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400 COMMONWEALTH DRIVE WARRENDALE PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 5545B
Superseding AMS 5545A

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ALLOY SHEET, STRIP, AND PLATE, CORROSION AND HEAT RESISTANT
54Ni - 19Cr - 11Co - 9.8Mo - 3.2Ti - 1.5Al - 0.006B
Vacuum Induction and Consumable Electrode Melted, Solution Heat Treated
Precipitation Heat Treatable UNS N07041

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 1600°F (870°C) and oxidation resistance up to 1800°F (980°C).

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 2262 - Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Sheet, Strip, and Plate
MAM 2262 - Tolerances, Metric, Nickel, Nickel Alloy, and Cobalt 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 E21 - Elevated Temperature Tension Tests of Metallic Materials
ASTM E112 - Determining Average Grain Size
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 Specifications:

MIL-H-6875 - Heat Treatment of Steel, Process for

2.3.3 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, 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	--	0.12
Manganese	--	0.10
Silicon	--	0.50
Sulfur	--	0.015
Chromium	18.00	20.00
Cobalt	10.00	12.00
Molybdenum	9.00	10.50
Titanium	3.00	3.30
Aluminum	1.40	1.60
Boron (3.1.1)	0.0030	0.010
Iron	--	5.00
Copper	--	0.50
Nickel	remainder	

3.1.1 Boron may be less than 0.0030, determined on sheet and strip less than 0.050 in. (1.25 mm) in nominal thickness provided the specified content is met on stock prior to rolling into sheet or strip.

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 and Strip: Hot or cold rolled, solution heat treated, and, unless solution heat treatment is performed in an atmosphere yielding a bright finish, descaled having a surface appearance comparable to a corrosion resistant steel No. 2D finish. Standards for acceptance shall be as agreed upon by purchaser and vendor.

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

3.3 Solution Heat Treatment: The product shall be solution heat treated by Ø heating to 1975°F ± 25 (1080°C ± 15) in a suitable atmosphere, holding at heat for not less than 60 min. per inch (25 mm) of nominal thickness, and cooling at a rate equivalent to rapid air cooling or faster. Furnace surveys and calibration of temperature controllers and recorders shall be in accordance with MIL-H-6875.

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 specified in Table I, determined in accordance with ASTM E8.

TABLE I

Nominal Thickness Inches	Tensile Strength psi, max	Yield Strength at 0.2% Offset psi, max	Elongation in 2 in. or 4D %, min
Up to 0.015, incl	170,000	100,000	20
Over 0.015 to 0.115, incl	170,000	100,000	30
Over 0.115 to 0.187, incl	180,000	115,000	30
Over 0.187	195,000	140,000	30

TABLE I (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, max	Yield Strength at 0.2% Offset MPa, max	Elongation in 50 mm or 4D %, min
Up to 0.38, incl	1170	690	20
Over 0.38 to 2.90, incl	1170	690	30
Over 2.90 to 4.65, incl	1240	795	30
Over 4.65	1345	965	30

3.4.1.2 Hardness: Should be not higher than shown below, or equivalent, determined in accordance with ASTM E18, but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.1.1 are met.

Nominal Thickness		
Inch	Millimetres	Hardness
Up to 0.040, incl	Up to 1.00, incl	75 HR15N
Over 0.040 to 0.070, incl	Over 1.00 to 1.75, incl	64 HRA
Over 0.070 to 0.187, incl	Over 1.75 to 4.65, incl	30 HRC

3.4.1.2.1 Hardness of product over 0.187 in. (4.65 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4.1.3 Bending: Product 0.187 in. (4.65 mm) and under in nominal thickness shall withstand, without cracking, bending in accordance with ASTM E290 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	Millimetres	Bend Factor
Up to 0.062, incl	Up to 1.55, incl	2
Over 0.062 to 0.125, incl	Over 1.55 to 3.12, incl	2.5
Over 0.125 to 0.187, incl	Over 3.12 to 4.65, incl	3

3.4.1.3.1 Bending requirements for product over 0.187 in. (4.65 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4.1.4 Grain Size: Shall be predominantly 3 or finer with occasional grains as large as 1 permissible, determined by comparison of a polished and etched specimen with the chart in ASTM E112.

3.4.1.5 Microstructure: Metallographic examination shall disclose no significant alloy depleted layer or other undesirable surface condition. Standards for acceptance 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 1400°F ± 15 (760°C ± 8), holding at heat for not less than 16 hr, and cooling in air:

3.4.2.1 Tensile Properties:

3.4.2.1.1 At Room Temperature: Shall be as specified in Table II, determined in accordance with ASTM E8.

TABLE II

Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
Up to 0.020, incl	160,000	120,000	6
Over 0.020	170,000	130,000	10

TABLE II (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 4D %, min
Up to 0.50, incl	1105	825	6
Over 0.50	1170	895	10

3.4.2.1.2 Ø At 1400°F (760°C): Shall be as specified in Table III, determined in accordance with ASTM E21 on specimens heated to 1400°F ± 10 (760°C ± 5), held at heat for 20 - 30 min. before testing, and tested at 1400°F ± 10 (760°C ± 5).

TABLE III

Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
Up to 0.020, incl	130,000	110,000	3
Over 0.020	140,000	110,000	3

TABLE III (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50 mm or 4D %, min
Up to 0.50, incl	895	760	3
Over 0.50	965	760	3

3.4.2.2 Hardness: Should be not lower than 35 HRC, determined in accordance with ASTM E18, or equivalent, but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.2.1.1 are met.

3.5 Quality:

3.5.1 Alloy shall be produced by multiple melting, using vacuum induction followed by consumable electrode practice in the remelt cycle.

3.5.2 The product, 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 product.

3.6 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2262 or MAM 2262.

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 Ø 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: 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 as a single furnace charge.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and the results of tests on each lot to determine conformance to the other technical requirements of this specification. This report shall include the purchase order number, heat number, AMS 5545B, size, and quantity from each heat.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 5545B, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification and shall include in the report either a statement that the material conforms or copies of laboratory reports showing the results of tests to determine conformance.