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

AEROSPACE MATERIAL SPECIFICATION

AMS 5874

Issued 7-15-80
Revised

ALLOY SHEET, STRIP, AND PLATE, CORROSION AND HEAT RESISTANT
29Fe - 22Cr - 21Ni - 18.5Co - 3.2Mo - 2.8W - 0.78Ta - 0.30Al - 0.05Zr - 0.05La - 0.20N

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 formed, drawn, and welded parts requiring high strength and oxidation resistance up to 2000°F (1095°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 2242 - Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy Titanium, and Titanium Alloy Sheet, Strip, and Plate
AMS 2248 - Chemical Check Analysis Limits, Wrought Heat and Corrosion Resistant Steels and 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 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

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	0.05	0.15
Manganese	0.50	2.00
Silicon	0.20	0.80
Phosphorus	--	0.04
Sulfur	--	0.015
Chromium	21.00	23.00
Nickel	19.00	22.50
Cobalt	16.00	21.00
Molybdenum	2.50	4.00
Tungsten	2.00	3.50
Tantalum	0.30	1.25
Aluminum	0.10	0.50
Zirconium	0.001	0.10
Lanthanum	0.005	0.10
Nitrogen	0.10	0.30
Columbium	--	0.30
Boron	--	0.02
Iron	remainder	

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2248; check analysis limits for lanthanum shall be 0.002 under min and 0.01 over maximum.

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 or cold rolled, solution heat treated, and descaled unless solution heat treatment is performed in an atmosphere yielding a bright surface, 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.

3.3 Heat Treatment: The product shall be solution heat treated by heating to a temperature within the range 2100° - 2225°F (1150° - 1215°C), holding at the selected temperature within ± 25°F (± 15°C) for a time commensurate with section thickness but not more than 30 min., and cooling rapidly.

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

3.4.1 Grain Size: Shall be predominantly 3 or finer with occasional grains as large as 2 permissible, determined by comparison of a polished and etched specimen with the chart in ASTM E112.

3.4.2 Tensile Properties: Shall be as follows, determined in accordance with ASTM E8:

Tensile Strength, min	100,000 psi (690 MPa)
Yield Strength at 0.2% offset, min	47,000 psi (324 MPa)
Elongation in 4D, min	
Nominal Thickness	
Up to 0.020 in. (0.51 mm), incl	35%
Over 0.020 in. (0.51 mm)	40%

3.4.3 Hardness: Should be not higher than 21 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 are met.

3.4.4 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 following bend factor times the nominal thickness of the product with axis of bend parallel to the direction of rolling:

Nominal Thickness		Bend
Inch	(Millimetres)	Factor
Up to 0.050, incl	(Up to 0.27, incl)	1.5
Over 0.050 to 0.187, incl	(Over 1.27 to 4.75, incl)	2.0

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

3.4.5 Stress-Rupture Properties at 1500°F (816°C): A tensile test specimen, maintained at 1500°F ± 3 (816°C ± 2) while a load sufficient to produce the initial axial stress specified in Table I 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 as specified in Table I. Tests shall be conducted in accordance with ASTM E139.

TABLE I

Nominal Thickness		Stress		Elongation in 2 in. (50 mm) or 4D
Inches	(Millimetres)	psi	(MPa)	%, min
Up to 0.020, incl	(Up to 0.51, incl)	18,000	(124)	20
Over 0.020	(Over 0.51)	19,000	(131)	25

3.4.5.1 The test of 3.4.5 may be conducted using a load higher than required to produce the initial axial stress specified in Table I 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, a load sufficient to produce the initial axial stress specified in Table I 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 (13.8 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.5.

3.4.6 Oxidation Resistance: Product shall meet the following oxidation requirements, determined in accordance with 4.4.1:

3.4.6.1 Metal converted to oxide scale plus any continuous intergranular oxidation shall not exceed an average of 0.0015 in. (0.038 mm) per side or 0.003 in. (0.08 mm) per specimen.

3.4.6.2 Specimens displaying localized areas greater than 0.062 in. (1.57 mm) in diameter with excessive oxidation attack, unless such attack can be attributed to contact with ceramic supports, shall be considered invalid and the test repeated. If the condition is duplicated, the product is not acceptable.

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 2242.

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 4.5. 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), grain size (3.4.1), tensile properties (3.4.2), bending (3.4.4), stress-rupture properties (3.4.5), and tolerances (3.6) are classified as acceptance tests and shall be performed on each lot.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for hardness (3.4.3) and oxidation resistance (3.4.6) 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. (229 mm) and over shall be taken with the axis of the specimen perpendicular to the direction of rolling; for widths less than 9 in. (229 mm), specimens shall be taken with the axis parallel to the direction of rolling.

4.4 Test Methods:

4.4.1 Oxidation Resistance:

4.4.1.1 Specimen Preparation: Specimens shall have surface area not less than 1.5 sq in. (9.7 cm^2) available for exposure in excess of material required for fixturing. Both sides of the specimen shall have a 120-grit surface finish. Specimen dimensions shall then be measured to within ± 0.0003 in. (± 0.008 mm). Specimens shall be degreased.

4.4.1.2 Testing: Specimens shall be exposed for four cycles, each cycle consisting of heating in air to 2000°F ± 25 (1093°C ± 15), holding at heat for 25 hr ± 1, and cooling in air to 300°F (150°C) or lower between each cycle, for a total of 100 hr ± 4 at heat. Specimens may be partially inserted into inert ceramic bricks or suspended from inert ceramic rods or suitable metallic rods, but shall not be placed in crucibles. The specimens may be tested in a muffle or comparable furnace provided that air flow is such that the required surface areas are equally exposed to the flowing air and temperature.

4.4.1.3 Examination: Test specimens shall be cross sectioned and examined metallographically in the as-polished condition at magnification not lower than 500X. Not less than eight randomly selected surface areas (0.008 in. (0.20 mm) in length) shall be measured and the values averaged to determine compliance with 3.4.6.1.

4.5 Reports:

4.5.1 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 for the grain size, tensile properties, bending, and stress-rupture properties on each lot and stating that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, AMS 5874, heat number, size, and quantity from each heat.