



AEROSPACE MATERIAL

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

SPECIFICATION

AMS 5530E

Superseding AMS 5530D

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ALLOY SHEET, STRIP, AND PLATE, CORROSION AND HEAT RESISTANT

58Ni - 15.5Cr - 16Mo - 3.8W - 5.5Fe

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, such as nozzle diaphragms, burner liners, tail pipes, exhaust cones requiring high strength up to 1500°F (815°C) and oxidation resistance up to 1800°F (980°C), and which may require welding during fabrication.

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 E18 - Rockwell Hardness and Rockwell Superficial Hardness 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
Carbon	--	0.08
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	14.50 - 16.50	
Molybdenum	15.00 - 17.00	
Tungsten	3.00 - 4.50	
Iron	4.00 - 7.00	
Vanadium	--	0.35
Cobalt (3.1.1)	--	2.50
Nickel plus Cobalt	remainder	

- 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; standards for acceptance shall be as agreed upon by purchaser and vendor:

- 3.2.1 Sheet and Strip: Hot 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.

- 3.2.2 Plate: Hot rolled, solution heat treated, and descaled, having a surface appearance comparable to a commercial corrosion-resistant steel No. 1 Finish.

- 3.3 Solution Heat Treatment: The product shall be solution heat treated by heating to $2225^{\circ}\text{F} \pm 25$ ($1220^{\circ}\text{C} \pm 15$), holding at heat for a time commensurate with section thickness but not more than 30 min., and cooling in air.

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

- 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 0.187, incl	115,000	50,000	40
Over 0.187 to 0.750, incl	100,000	45,000	30
Over 0.750 to 2.500, incl	90,000	45,000	20

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 4.75, incl	793	345	40
Over 4.75 to 19.05, incl	690	310	30
Over 19.05 to 63.50, incl	621	310	20

3.4.1.1 Tensile properties of plate over 2.500 in. (63.50 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4.2 Hardness: Should be as shown in Table II, determined in accordance with ASTM E18, but the product shall not be rejected on the basis of hardness if the tensile property requirements are met.

TABLE II

Nominal Thickness		Hardness, HRC, max
Inches	(Millimetres)	
Up to 0.187, incl	(Up to 4.75, incl)	24
Over 0.187 to 2.500, incl	(Over 4.75 to 63.50, incl)	25
Over 2.500	(Over 63.50)	As agreed upon

3.4.3 Grain Size: Sheet and strip shall have grain size not coarser than shown in Table III, determined by comparison of a polished and etched specimen with the chart in ASTM E112.

TABLE III

Nominal Thickness		Grain Size
Inch	(Millimetres)	
Up to 0.125, incl	(Up to 3.18, incl)	3
Over 0.125	(Over 3.18)	1.5

3.4.3.1 Grain size of plate shall be as agreed upon by purchaser and vendor.

3.4.4 Bending: Sheet and strip 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 direction of rolling.

Nominal Thickness		Bend Factor
Inch	(Millimetres)	
Up to 0.50, excl	(Up to 1.27, excl)	1
0.50 and over	(1.27 and over)	2

3.4.4.1 Bending requirements for plate shall be as agreed upon by purchaser and vendor.

3.4.5 Stress Rupture Properties at 1500°F (815°C): A tensile test specimen, maintained at 1500°F $\pm$ 3 (815°C $\pm$ 2) while a load sufficient to produce an initial axial stress of 18,000 psi (124 MPa) is applied continuously, shall not rupture in less than 24 hours. The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be not less than 10% in 2 in. (50 mm) or 4D. The test shall be conducted in accordance with ASTM E139.

3.4.5.1 The test of 3.4.5 may be conducted using a load higher than required to produce an initial axial stress of 18,000 psi (124 MPa) but load shall not be changed while test is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.5.

3.4.5.2 When permitted by purchaser, the test of 3.4.5 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 18,000 psi (124 MPa) shall be maintained 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 3.4.5.

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: Tests to determine conformance to all technical 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 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 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 5530E, size, and quantity from each heat.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, AMS 5530E, 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 a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.