



AEROSPACE MATERIAL SPECIFICATION

AMS5860™**REV. H**

Issued	1971-11
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Superseding AMS5860G

Steel, Corrosion-Resistant, Sheet, Strip, and Plate
12Cr - 8.5Ni - 0.30Cb - 1.1Ti - 2.0Cu
Multiple Melted, Solution Heat Treated, Precipitation Hardenable
(Composition similar to UNS S45500)

RATIONALE

AMS5860H is the result of a Five-Year Review and update of the specification. The revision updates composition reporting (see 3.1.1), adds pyrometry controls (see 3.5.2), adds strain rate requirements during tensile testing (see 3.5.2.1.3), updates product exceptions requirements (see 8.5), and adds ordering information based on heat treatment requirements (see 8.6).

1. SCOPE

1.1 Form

This specification covers a corrosion-resistant steel in the form of sheet, strip, and plate.

1.2 Application

These products have been used typically for parts requiring corrosion resistance and high strength up to 800 °F (427 °C), but usage is not limited to such applications. The steel can be precipitation hardened to minimum tensile strengths up to 225 ksi (1551 MPa).

1.2.1 Certain design and processing procedures may cause these products to become susceptible to stress-corrosion cracking after heat treatment. ARP1110 recommends practices to minimize such conditions.

2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

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<https://www.sae.org/standards/content/AMS5860H/>

SAE WEB ADDRESS:

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS2242	Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium and Titanium Alloy Sheet, Strip, and Plate
AMS2248	Chemical Check Analysis Limits, Corrosion- and Heat-Resistant Steels and Alloys, Maraging and Other Highly Alloyed Steels, and Iron Alloys
AMS2300	Steel Cleanliness, Premium Aircraft-Quality, Magnetic Particle Inspection Procedure
AMS2371	Quality Assurance Sampling and Testing, Corrosion and Heat-Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS2750	Pyrometry
AMS2807	Identification, Carbon and Low-Alloy Steels, Corrosion and Heat-Resistant Steels and Alloys Sheet, Strip, Plate, and Aircraft Tubing
ARP1110	Minimizing Stress Corrosion Cracking in Wrought Forms of Steels, and Corrosion Resistant Steels and Alloys
AS4194	Sheet and Strip Surface Finish Nomenclature
AS7766	Terms Used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM A370	Mechanical Testing of Steel Products
ASTM A480/A480M	Flat Rolled Stainless and Heat-Resisting Steel Plate, Sheet, and Strip
ASTM A751	Chemical Analysis of Steel Products
ASTM E140	Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness
ASTM E290	Bend Testing of Material for Ductility

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Composition shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM A751 or by other analytical methods acceptable to the purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	--	0.05
Manganese	--	0.50
Silicon	--	0.50
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	11.00	12.50
Nickel	7.50	9.50
Columbium	0.10	0.50
Titanium	0.80	1.40
Copper	1.50	2.50
Molybdenum	--	0.50

3.1.1 The producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection unless limits of acceptability are specified by the purchaser.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2248.

3.2 Melting Practice

Steel shall be multiple melted using consumable electrode practice in the remelt cycle. If consumable electrode remelting is not performed in a vacuum, electrodes which have been produced by vacuum induction melting shall be used.

3.3 Condition

The product shall be supplied in the following condition:

3.3.1 Sheet and Strip

Sheet and strip shall be hot or cold rolled, solution heat treated, and, unless solution heat treatment is performed in an atmosphere yielding a bright finish, descaled having a surface appearance in accordance with ASTM A480/A480M, AS4194, and 3.3.1.1 or 3.3.1.2 as applicable.

3.3.1.1 Sheet shall have a No. 2D finish.

3.3.1.2 Strip shall have a No. 1 strip finish.

3.3.2 Plate

Plate shall be hot rolled, solution heat treated, and descaled.

3.4 Heat Treatment

Except as specified in 3.4.1, the product shall be solution heat treated by heating to 1525 °F ± 25 °F (829 °C ± 14 °C), holding at heat for 5 to 30 minutes, and quenching rapidly; plate over 1.25 inches (31.8 mm) in nominal thickness shall be water quenched.

3.4.1 Continuous Heat Treating

When continuous heat treating is used, process parameters (e.g., furnace temperature set points, heat input, travel rate, etc.) for continuous heat-treating lines shall be established by the material producer and validated by testing of product to the requirements of 3.5.

3.5 Properties

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

3.5.1 As Solution Heat Treated

3.5.1.1 Tensile Properties

Solution heat-treated properties shall be as shown in Table 2:

Table 2 - Tensile properties

Property	Value
Tensile Strength, Maximum	175 ksi (1207 MPa)
Yield Strength at 0.2% Offset, Maximum	160 ksi (1103 MPa)
Elongation in 2 Inches (50 mm) or 4D, Minimum	3%

3.5.1.2 Hardness

Product 0.010 inch (0.25 mm) and over in nominal thickness shall have hardness not higher than 35 HRC, or equivalent (see 8.2).

3.5.1.3 Bending

Product 0.1874 inch (4.760 mm) and under in nominal thickness shall be tested in accordance with ASTM E290 using a sample prepared nominally 0.75 inch (19.0 mm) in width with its axis of bending parallel to the direction of rolling and shall withstand, without cracking, free bending through an angle of 90 degrees around a diameter equal to 2-1/2 times the nominal thickness of the product.

3.5.2 Response to Precipitation Heat Treatment

Samples from solution heat-treated product, precipitation heat treated to a particular condition in accordance with the corresponding temperatures and times shown in Table 3, and cooled in air shall have the tensile properties shown in Table 4 or Table 5 and hardness shown in 3.5.2.2 for that particular condition. Pyrometry shall be in accordance with AMS2750. Tensile and hardness tests shall be made in only the H950 precipitation heat treated condition unless the purchaser specifies another heat-treated condition.

Table 3 - Response to precipitation heat treatment

Condition	Temperature	Time
H950	950 °F ± 10 °F (510 °C ± 6 °C)	4 hours ± 0.25 hour
H1000	1000 °F ± 10 °F (538 °C ± 6 °C)	4 hours ± 0.25 hour

3.5.2.1 Tensile Properties

3.5.2.1.1 Condition H950 tensile properties shall be as shown in Table 4:

Table 4A - Minimum tensile properties, response to H950 heat treatment, inch/pound units

Nominal Thickness Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 0.020, incl	225	210	2
Over 0.020 to 0.062, incl	225	210	3
Over 0.062	225	210	4

Table 4B - Minimum tensile properties, response to H950 heat treatment, SI units

Nominal Thickness Millimeters	Tensile Strength Mpa	Yield Strength at 0.2% Offset Mpa	Elongation in 50 mm or 4D %
Up to 0.051, incl	1551	1448	2
Over 0.051 to 0.157, incl	1551	1448	3
Over 0.157	1551	1448	4

3.5.2.1.2 Condition H1000 tensile properties shall be as shown in Table 5:

Table 5A - Minimum tensile properties, response to H1000 heat treatment, inch/pound units

Nominal Thickness Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongation in 2 Inches or 4D %
Up to 0.020, incl	200	185	3
Over 0.020 to 0.062, incl	200	185	4
Over 0.062	200	185	5

Table 5B - Minimum tensile properties, response to H1000 heat treatment, SI units

Nominal Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
Up to 0.51, incl	1379	1276	3
Over 0.51 to 1.57, incl	1379	1276	4
Over 1.57	1379	1276	5

3.5.2.1.3 Unless otherwise specified, the tensile test strain rate (applicable to H950 and H1000 heat treatments [Tables 4 and 5]), shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ± 0.002 in/in/min (± 0.002 mm/mm/min) through 0.2% offset yield strain. After the yield strain, the speed of the testing machine shall be set between 0.05 in/in and 0.5 in/in (0.05 mm/mm and 0.5 mm/mm) of the length of the reduced parallel section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 in/in/min and 0.5 in/in/min (0.05 mm/mm/min and 0.5 mm/mm/min). The requirement for compliance becomes effective for material produced 1 year after the publication date of this specification.

3.5.2.2 Hardness

Product 0.010 inch (0.25 mm) and over in nominal thickness should have hardness not lower than shown in Table 6, or equivalent (see 8.2).

Table 6 - Minimum hardness

Condition	Hardness HRC
H950	44
H1000	40

3.5.3 After Re-Solution and Precipitation Heat Treatment

The product shall have the properties specified in 3.5.2.1 and 3.5.2.2 after being re-solution heat treated as in 3.4 and precipitation heat treated as in 3.5.2.

3.5.4 After Other Precipitation Heat Treatment

Properties after precipitation heat treatment at temperatures other than specified in Table 3 shall be as agreed upon by the purchaser and producer.

3.6 Quality

The product, as received by the purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from imperfections detrimental to usage of the product.

3.6.1 Steel shall be premium aircraft-quality conforming to AMS2300.

3.7 Tolerances

Tolerances shall conform to all applicable requirements of AMS2242.

3.8 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests

4.2.1 Acceptance Tests

The following requirements are acceptance tests and shall be performed on each heat or lot as applicable:

Composition (see 3.1) of each heat

Tensile properties (see 3.5.1.1) and hardness (see 3.5.1.2) of each lot as solution heat treated

Tensile properties (see 3.5.2.1) and hardness (see 3.5.2.2) of each lot after precipitation heat treatment at 950 °F (510 °C) or other precipitation heat treatment specified by the purchaser

Tolerances (see 3.7) of each lot