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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6524C

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Superseding AMS 6524B

Submitted for recognition as an American National Standard

STEEL SHEET, STRIP, AND PLATE
1.0Cr - 7.5Ni - 4.5Co - 1.0Mo - 0.09V (0.29 - 0.34C)
Consumable Electrode Vacuum Melted, Annealed

UNS K91313

1. SCOPE:

1.1 Form:

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

1.2 Application:

These products have been used typically for parts, such as pressure vessels, requiring through-hardening to high strength levels and where such parts may require welding during fabrication, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

REAFFIRMED
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2.1 SAE Publications:

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

AMS 2252 Tolerances, Low-Alloy Steel Sheet, Strip, and Plate
MAM 2252 Tolerances, Metric, Low-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
MAM 2300 Premium Aircraft-Quality Steel Cleanliness, Magnetic Particle Inspection Procedure, Metric (SI) Measurement
AMS 2370 Quality Assurance Sampling and Testing of Carbon and Low-Alloy Steels, 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

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM A 370 Mechanical Testing of Steel Products
ASTM A 604 Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets
ASTM E 45 Determining the Inclusion Content of Steel
ASTM E 112 Determining Average Grain Size
ASTM E 338 Sharp-Notch Tension Testing of High-Strength Sheet Materials
ASTM E 350 Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
ASTM E 399 Plane-Strain Fracture Toughness of Metallic Materials

2.3 U.S. Government Publications:

Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

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

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

(R)

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 350, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Carbon	0.29	0.34
Manganese	0.10	0.35
Silicon	--	0.20
Phosphorus	--	0.01
Sulfur	--	0.01
Chromium	0.90	1.10
Nickel	7.00	8.00
Cobalt	4.25	4.75
Molybdenum	0.90	1.10
Vanadium	0.06	0.12
Copper	--	0.35

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 shall be determined in accordance with ASTM A 370:

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 normalized and tempered product is ordered, hardness shall be not higher than 40 HRC, or equivalent.

3.3 Properties:

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

3.3.1 Macrostructure: Visual examination of specimens, etched in hot hydrochloric acid in accordance with ASTM A 604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than standards agreed upon by purchaser and vendor.

3.3.2 (R) Micro-Inclusion Rating: No specimen shall exceed the limits of Table 2, determined in accordance with ASTM E 45, Method D:

TABLE 2 - Micro-Inclusion Rating Limits

Type	A Thin	A Heavy	B Thin	B Heavy	C Thin	C Heavy	D Thin	D Heavy
Worst Field Severity	1.5	1.0	1.0	1.0	1.0	1.0	1.5	1.0
Worst Field Frequency	*	1	*	1	*	1	3	1
Total Rateable Fields Frequency, maximum	**	1	**	1	**	1	8	1

* Combined A + B + C, not more than 3 fields
** Combined A + B + C, not more than 8 fields

3.3.2.1 A rateable field is defined as one which has a type A, B, C, or D inclusion rating of at least No. 1.0 thin or heavy in accordance with the Jernkontoret Chart, Plate III, ASTM E 45.

3.3.3 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, determined in accordance with ASTM E 112.

3.3.4 Decarburization:

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

3.3.4.2 Product 0.045 to 0.375 Inch (1.14 to 9.52 mm), Exclusive, in Nominal Thickness:

3.3.4.2.1 Specimens: Shall be the full thickness of the product except that specimens from plate 0.250 inch (6.35 mm) and over in nominal thickness shall be slices approximately 0.250 inch (6.35 mm) thick cut parallel to and preserving one original surface of the plate. Recommended specimen size is 1 x 4 inches (25 x 102 mm).

3.3.4.2.2 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 (149°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 inch (1.14 to 6.35 mm), exclusive, in nominal thickness and a portion of the specimen shall be ground to a depth of 0.050 inch (1.27 mm) or one-half thickness, whichever is less. Specimens from product 0.250 to 0.375 inch (6.35 to 9.52 mm), exclusive, in nominal thickness shall be ground to remove 0.020 inch (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.

3.3.4.2.3 Allowance:

3.3.4.2.3.1 Product 0.045 to 0.250 Inch (1.14 to 6.35 mm), Exclusive, in Nominal Thickness: The product 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 3.3.4.2.2 shall be not greater than 2 units on the Rockwell "A" Scale.

3.3.4.2.3.2 Product 0.250 to 0.375 Inch (6.35 to 9.52 mm), Exclusive, in Nominal Thickness: Shall be free from 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.

3.3.4.3 Product 0.375 Inch (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 3.

TABLE 3A - Decarburization, Maximum, Inches

Nominal Thickness	Depth of Decarburization
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
Over 2.000	As agreed upon

TABLE 3B - Decarburization, Maximum, Millimeters

Nominal Thickness	Depth of Decarburization
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

3.3.5 Properties After Heat Treatment: Product shall meet the following requirements after being normalized by heating to 1650°F ± 25 (899°C ± 14), holding at heat for 1 hour per inch (25 mm) of maximum cross-section, and cooling in air to room temperature; hardened by heating to 1550°F ± 25 (843°C ± 14), holding at heat for 1 hour per inch (25 mm) of maximum cross-section but not less than 1 hour, and quenching in oil or water; cooling to -100°F ± 10 (-73°C ± 6), holding at -100°F ± 10 (-73°C ± 6) for not less than 2 hours, warming to room temperature; and double tempered by heating to 975°F ± 15 (524°C ± 8), holding at heat for 2 hours per inch (25 mm) of maximum cross-section but not less than 2 hours, cooling to approximately 125°F (52°C), reheating to 975°F ± 15 (524°C ± 8), holding at heat for 2 hours per inch (25 mm) of maximum cross-section but not less than 2 hours, and cooling in air to room temperature:

3.3.5.1 Tensile Properties: Shall be as specified in Table 4.

TABLE 4A - Tensile Properties

Nominal Thickness Inches	Tensile Strength ksi, min	Yield Strength at 0.2% Offset ksi, min	Elongation In 2 Inches or 4D %, min	Reduction of Area %, min
Up to 0.250, excl	220	185	6	--
0.250 and over	220	190	10	35

TABLE 4B - Tensile Properties (SI)

Nominal Thickness Millimeters	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation In 50.8 mm or 4D %, min	Reduction of Area %, min
Up to 6.35, excl	1517	1276	6	--
6.35 and over	1517	1310	10	35

3.3.5.2 Hardness: Should be not lower than 46 HRC, or equivalent, but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.3.5.1 are met.

3.3.5.3 Fracture Toughness: When specified, the product shall be subjected to fracture toughness testing and the results reported. Sheet and strip shall be tested in accordance with ASTM E 338 and plate shall be tested in accordance with ASTM E 399. Acceptance standards shall be as agreed upon by purchaser and vendor.

3.4 Quality:

3.4.1 Steel shall be premium aircraft-quality conforming to AMS 2300 or MAM 2300. It shall be multiple melted using consumable electrode vacuum practice in the remelt cycle.

3.4.2 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.

3.5 Tolerances:

Shall conform to all applicable requirements of AMS 2252 or MAM 2252.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:
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The vendor of the product shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.