

AEROSPACE MATERIAL SPECIFICATION



AMS 5860E

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Superseding AMS 5860D

Steel, Corrosion Resistant, Sheet, Strip, and Plate
12Cr - 8.5Ni - 0.30Cb - 1.1Ti - 2.0Cu
Multiple Melted, Solution Heat Treated, Precipitation Hardenable

UNS S45500

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). The steel can be precipitation hardened to minimum tensile strengths up to 225,000 psi (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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2242	Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate
MAM 2242	Tolerances, Metric, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Sheet, Strip, and Plate
AMS 2248	Chemical Check Analysis Limits, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys

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2.1 (Continued):

AMS 2300	Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
MAM 2300	Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure, Metric (SI) Measurement
AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steels and Alloys, Wrought Products and Forging Stock
AMS 2807	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

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

ASTM A 370 Mechanical Testing of Steel Products

ASTM E 353 Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Carbon	--	0.05
Manganese	--	0.50
Silicon	--	0.50
Phosphorus	--	0.025
Sulphur	--	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 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2248.

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: Cold rolled, solution heat treated, and, unless solution heat treatment is performed in an atmosphere yielding a bright finish, descaled having a surface appearance comparable to 3.3.1.1 or 3.3.1.2 as applicable (See 8.2).

3.3.1.1 Sheet: No. 2D finish.

3.3.1.2 Strip: No. 1 strip finish.

3.3.2 Plate: 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 $1525^{\circ}\text{F} \pm 25$ ($829^{\circ}\text{C} \pm 14$), 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 For product heat treated in a continuous process, the product shall be solution heat treated by heating to $1650^{\circ}\text{F} \pm 25$ ($899^{\circ}\text{C} \pm 14$), holding at heat for a time commensurate with section thickness and the heating equipment and procedure used, and cooling in air.

3.5 Properties:

The product shall conform to the following requirements; hardness, tensile, and bend testing shall be performed in accordance with ASTM A 370:

3.5.1 As Solution Heat Treated:

3.5.1.1 Tensile Properties:

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 (50.8 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 8.3).

3.5.1.3 Bending: Product 0.1874 inch (4.760 mm) and under in nominal thickness 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 with axis of bend parallel to the direction of rolling.

3.5.2 After Precipitation Heat Treatment: 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 5 and hardness shown in 3.5.2.2 for that particular condition. Tensile and hardness tests shall be made in only the H 950 precipitation heat treated condition unless purchaser specifies another heat treated condition.

TABLE 3 - Precipitation Heat Treatment

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

3.5.2.1 Tensile Properties:

3.5.2.1.1 Condition H 950:

TABLE 4A - Minimum Tensile Properties, Inch/Pound Units

Nominal Thickness Inch	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, SI Units

Nominal Thickness Millimeters	Tensile Strength MPa	Yield Strength at 0.2% Offset MPa	Elongation in 50.8 mm or 4D %
Up to 0.051, 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 H 1000:

TABLE 5A - Minimum Tensile Properties, Inch/Pound Units

Nominal Thickness Inch	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, 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

3.5.2.2 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 8.3).

TABLE 6 - Minimum Hardness

Condition	Hardness HRC
H 950	44
H 1000	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 purchaser and vendor.

3.6 Quality:

The product, as received by 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 AMS 2300 or MAM 2300.

3.7 Tolerances:

Shall conform to all applicable requirements of AMS 2242 or MAM 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 the performance of all required tests. 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:

4.2.1.1 Composition (3.1) of each heat.

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

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

4.2.1.4 Tolerances (3.7).

4.2.2 Periodic Tests: The following requirements are periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser:

4.2.2.1 Bending (3.5.1.3) as solution heat treated.