



AEROSPACE MATERIAL SPECIFICATION

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

AMS 5536H

Superseding AMS 5536G

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ALLOY SHEET, STRIP, AND PLATE, CORROSION AND HEAT RESISTANT
47.5Ni - 22Cr - 1.5Co - 9.0Mo - 0.60W - 18.5Fe

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 oxidation resistance up to 2200°F (1205°C) and relatively high strength up to 1500°F (815°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 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 E112 - Estimating the Average Grain Size of Metals

ASTM E139 - Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials

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

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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 analytical methods approved by purchaser:

		min	max
0	Carbon	0.05 -	0.15
	Manganese	--	1.00
	Silicon	--	1.00
	Phosphorus	--	0.040
	Sulfur	--	0.030
	Chromium	20.50 -	23.00
	Cobalt	0.50 -	2.50
	Molybdenum	8.00 -	10.00
	Tungsten	0.20 -	1.00
	Iron	17.00 -	20.00
	Aluminum	Present but not exceeding	0.50
	Titanium	Present but not exceeding	0.15
	Boron	Present but not exceeding	0.010
	Copper	--	0.50
	Nickel	remainder	

- 3.1.1 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 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. 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 Heat Treatment: The product shall be solution heat treated by heating in a suitable atmosphere to $2150^{\circ}\text{F} \pm 25$ ($1175^{\circ}\text{C} \pm 15$), except that sheet and strip 0.030 in. (0.75 mm) and under in nominal thickness may be heated to as low as $2100^{\circ}\text{F} \pm 25$ ($1150^{\circ}\text{C} \pm 15$), holding at heat for a time commensurate with product thickness, and rapidly cooling.

- 3.4 Properties: The product shall conform to the following requirements:

Ø 3.4.1 Tensile Properties: Shall be as specified in Table I, determined in accordance with ASTM E8.

TABLE I

Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min
Up to 0.010, excl	105,000	45,000	--
0.010 to 0.020, excl	105,000	45,000	29
0.020 to 0.187, incl	105,000	45,000	35
Over 0.187 to 2.000, incl	100,000	40,000	35
Over 2.000	95,000	40,000	35

TABLE I (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 0.25, excl	724	310	--
0.25 to 0.50, excl	724	310	29
0.50 to 4.75, incl	724	310	35
Over 4.75 to 50.00, incl	690	276	35
Over 50.00	655	276	35

Ø 3.4.2 Bending: Product 0.187 in. (4.75 mm) and under in nominal thickness shall withstand, without cracking, bending at room temperature 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		Bend Factor
Inch	(Millimetres)	
Up to 0.050, incl	(Up to 1.25, incl)	1.5
Over 0.050 to 0.187, incl	(Over 1.25 to 4.75, incl)	2

Ø 3.4.2.1 Bending requirements for plate over 0.187 in. (4.75 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

Ø 3.4.3 Stress-Rupture Properties at 1500°F (815°C): A tensile test specimen, maintained at 1500°F ± 3 (815°C ± 2) while a load sufficient to produce an initial axial stress of 16,000 psi (110 MPa) is applied continuously, shall not rupture in less than the time indicated below. The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be not less than shown below. Tests shall be conducted in accordance with ASTM E139.

Nominal Thickness		Time to Rupture hr, min	Elongation % in 4D
Inches	(Millimetres)		
0.010 to 0.020, excl	(0.25 to 0.50, excl)	15	3
0.020 and over	(0.50 and over)	24	8

Ø 3.4.3.1 The test of 3.4.3 may be conducted using a load higher than required to produce an initial axial stress of 16,000 psi (110 MPa) but load shall not be changed while test is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.3.

3.4.3.2 When permitted by purchaser, the test of 3.4.3 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 16,000 psi (110 MPa) shall be used to rupture or for 24 hr, whichever occurs first. After the 24 hr and at intervals of 8 - 16 hr, preferably 8 - 10 hr, thereafter, the stress shall be increased in increments of 2000 psi (14 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.3.

3.4.3.2.1 The test of 3.4.3.2 applies only to product 0.020 in. (0.50 mm) and over in nominal thickness.

3.4.3 Grain Size: Sheet and strip 0.125 in. (3.18 mm) and under in nominal thickness shall have average grain size of 4 or finer, determined in accordance with ASTM E112. Grain size requirements for product over 0.125 in. (3.18 mm) in nominal thickness shall be as agreed upon by purchaser.

3.5 Quality: 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.

3.6 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 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 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 such confirmatory testing as he deems necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), tensile properties (3.4.1), bending (3.4.2), grain size (3.4.4), and tolerances (3.6) are classified as acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for stress-rupture properties (3.4.3) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling: Shall be in accordance with AMS 2371 and the following:

4.3.1 Specimens for tensile tests of widths 9 in. (225 mm) and over shall be taken with the axis of specimen perpendicular to the direction of rolling; for widths less than 9 in. (225 mm), specimens shall be taken with the axis parallel to the direction of rolling.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of each heat and the results of tests for tensile and bending properties and grain size of each lot and, when performed, the results of tests to determine conformance to the stress-rupture property requirements. This report shall include the purchase order number, heat number, AMS 5536H, size, and quantity from each heat.