mm) and over in nominal thickness shall have an average grain size not over 0.0025 in. (0.064 mm) in diameter (ASTM Grain Size No. 5), determined in accordance with ASTM E112.

3.4.1.3.1 Grain size requirements for sheet and strip up to 0.010 in. (0.25 mm), Ø excl, in nominal thickness and for plate shall be as agreed upon by purchaser and vendor.

3.4.2 After Precipitation Heat Treatment: The product shall have the following properties after being precipitation heat treated by heating to 1350°F ± 15 (730°C ± 8), holding at heat for 8 hr ± 0.5, cooling at a rate of 100 F ± 15 (55 C ± 8) deg per hr to 1150°F ± 15 (620°C ± 8) holding at 1150°F ± 15 (620° ± 8) for 8 hr ± 0.5, and cooling in air. Instead of the 100 F ± 15 (55 C ± 8) deg per hr cooling rate to 1150°F ± 15 (620°C ± 8), product may be furnace cooled at any rate provided the time at 1150°F ± 15 (620°C ± 8) is adjusted to give a total precipitation heat treatment time of 18 hours.

3.4.2.1 Tensile Properties: Shall be as shown in Table III, determined in Ø accordance with ASTM E8:

TABLE III

Product	Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
Strip	Up to 0.010, excl	155,000	--	--
	0.010 and Over	160,000	--	12
Sheet	0.010 to 0.250, incl	170,000	115,000	18
Plate	0.187 to 4.000, incl	160,000	105,000	18

TABLE III (SI)

Product	Nominal Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 4D %, min
Strip	Up to 0.25, excl	1070	--	--
	0.25 and Over	1105	--	12
Sheet	0.25 to 6.25, incl	1170	795	18
Plate	4.75 to 100.00, incl	1105	725	18

3.4.2.1.1 Elongation requirements do not apply to strip under 0.020 in. (0.50 mm) in nominal thickness.

3.4.2.1.2 Tensile property requirements for sheet under 0.010 in. (0.25 mm) Ø and for plate over 4.000 in. (100.00 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4.2.2 Hardness: Should be not lower than the following or equivalent, Ø determined in accordance with ASTM E18, but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.2.1 are met.

Product	Hardness
Strip 0.005 in. (0.13 mm) and over in nominal thickness	30 HRC
Sheet	32 HRC
Plate	30 HRC

3.5 Quality:

3.5.1 Alloy shall be multiple melted using consumable electrode practice in the remelt cycle or shall be induction melted under vacuum. If consumable electrode remelting is not performed in vacuum, electrodes which have been produced by vacuum induction melting shall be used for remelting.

3.5.2 The product, as received by purchaser, shall be uniform in quality and Ø and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the product.

3.6 Tolerances: Unless otherwise specified, tolerances for sheet 44 in. (1100 mm) and under in width and 0.010 in. (0.25 mm) and over in nominal thickness; for strip, other than for thickness; and for plate shall conform Ø to all applicable requirements of AMS 2262. Thickness tolerances for strip shall be ±10% of the nominal thickness. Tolerances for sheet over 44 in. (1100 mm) in width and under 0.010 in. (0.25 mm) in nominal thickness 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 Ø 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: Tests to determine conformance to all technical Ø requirements of this specification are classified as acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling: Shall be in accordance with AMS 2371; a heat shall be the consumable electrode remelted ingots produced from alloy originally melted Ø as a single furnace charge or the ingots produced from a single vacuum induction melt.