



# AEROSPACE MATERIAL SPECIFICATION

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

## AMS 5604B

Superseding AMS 5604A

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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 precipitation-hardenable, corrosion-resistant steel in the form of sheet, strip, and plate.
- 1.2 Application: Primarily for parts requiring corrosion resistance and high strength up to 600°F (315°C) and where such parts may require welding during fabrication. Certain processing procedures and service conditions may cause these products to become 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, 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 2315 - Determination of Free Ferrite Content

AMS 2350 - Standards and Test Methods

AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Alloys, Wrought Products Except Forgings and Forging Stock

#### 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, PA 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 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

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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 E353, 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               | --      | 0.07  |
| Manganese            | --      | 1.00  |
| Silicon              | --      | 1.00  |
| Phosphorus           | --      | 0.040 |
| Sulfur               | --      | 0.030 |
| Chromium             | 15.00 - | 17.50 |
| Nickel               | 3.00 -  | 5.00  |
| Columbium + Tantalum | 5xC     | 0.45  |
| Copper               | 3.00 -  | 5.00  |
| Molybdenum           | --      | 0.50  |

- 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 unless solution heat treatment is performed in an atmosphere yielding a bright finish (No. 1 Strip Finish).

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

- 3.3 Solution Heat Treatment: The product shall be solution heat treated by heating to  $1950^{\circ}\text{F} \pm 25$  ( $1040^{\circ}\text{C} \pm 15$ ), holding at heat for a time commensurate with the thickness and the heating equipment and procedure used, and cooling in air.

- 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: Shall be as follows:

- 3.4.1.1.1 Nominal Thickness 0.015 to 0.1875 in. (0.38 to 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 mm), min   | 3%                     |

- 3.4.1.1.2 Nominal Thickness Less than 0.015 in. (0.38 mm) or 0.1875 in. (4.762 mm) and Over: 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 Microstructure: The product shall contain not more than 5% ferrite, determined in accordance with AMS 2315.

3.4.1.4 Bending: Product 0.109 in. (2.75 mm) and under in nominal thickness shall withstand without cracking, bending through an angle of 180 deg around a diameter equal to 18 times the nominal thickness of the product with axis of bend parallel to the direction of rolling. Bending requirements for product over 0.109 in. (2.75 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

3.4.2 After Precipitation Heat Treatment: The solution heat treated product up to 4.0 in. (102 mm), incl, in nominal thickness, precipitation heat treated to a particular condition in accordance with the corresponding temperatures and times shown in Table I and cooled in air, shall have the tensile properties shown in Table II for that particular condition. Tensile and hardness tests shall be made in only one precipitation heat treated condition; unless otherwise specified, that precipitation heat treated condition shall be H900:

TABLE I

| Condition | Temperature            | Time        |
|-----------|------------------------|-------------|
| H900      | 900°F ± 10(482°C ± 5)  | 60 min. ± 5 |
| H925      | 925°F ± 10(496°C ± 5)  | 4 hr ± 0.25 |
| H1025     | 1025°F ± 10(552°C ± 5) | 4 hr ± 0.25 |
| H1075     | 1075°F ± 10(579°C ± 5) | 4 hr ± 0.25 |
| H1100     | 1100°F ± 10(593°C ± 5) | 4 hr ± 0.25 |
| H1150     | 1150°F ± 10(621°C ± 5) | 4 hr ± 0.25 |

3.4.2.1 Tensile Properties:

TABLE II

| Condition | Nominal Thickness<br>Inches | Tensile Strength<br>psi, min | Yield Strength<br>at 0.2% Offset<br>psi, min | Elongation<br>in 2 in. or 4D<br>%, min | Reduction<br>of Area<br>%, min |
|-----------|-----------------------------|------------------------------|----------------------------------------------|----------------------------------------|--------------------------------|
| H900      | Up 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                             |
| H925      | Up to 0.1875, excl          | 170,000                      | 155,000                                      | 5                                      | --                             |
|           | 0.1875 to 0.625, incl       | 170,000                      | 155,000                                      | 8                                      | 30                             |
|           | Over 0.625 to 4.000, incl   | 170,000                      | 155,000                                      | 10                                     | 35                             |
| H1025     | Up to 0.1875, excl          | 155,000                      | 145,000                                      | 5                                      | --                             |
|           | 0.1875 to 0.625, incl       | 155,000                      | 145,000                                      | 8                                      | 35                             |
|           | Over 0.625 to 4.000, incl   | 155,000                      | 145,000                                      | 12                                     | 40                             |
| H1075     | Up to 0.1875, excl          | 145,000                      | 125,000                                      | 5                                      | --                             |
|           | 0.1875 to 0.625, incl       | 145,000                      | 125,000                                      | 9                                      | 35                             |
|           | Over 0.625 to 4.000, incl   | 145,000                      | 125,000                                      | 13                                     | 45                             |
| H1100     | Up to 0.1875, excl          | 140,000                      | 115,000                                      | 5                                      | --                             |
|           | 0.1875 to 0.625, incl       | 140,000                      | 115,000                                      | 10                                     | 35                             |
|           | Over 0.625, to 4.000, incl  | 140,000                      | 115,000                                      | 14                                     | 45                             |
| H1150     | Up to 0.1875, excl          | 135,000                      | 105,000                                      | 8                                      | --                             |
|           | 0.1875 to 0.625, incl       | 135,000                      | 105,000                                      | 10                                     | 40                             |
|           | Over 0.625 to 4.000, incl   | 135,000                      | 105,000                                      | 16                                     | 50                             |

TABLE II (SI)

| Condition | Nominal Thickness<br>Millimetres | Tensile Strength<br>MPa, min | Yield Strength<br>at 0.2% Offset<br>MPa, min | Elongation<br>in 50 mm<br>or 4D<br>%, min | Reduction<br>of Area<br>%, min |
|-----------|----------------------------------|------------------------------|----------------------------------------------|-------------------------------------------|--------------------------------|
| H900      | Up to 4.762, excl                | 1310                         | 1170                                         | 5                                         | --                             |
|           | 4.762 to 15.88, incl             | 1310                         | 1170                                         | 8                                         | 30                             |
|           | Over 15.88 to 102, incl          | 1310                         | 1170                                         | 10                                        | 35                             |
| H925      | Up to 4.762, excl                | 1170                         | 1070                                         | 5                                         | --                             |
|           | 4.762 to 15.88, incl             | 1170                         | 1070                                         | 8                                         | 30                             |
|           | Over 15.88 to 102, incl          | 1170                         | 1070                                         | 10                                        | 35                             |
| H1025     | Up to 4.762, excl                | 1070                         | 1000                                         | 5                                         | --                             |
|           | 4.762 to 15.88, incl             | 1070                         | 1000                                         | 8                                         | 35                             |
|           | Over 15.88 to 102, incl          | 1070                         | 1000                                         | 12                                        | 40                             |
| H1075     | Up to 4.762, excl                | 1000                         | 860                                          | 5                                         | --                             |
|           | 4.762 to 15.88, incl             | 1000                         | 860                                          | 9                                         | 35                             |
|           | Over 15.88 to 102, incl          | 1000                         | 860                                          | 13                                        | 45                             |
| H1100     | Up to 4.762, excl                | 965                          | 790                                          | 5                                         | --                             |
|           | 4.762 to 15.88, incl             | 965                          | 790                                          | 10                                        | 35                             |
|           | Over 15.88 to 102, incl          | 965                          | 790                                          | 14                                        | 45                             |
| H1150     | Up to 4.762, excl                | 930                          | 725                                          | 8                                         | --                             |
|           | 4.762 to 15.88, incl             | 930                          | 725                                          | 10                                        | 40                             |
|           | Over 15.88 to 102, incl          | 930                          | 725                                          | 16                                        | 50                             |

3.4.2.2 Hardness: Shall be within the range shown in Table III for the corresponding precipitation heat treatment condition.

TABLE III

| Condition | Hardness  |         |
|-----------|-----------|---------|
|           | HB        | HRC     |
| H900      | 388 - 448 | 40 - 48 |
| H925      | 375 - 438 | 38 - 47 |
| H1025     | 331 - 401 | 33 - 42 |
| H1075     | 302 - 375 | 29 - 38 |
| H1100     | 311 - 364 | 29 - 38 |
| H1150     | 277 - 352 | 26 - 36 |

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; flatness tolerance for sheet shall be as specified for cold worked austenitic sheet in 1/2-hard temper.

#### 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.