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

AEROSPACE MATERIAL SPECIFICATION

AMS 6546B
Superseding AMS 6546A

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UNS K91122

STEEL SHEET, STRIP, AND PLATE
0.48Cr - 8.0Ni - 4.0Co - 0.48Mo - 0.09V (0.24 - 0.30C)
Premium Quality, Consumable Electrode Melted, Annealed

1. SCOPE:

1.1 Form: This specification covers a premium-quality, low-alloy steel in the form of sheet, strip, and plate.

1.2 Application: Primarily for heat treated parts, such as pressure vessels, requiring through hardening to high strength levels, and where such parts may require welding.

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) 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 2252 - Tolerances, Alloy Steel Sheet, Strip, and Plate
AMS 2259 - Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
AMS 2300 - Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
AMS 2350 - Standards and Test Methods
AMS 2370 - Quality Assurance Sampling of Carbon and Low-Alloy Steels, Wrought Products Except Forgings and Forging Stock

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 E45 - Determining the Inclusion Content of Steels
ASTM E112 - Estimating the Average Grain Size of Metals
ASTM E338 - Sharp-Notch Tension Testing of High Strength Sheet Materials
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
ASTM E399 - Plane-Strain Fracture Toughness of Metallic Materials

2.3 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

2.3.2 Military Standards:

MIL-STD-163 - Steel Mill Products, Preparation for Shipment and Storage

Printed in U.S.A.

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E350, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	min	max
Carbon	0.24	0.30
Manganese	0.10	0.35
Silicon	--	0.10
Phosphorus	--	0.010
Ø Sulfur	--	0.010
Chromium	0.35	0.60
Nickel	7.00	9.00
Cobalt	3.50	4.50
Molybdenum	0.35	0.60
Vanadium	0.06	0.12
Copper	--	0.35

Ø 3.1.1 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2259.

3.2 Condition: The product shall be supplied in the following condition; hardness tests shall be conducted Ø in accordance with ASTM A370:

3.2.1 Sheet and Strip: Cold finished, bright or atmosphere annealed, and descaled if necessary; or hot rolled, annealed, and descaled; having hardness not higher than 36 HRC or equivalent.

3.2.2 Plate: Hot rolled, annealed, and descaled, having hardness not higher than 36 HRC or equivalent.

3.2.3 When the product is ordered normalized and tempered, hardness shall be not higher than 30 HRC or equivalent.

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

3.3.1 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, Ø determined in accordance with ASTM E112.

3.3.2 Micro-Inclusion Rating: Two-thirds of the total number of specimens as well as the average of all specimens shall not exceed the following limits, determined in accordance with ASTM E45, Method D, except that the length of any inclusion shall be not greater than 0.015 in. (0.38 mm):

Ø

	Inclusion Rating			
Type	A	B	C	D
Thin	1.5	1.5	1.5	2.0
Heavy	1.0	1.0	1.0	1.5

3.3.3 Decarburization:

3.3.3.1 Product Under 0.045 In. (1.14 mm) in Nominal Thickness: The method of test and the allowance shall be as agreed upon by purchaser and vendor.

3.3.3.2 Product 0.045 to 0.375 In. (1.14 to 9.52 mm), Excl, in Nominal Thickness:

3.3.3.2.1 Specimens: Shall be the full thickness of the product except that specimens from plate over 0.249 in. (6.32 mm) thick shall be slices approximately 0.250 in. (6.35 mm) thick cut parallel to and preserving one original surface of the plate. Recommended specimen size is 1 x 4 in. (25 x 100 mm).

3.3.3.2.2 Procedure: Specimens shall be hardened by austenitizing and quenching; preferably, they shall not be tempered but, if tempered, the tempering temperature shall be not higher than 300°F (150°C). During heat treatment, specimens shall be protected by suitable atmosphere or medium or by suitable plating to prevent carburization or further decarburization. Protective plating, if used, shall then be removed from specimens of product 0.045 to 0.250 in. (1.14 to 6.35 mm), ø excl, in nominal thickness and a portion of the specimen shall be ground to a depth of 0.050 in. (1.27 mm) or one-half thickness, whichever is less. Specimens from product 0.250 to 0.375 in. (6.35 to 9.52 mm) excl, in nominal thickness shall be ground to remove 0.020 in. (0.51 mm) of metal from the original surface of the plate and a portion of the specimen shall be further ground to a depth of at least one-third the original thickness of the specimen. At least three Rockwell hardness readings shall be taken on each prepared step and each group of readings averaged.

3.3.3.2.3 Allowance:

3.3.3.2.3.1 Product 0.045 to 0.250 In. (1.14 to 6.35 mm), Excl, in Nominal Thickness: The product ø shall show no layer of complete decarburization, determined microscopically at a magnification not exceeding 100X. It shall also be free from partial decarburization to the extent that the difference in hardness between the original surface and the portion ground as in 3.3.3.2.2 shall be not greater than 2 units on the Rockwell "A" scale.

3.3.3.2.3.2 Product 0.250 to 0.375 In. (6.35 to 9.52 mm), Excl, in Nominal Thickness: Shall be free from ø decarburization to the extent that the difference in hardness between the two prepared steps shall be not greater than 3 units on the Rockwell "A" scale.

3.3.3.3 Product 0.375 In. (9.52 mm) and Over in Nominal Thickness: The total decarburization, determined microscopically at a magnification not exceeding 100X on the as-supplied plate, shall be not greater than shown in Table I.

TABLE I

Nominal Thickness Inches	Depth of Decarburization Inch
0.375 to 0.500, incl	0.015
Over 0.500 to 1.000, incl	0.025
Over 1.000 to 2.000, incl	0.035
ø Over 2.000	As agreed upon

TABLE I (SI)

Nominal Thickness Millimetres	Depth of Decarburization Millimetre
9.52 to 12.70, incl	0.38
Over 12.70 to 25.40, incl	0.64
Over 25.40 to 50.80, incl	0.89
Over 50.80	As agreed upon

3.3.4 Properties After Heat Treatment: Product, heat treated as in 3.3.4.1 except that annealing (3.3.4.1.1) is optional, shall meet the requirements of 3.3.4.2 and 3.3.4.3.

3.3.4.1 Heat Treatment:

3.3.4.1.1 Annealing: Heat to 1140°F ± 25 (615°C ± 15), hold at heat for 8 - 24 hr, and cool in air to room temperature.

3.3.4.1.2 Normalizing: Heat to a temperature within the range 1600 - 1700°F (870 - 925°C), hold at the selected temperature within ±25°F (±15°C) for 1 hr per inch (25 mm) of section thickness, and cool in air to room temperature.

3.3.4.1.3 Hardening: Heat to 1550°F ± 25 (843°C ± 15), hold at heat for 1 hr per inch (25 mm) of section thickness but not less than 1 hr, and from that temperature quench sections up to 4 in. (100 mm) in nominal thickness into room-temperature oil or water.

3.3.4.1.4 Tempering: Heat to a temperature not higher than 1050°F (565°C), hold at heat for 2 hr per inch (25 mm) of thickness but not less than 2 hr, and cool in air to room temperature.

3.3.4.2 Tensile Properties:

Tensile Strength, min		185,000 psi (1276 MPa)
Yield Strength at 0.2% offset, min		175,000 psi (1207 MPa)
Elongation in 2 in. (50 mm), min		
Nominal Thickness		
Inch	(Millimetres)	
0.020 to 0.060, incl	(0.51 to 1.52), incl	5%
Over 0.060 to 0.100, incl	(Over 1.52 to 2.54), incl	8%
Over 0.100 to 0.187, incl	(Over 2.54 to 4.75), incl	10%
Over 0.187	(Over 4.75)	13%
Reduction of Area (round specimens), min		50%

3.3.4.3 Fracture Toughness: When specified, product shall be subjected to fracture toughness testing. The method of testing and the standards for acceptance of product shall be as agreed upon by purchaser and vendor. ASTM E338 is a suggested method of test for sheet and ASTM E399 is a suggested method of test for plate.

3.4 Quality:

3.4.1 Steel shall be premium quality conforming to AMS 2300; it shall be multiple melted using consumable electrode practice in the remelt cycle; at least one of the melting cycles shall be under vacuum, unless otherwise permitted.

3.4.2 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.

3.5 Tolerances: Unless otherwise specified, tolerances shall conform to all applicable requirements of AMS 2252.

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 ensure that the product conforms to the requirements of this specification.