SAE The Engineering Society For Advancing Mobility Land Sea Air and Space,
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6546E

Issued FEB 1965
Revised DEC 1995

Submitted for recognition as an American National Standard

Superseding AMS 6546D

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

UNS K91122

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE as of December 1995. It is recommended, therefore, that this specification not be specified for new designs.

This cover sheet should be attached to the "D" revision of the subject specification.

NONCURRENT" refers to those materials which have previously been widely used and which may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these as standard materials for future use in new designs. Each of these "NONCURRENT" specifications is available from SAE upon request.

PREPARED UNDER THE JURISDICTION OF AMS COMMITTEE "E"

SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6546D

Issued 15 FEB 1965
Revised 1 OCT 1991

Submitted for recognition as an American National Standard

Superseding AMS 6546C

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

UNS K91122

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:

This product has been used typically for heat treated parts, such as pressure vessels, requiring through hardening to high strength levels, and where such parts may require welding, 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.

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

2.1 SAE Publications (Continued):

AMS 2370 Quality Assurance Sampling and Testing of Carbon and Low-Alloy Steels, Wrought Products and Forglng 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, Phlladelphia, PA 19103-1187.

ASTM A 370 Mechanical Testing of Steel Products
ASTM E 45 Determining the Inclusion Content of Steels
ASTM E 112 Determining Average Grain Size
ASTM E 338 Sharp-Notch Tenslon Testing of High-Strength Sheet Materials
ASTM E 350 Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrlcal Steel, Ingot Iron, and Wrought Iron
ASTM E 399 Plane-Strain Fracture Toughness of Metallic Materials

2.3 U.S. Government Publlcatlons:

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

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

3. TECHNICAL REQUIREMENTS:

3.1 Composltlon:
(R)

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

TABLE 1 - Composition

Element	min	max
Carbon	0.24	0.30
Manganese	0.10	0.35
Silicon	--	0.10
Phosphorus	--	0.010
Sulfur	--	
Chromium	0.35	0.010 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

3.1.1 Check Analysfs: Compositlon variations shall meet the applicable requirements of AMS 2259.

3.2 Condltlon:

The product shall be supplled In the following condition; hardness tests shall be conducted In accordance wlth ASTM A 370:

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

3.2.2 Plate: Hot rolled, annealed, and descaled, havlng hardness not hlgher than 36 HRC, or equlvalent.

3.2.3 When the product Is ordered normallzed and tempered, hardness shall be not higher than 30 HRC, or equlvalent.

3.3 Propertles:

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

3.3.1 Graln Size: Predominantly 5 or finer with occasional grains as large as 3 permlsslble, determlned In accordance with ASTM E 112.

3.3.2 Micro-Inclusion Ratlng: Two-thirds of the total number of specimens, selected as In 4.3.1, as well as the average of all specimens tested shall not exceed the llmlts of Table 2, determlned In accordance wlth ASTM E 45, Method D, except that the length of any inclusion shall be not greater than 0.015 Inch (0.38 mm):

TABLE 2 - Micro-Inclusion Rating Llmlts

Type	A	B	C	D
Thln	1.5	1.5	1.5	2.0
Heavy	1.0	1.0	1.0	1.5

3.3.3 Decarburlzatlon:

3.3.3.1 Product Under 0.045 Inch (1.14 mm) In Nomlnal 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 Inch (1.14 to 9.52 mm), Exclusive, in Nominal Thickness:

3.3.3.2.1 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 slze is 1 x 4 inches (25 x 102 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 (149 °C). During heat treatment, specimens shall be protected by sultable atmosphere or medium or by suitable platlng to prevent carburization or further decarburizatlon. Protective platlng, 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, whlchever 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 orlginal surface of the plate and a portlon of the specimen shall be further ground to a depth of at least one-third the orlginal 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 Inch (1.14 to 6.35 mm), Exclusive, in Nomlnal Thickness: The product shall show no layer of complete decarburizatlon, determined microscopically at a magnification not exceeding 100X. It shall also be free from partlal decarburization to the extent that the difference in hardness between the origlnal surface and the portlon ground as In 3.3.3.2.2 shall be not greater than two unlts on the Rockwell "A" scale.

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

3.3.3.3 Product 0.375 Inch (9.52 mm) and Over In Nomlnal Thickness: The total decarburlzatlon, determined mlcroscopically at a magnification not exceeding 100X on the as-supplied plate, shall be not greater than shown In Table 3.

TABLE 3A - Maximum Depth of Decarburization, Inches

Nomlnal Thickness	Depth
0.375 to 0.500, incl	0.015
Over 0.500 to 1.000, lncl	0.025
Over 1.000 to 2.000, lncl	0.035
Over 2.000	As agreed upon

TABLE 3B - Maximum Depth of Decarburlzatlon, Millimeters

Nominal Thickness	Depth
9.52 to 12.70, lncl	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 Propertles After Heat Treatment: Product, heat treated as in 3.3.4.1 except that annealing as in 3.3.4.1.1 is optlonal, 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 (616 °C ± 14), hold at heat for 8 - 24 hours, and cool in air to room temperature.

3.3.4.1.2 Normalizing: Heat to a temperature within the range 1600 - 1700 °F (871 - 927 °C), hold at the selected temperature within ±25 °F (±14 °C) for 1 hour per Inch (25 mm) of section thickness, and cool in air to room temperature.

3.3.4.1.3 Hardenlng: Heat to 1550 °F ± 25 (843 °C ± 14), hold at heat for 1 hour per inch (25 mm) of section thickness but not less than 1 hour, and from that temperature quench sections up to 4 Inches (102 mm) in nominal thickness into room-temperature oil or water.

3.3.4.1.4 Temperlng: Heat to a temperature not higher than 1050 °F (566 °C), hold at heat for 2 hours per Inch (25 mm) of thickness but not less than 2 hours, and cool In air to room temperature.

3.3.4.2 Tenslle Properties: The product shall conform to the properties specified in Table 4; testlng shall be In accordance with ASTM A 370:

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

Nomlnal Thickness Inches	Tensile Strength ksi	Yield Strength at 0.2% Offset ksi	Elongatlon in 2 Inches %	Reduction of Area %
0.020 to 0.060, incl	185.0	175.0		50
Over 0.060 to 0.100, incl	185.0	175.0	5	50
Over 0.100 to 0.187, incl	185.0	175.0	10	50
Over 0.187 to 4.000, excl	185.0	175.0	13	50

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 %	Reduction of Area %
0.51 to 1.52, incl	1276	1207	5	50
Over 1.52 to 2.54, incl	1276	1207	8	50
			10	50
Over 2.54 to 101.60, excl	1276	1207	13	50

3.3.4.3 fracture Toughness: When specified, product shall be subjected to fracture toughness testlng. The method of test and standards for acceptance shall be as agreed upon by purchaser and vendor. ASTM E 338 Is a suggested method of test for sheet and ASTM E 399 is a suggested method of test for plate.

3.4 Quality:

3.4.1 Steel shall be premium aircraft-quality conforming to AMS 2300 or
(R) MAM 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.

3.4.2 The product, as received by purchaser, shall be unlform in quality and condition, sound, and free from forelgn 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. QUALIN ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:
(R)

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 requlrements of this specification.

4.2 Classification of Tests:

Tests for all technical requlrements are acceptance tests and shall be performed on each heat or lot as applicable.