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

AEROSPACE MATERIAL SPECIFICATION

AMS 5601A
Superseding 5601

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STEEL SHEET AND STRIP, CORROSION AND MODERATE HEAT RESISTANT UNS S14800
14.4Cr - 8.2Ni - 2.5Mo - 1.1Al
Solution Heat Treated

1. SCOPE:

1.1 Form: This specification covers a precipitation-hardenable, corrosion and moderate heat resistant steel in the form of sheet and strip.

1.2 Application: Primarily for parts requiring corrosion resistance, high strength, high fracture toughness, stress-corrosion resistance, and oxidation resistance up to 800°F (427°C) where such parts may require welding or brazing during fabrication. Certain processing procedures and service conditions may cause this material to be subject to stress-corrosion cracking; ARP 1110 recommends practices to minimize such conditions.

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) and Aerospace Recommended Practices (ARP) 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, Pennsylvania 15096.

2.1.1 Aerospace Material Specifications:

AMS 2242 - Tolerances, Corrosion and Heat Resistant Steel and Iron Base Alloy Sheet, Strip, and Plate and 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

2.1.2 Aerospace Recommended Practices

ARP 1110 - Minimizing Stress-Corrosion Cracking in Heat-Treatable Wrought Low-Alloy and Martensitic Corrosion-Resistant Steels

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM A370 - Mechanical Testing of Steel Products
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E353, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	min	max
Carbon	--	0.05
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.015
Sulfur	--	0.010
Chromium	13.75	15.00
Nickel	7.75	8.75
Molybdenum	2.00	3.00
Aluminum	0.75	1.50

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2248.

3.2 Condition: The product shall be supplied in the following condition:

3.2.1 Sheet: Cold rolled, solution heat treated, and descaled (No. 2D Finish).

3.2.2 Strip: Cold rolled, solution heat treated, and descaled (No. 1 Strip Finish).

3.3 Solution Heat Treatment: The product shall be solution heat treated by heating to 1825°F ± 25 (996.1°C ± 14), holding at heat for not less than 3 min. per 0.10 in. (2.5 mm) of nominal thickness, and cooling in air to room temperature.

3.4 Properties: The product shall conform to the following requirements; tensile, hardness, and bend testing shall be performed in accordance with ASTM A370:

3.4.1 As Solution Heat Treated:

3.4.1.1 Tensile Properties:

3.4.1.1.1 Product 0.005 In. (0.13 mm) and Over in Nominal Thickness:

Tensile Strength, max	150,000 psi (1034 MPa)
Yield Strength at 0.2% offset, max	65,000 psi (448 MPa)
Elongation in 2 in. (50.8 mm), min	20%

3.4.1.1.2 Product Less than 0.005 In. (0.13 mm) in Nominal Thickness: Shall be as agreed upon by purchaser and vendor.

3.4.1.2 Hardness:

3.4.1.2.1 Product Over 0.010 In. (0.25 mm) in Nominal Thickness: Shall be not higher than 100 HRB or equivalent.

3.4.1.2.2 Product 0.010 In. (0.25 mm) and Under in Nominal Thickness: Shall be as agreed upon by purchaser and vendor.

3.4.1.3 Bending: Product shall withstand, without cracking, bending through the angle indicated below around a diameter equal to the nominal thickness of the product with axis of bend parallel to the direction of rolling:

Type of Bend	Angle, min deg	(rad)
Free Bend	180	(3.14)
V-Block	135	(2.36)

3.4.2 After Austenite Conditioning, Sub-Zero Transformation, and Precipitation Hardening: Product shall conform to the following requirements after heating to 1700°F ± 15 (926.7°C ± 8.3), holding at heat for not less than 1 hr, rapidly cooling to 75°F (24°C) or lower, cooling to -100°F ± 10 (-73.3°C ± 5.6) within 1 hr, holding at this temperature for not less than 8 hr, warming in air to room temperature, heating to 950°F ± 10 (510°C ± 5.6), holding at heat for not less than 1 hr, and cooling in air.

3.4.2.1 Tensile Properties: Shall be as shown in Table I and 3.4.2.1.2.

TABLE I

Nominal Thickness Inch	Tensile Strength psi, min	Yield Strength at 2% Offset psi, min	Elongation in 2 in. %, min
0.005 to 0.010, excl	220,000	190,000	2
0.010 to 0.020, excl	220,000	190,000	3
0.020 to 0.1875, excl	220,000	190,000	4

TABLE I (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 2% Offset MPa, min	Elongation in 50.8 mm %, min
0.13 to 0.25, excl	1517	1310	2
0.25 to 0.51, excl	1517	1310	3
0.51 to 4.762, excl	1517	1310	4

3.4.2.1.2 Product Less Than 0.005 In. (0.13 mm) in Nominal Thickness: Shall be as agreed upon by purchaser and vendor.

3.4.2.2 Hardness:

3.4.2.2.1 Ø Product Over 0.010 In. (0.25 mm) in Nominal Thickness: Should be not lower than 45 HRC or equivalent but the product shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.4.2.2.2 Product 0.010 In. (0.25 mm) and Under in Nominal Thickness: As agreed upon by purchaser and vendor.

3.5 Quality: The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.

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 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 perform such confirmatory testing as he deems necessary to assure 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 or routine control tests.

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

4.3.1 Tensile test specimens from widths 9 in. (229 mm) and over shall be taken with the axis 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 Reports:

4.4.1 The vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition of each heat in the shipment and the results of tests on each thickness from each heat to determine conformance to the other technical requirements of this specification. This report shall include the purchase order number, heat number, material specification number and its revision letter, 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, material specification number and its revision letter, 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.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2371.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Each sheet and strip shall be marked on one face, in the respective location indicated below, with AMS 5601A, heat number, manufacturer's identification, and nominal thickness. The characters shall be of such size as to be clearly legible, shall be applied using a suitable marking fluid, and shall be capable of being removed in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the material or its performance and shall be sufficiently stable to withstand normal handling.

5.1.1 Flat Strip 6 In. (152 mm) and Under in Width: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater that 3 ft (914 mm).

5.1.2 Flat Sheet and Flat Strip Over 6 In. (152 mm) in Width: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft (914 mm), the rows being spaced not more than 6 in. (152 mm) apart and alternately staggered.