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

AEROSPACE MATERIAL SPECIFICATION

AMS 5545A
Superseding AMS 5545

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UNS N07041

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

1. SCOPE:

1.1 Form: This specification covers a precipitation heat-treatable, 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 (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 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 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 E21 - Elevated Temperature Tension Tests 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-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

Printed in U.S.A.

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	--	0.12
Manganese	--	0.10
Silicon	--	0.50
Sulfur	--	0.015
ø 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. (1.3 mm) in ø 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 descaled unless solution heat treatment is performed in an atmosphere yielding a bright finish, having a surface appearance comparable ø 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 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.

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

ø 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	1172	690	20
Over 0.38 to 2.92, incl	1172	690	30
Over 2.92 to 4.75, incl	1241	793	30
Over 4.75	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 1.02, incl)	75 HR15N
Over 0.040 to 0.070, incl	(Over 1.02 to 1.78, incl)	64 HRA
Over 0.070 to 0.187, incl	(Over 1.78 to 4.75, incl)	30 HRC

3.4.1.2.1 Hardness of product over 0.187 in. (4.75 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4.1.3 Bending: Product 0.187 in. (4.75 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		
Inches	(Millimetres)	Bend Factor
Up to 0.062, incl	(Up to 1.57, incl)	2
Over 0.062 to 0.125, incl	(Over 1.57 to 3.18, incl)	2.5
Over 0.125 to 0.187, incl	(Over 3.18 to 4.75, incl)	3

3.4.1.3.1 Bending requirements for product over 0.187 in. (4.75 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

ø	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 0.51, incl	1103	827	6
Over 0.51	1172	896	10

3.4.2.1.2 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 not less than 30 min. before testing, and tested at 1400°F ± 10 (760°C ± 5).

TABLE III

ø	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 0.51, incl	896	758	3
Over 0.51	965	758	3

3.4.2.2 ø Hardness: Should be not lower than 35 HRC 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 3.4.2.1.1 are met.

3.5 Quality:

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

3.5.2 ø 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.