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

AEROSPACE MATERIAL SPECIFICATION

AMS 5604A
Superseding AMS 5604
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UNS S17400

STEEL, SHEET, STRIP, AND PLATE, CORROSION RESISTANT
16.5Cr - 4.0Ni - 4.0Cu - 0.30(Cb+Ta)
Solution Heat Treated

1. SCOPE:

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

1.2 Application: Primarily for parts requiring corrosion resistance and high strength at temperatures up to 600°F (316°C) and where such parts may require welding 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	--	0.07
Manganese	--	1.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	15.50	17.50
Nickel	3.00	5.00
Columbium + Tantalum	0.15	0.45
Copper	3.00	5.00

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2248 except that check analysis limits for copper shall be 0.010 under min or over maximum.

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).

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

3.3 Heat Treatment:

3.3.1 Sheet and Strip: Shall be solution heat treated by heating to 1900°F ± 25 (1037.8°C ± 14), holding at heat for not less than 3 min. per 0.10 in. (2.5 mm) of nominal thickness, and cooling as required to below 90°F (32°C).

3.3.2 Plate: Shall be solution heat treated by heating to 1950°F ± 25 (1065.6°C ± 14), holding at heat for not less than 1 hr plus 30 min. for each inch (25 mm) of nominal thickness, and cooling as required to below 90°F (32°C).

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 Sheet and Strip:

3.4.1.1.1.1 Nominal Thickness of 0.015 In. (0.38 mm) to 0.1875 In. (4.762 mm), Excl:

Tensile Strength, max	185,000 psi (1276 MPa)
Yield Strength at 0.2% Offset, max	160,000 psi (1103 MPa)
Elongation in 2 in. (50.8 mm), min	3%

3.4.1.1.1.2 Nominal Thickness Less than 0.015 In. (0.38 mm): As agreed upon by purchaser and vendor.

3.4.1.2 Hardness: Shall be not higher than 38 HRC or equivalent.

3.4.1.3 Bending: Product 0.109 in. (2.77 mm) and under in nominal thickness shall withstand, without cracking, bending through an angle of 180 deg (3.14 rad) around a diameter equal to 9 times the nominal thickness of the product with axis of bend parallel to the direction of rolling. Product over 0.109 in. (2.77 mm) in nominal thickness shall have bend requirements as agreed upon by purchaser and vendor.

3.4.2 After Precipitation Heat Treatment: Product up to 4.0 in. (102 mm), incl, in nominal thickness shall conform to the following requirements after being precipitation heat treated by heating to 900°F ± 10 (482.2°C ± 5.6), holding at heat for not less than 1 hr, and cooling in air.

3.4.2.1 Tensile Properties:

3.4.2.1.1 Nominal Thickness of 0.015 In. (0.38 mm) to 4.000 In. 101.60 mm), Incl: Shall be as specified in Table I.

3.4.2.1.2 Nominal Thickness Less than 0.015 In. (0.38 mm): As agreed upon by purchaser and vendor.

3.4.2.2 Hardness: Should be 40 - 47 HRC or equivalent but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.4.2.1 are met.

3.4.2.3 Bending: Product 0.109 in. (2.77 mm) and under in nominal thickness shall withstand, without cracking, bending through an angle of 180 deg (3.14 rad) around a diameter equal to 9 times the nominal thickness of the product with axis of bend parallel to the direction of rolling. Product over 0.109 in. (2.77 mm) in nominal thickness shall have bend requirements as agreed upon by purchaser and vendor.

3.4.3 Other Precipitation Heat Treatments: Properties after precipitation heat treatment at temperatures other than 900°F ± 10 (482.2°C ± 5.6) shall be 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; flatness tolerance for sheet shall be as specified for cold worked austenitic sheet in 1/2-hard temper.

TABLE I

Nominal Thickness Inches	Tensile Strength psi, min	Yield Strength at 0.2% Offset psi, min	Elongation in 2 in. or 4D %, min	Reduction of Area (Round Specimens) %, min
0.015 to 0.1875, excl	190,000	170,000	5	--
0.1875 to 0.625, incl	190,000	170,000	8	30
Over 0.625 to 4.000, incl	190,000	170,000	10	35

TABLE I (SI)

Nominal Thickness Millimetres	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation in 50.8 mm or 4D %, min	Reduction of Area (Round Specimens) %, min
0.381 to 4.762, excl	1310	1172	5	--
4.762 to 15.88, incl	1310	1172	8	30
Over 15.88 to 101.60, incl	1310	1172	10	35

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 of the specimen perpendicular to the direction of rolling; for widths less than 9 in. (229 mm), tensile test 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, strip, and plate shall be marked on one face in the respective location indicated below, with AMS 5604A, 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 than 3 ft (914 mm).

5.1.2 Flat Sheet, Flat Strip Over 6 In. (152 mm) in Width, and Plate: 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.

5.1.3 Coiled Sheet and Strip: Shall be marked near both the outside and inside ends of the coil; the marking at either or both ends shall be applied as in 5.1 or shall appear on a durable tag or label attached to the coil and marked with the information of 5.1. When the inside end of the coil is inaccessible, as when the product is wound on cores, the tag or label may be attached to the core.

5.2 Packaging: The product shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.