

Submitted for recognition as an American National Standard

ALLOY SHEET, STRIP, AND PLATE, CORROSION AND HEAT RESISTANT  
59Ni - 22Cr - 2Mo - 14W - 0.35Al - 0.03La  
Solution Heat Treated

UNS N06230

1. SCOPE:

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

1.2 Application: Primarily for parts requiring oxidation resistance up to 2100°F (1149°C) and relatively high strength up to 1800°F (982°C).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications 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

AMS 2750 - Pyrometry

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2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

- ASTM E 8 - Tension Testing of Metallic Materials
- ASTM E 8M - Tension Testing of Metallic Materials (Metric)
- ASTM E 18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
- ASTM E 112 - Determining Average Grain Size
- ASTM E 139 - Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
- ASTM E 290 - Semi-Guided Bend Test for Ductility of Metallic Materials
- ASTM E 354 - 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 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 E 354, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Carbon	0.05	0.15
Manganese	0.30	1.00
Silicon	0.25	0.75
Phosphorus	--	0.03
Sulfur	--	0.015
Chromium	20.00	24.00
Molybdenum	1.00	3.00
Tungsten	13.00	15.00
Aluminum	0.20	0.50
Lanthanum	0.005	0.05
Cobalt	--	5.00
Titanium	--	0.10
Boron	--	0.015
Iron	--	3.00
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 or cold rolled, solution heat treated, and, unless solution heat treatment is performed in an atmosphere yielding a bright surface, descaled having a surface appearance comparable to 3.2.1.1 or 3.2.1.2 as applicable (See 8.1).

3.2.1.1 Sheet: No. 2D finish.

3.2.1.2 Strip: No. 1 strip finish.

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

3.3 Heat Treatment: The product shall be solution heat treated by heating to a temperature within the range 2150° - 2275°F (1177° - 1246°C), holding at the selected temperature within  $\pm 25^\circ\text{F}$  ( $\pm 14^\circ\text{C}$ ) for a time commensurate with section thickness, and cooling rapidly. Pyrometry shall be in accordance with AMS 2750.

3.4 Properties: Product 0.015 - 1.5 inch (0.38 - 38 mm) in nominal thickness shall conform to the following requirements; property requirements for product under 0.015 inch (0.38 mm) or over 1.5 inch (38 mm) in nominal thickness shall be as agreed upon by purchaser and vendor:

3.4.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM E 8 or ASTM E 8M:

Tensile Strength, minimum	115,000 psi (793 MPa)
Yield Strength at 0.2% Offset, minimum	50,000 psi (345 MPa)
Elongation in 2 Inches (50.8 mm) or 4D, minimum	40%

3.4.2 Hardness: Should be not higher than 25 HRC, or equivalent, determined in accordance with ASTM E 18, but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.1 are met.

3.4.3 Grain Size: Shall be not larger than the following, determined in accordance with ASTM E 112.

Nominal Thickness		ASTM Grain Size No.
Inches	Millimetres	
0.015 to 0.125, incl	0.38 to 3.18, incl	4
Over 0.125 to 0.187, incl	Over 3.18 to 4.75, incl	3
Over 0.187	Over 4.75	3

3.4.4 Stress-Rupture Properties at 1700°F (927°C): A tensile specimen, maintained at 1700°F  $\pm 3$  (927°C  $\pm 2$ ) while a load sufficient to produce an initial axial stress of 9,000 psi (62 MPa) is applied continuously, shall not rupture in less than 36 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 inches (50.8 mm). Tests shall be conducted in accordance with ASTM E 139.

- 3.4.4.1 The test of 3.4.4 may be conducted using a load higher than required to produce an initial axial stress of 9000 psi (62 MPa) but load shall not be changed while tests is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.4.
- 3.4.4.2 When permitted by purchaser, the test of 3.4.4 may be conducted using incremental loading. In such case, a load sufficient to produce an initial axial stress of 9000 psi (62 MPa) shall be used to rupture or 36 hours whichever occurs first. After the 36 hours and at intervals of 8 - 16 hours, preferably 8 - 10 hours, thereafter, the stress shall be increased in increments of 1000 psi (6.9 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.4.
- 3.4.5 Bending: Product 0.187 inch (4.75 mm) and under in nominal thickness shall withstand, without cracking, bending in accordance with ASTM E 290 through an angle of 180 degrees 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 1.27, incl	1.5
Over 0.050 to 0.187, incl	Over 1.27 to 4.75, incl	2.0

- 3.4.5.1 Bending requirements for product over 0.187 inch (4.75 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.
- 3.5 Quality: 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: 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 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:
- 4.2.1 Acceptance Tests: Tests for all technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.
- 4.3 Sampling and Testing: Shall be in accordance with AMS 2371; the number of specimens to be sampled shall be the minimum number of specimens tested.