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AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6454B

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Superseding AMS 6454A

An American National Standard

STEEL SHEET, STRIP, AND PLATE
1.8Ni - 0.80Cr - 0.25Mo (0.38 - 0.43C) (SAE 4340)
Consumable Electrode Melted

UNS G43400

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: Primarily for heat treated parts requiring good tensile and endurance strengths in combination with good ductility. The product may be through-hardened to tensile strength ranges of 260 - 280 ksi (1793 - 1931 MPa) in nominal section thicknesses of 1.5 inches (38 mm) and under and 180 - 220 ksi (1241 - 1517 MPa) in nominal section thicknesses of 3 inches (76 mm) and under.

1.3 Classification: Product shall be classified as follows:

Type 1 - Steel multiple melted using consumable electrode vacuum practice in the remelt cycle.

Type 2 - Steel multiple melted using electro slag process in the remelt cycle.

1.3.1 Unless a specific type is ordered, either type may be supplied.

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.

2.1.1 Aerospace Material Specifications:

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 of Carbon and Low-Alloy Steels, Wrought Products Except Forgings and Forging Stock

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

ASTM A 255 - End-Quench Test for Hardenability of Steel
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 350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

2.3 U.S. Government Publications: Available from Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

2.3.1 Military Standards:

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

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E 350, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	min	max
Carbon	0.38	0.43
Manganese	0.60	0.90
Silicon	0.15	0.35
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	0.70	0.90
Nickel	1.65	2.00
Molybdenum	0.20	0.30
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 if necessary, and descaled, having hardness not higher than 98 HRB, or equivalent.

3.2.2 Plate: Hot rolled, annealed if necessary, and descaled, having hardness not higher than 25 HRC, or equivalent.

3.2.3 If product is ordered spheroidize annealed, the degree of spheroidization shall be as agreed upon by purchaser and vendor.

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

3.3.1 Macrostructure: Visual examination of transverse sections as in 4.3.1, 0 etched in accordance with ASTM A 604 in hot hydrochloric acid, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the following macrographs of ASTM A 604:

Class	Condition	Severity
1	Freckles	A
2	White Spots	A
3	Radial Segregation	B
4	Ring Pattern	B

3.3.2 Micro-Inclusion Rating: At least one specimen as in 4.3.2 from each ingot tested, as well as two-thirds of the total number of specimens and the average of all specimens, shall not exceed the following limits, determined in accordance with ASTM E 45, Method D, except that the length of any inclusion shall be not greater than 0.015 inch (0.38 mm):

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

3.3.4 Hardenability: Shall be J53=6 minimum and J50=20 minimum, determined on the standard end-quench test specimen in accordance with ASTM A 255 except that the steel shall be normalized at 1700°F ± 10 (927°C ± 6) and the test specimen austenitized at 1525°F ± 10 (829°C + 6). The hardenability test is not required on a product which will not yield a suitable specimen but the steel from which the product is made shall conform to the hardenability specified.

3.3.5 Decarburization:

3.3.5.1 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.

3.3.5.2 Product 0.045 to 0.375 Inch (1.14 to 9.52 mm), Excl, in Nominal Thickness:

3.3.5.2.1 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).

3.3.5.2.2 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 - 6.35 mm), excl, 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 - 9.52 mm), excl, 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.

3.3.5.2.3 Allowance:

3.3.5.2.3.1 Product 0.045 to 0.250 Inch (1.14 - 6.35 mm), Excl, 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 3.3.5.2.2 shall be not greater than 2 units on the Rockwell "A" scale.

3.3.5.2.3.2 Product 0.250 to 0.375 Inch (6.35 - 9.52 mm), Excl, 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.

3.3.5.3 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 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
Over 2.000	As agreed upon

TABLE I (SI)

Nominal Thickness Millimeters	Depth of Decarburization Millimeters
Over 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

3.3.6 Bending: Product 0.749 inch (19.02 mm) and under in nominal thickness shall withstand, without cracking, bending through the angle indicated below around a diameter equal to three times the nominal thickness of the product with axis of bend parallel to the direction of rolling:

Nominal Thickness		Angle
Inch	Millimeters	deg, min
Up to 0.249, incl	Up to 6.32, incl	180
Over 0.249 to 0.749, incl	Over 6.32 to 19.02, incl	90

3.3.6.1 Bending requirements for plate over 0.749 inch (19.02 mm) in nominal thickness 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. Steel shall be multiple melted using vacuum consumable electrode or electro slag process 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: 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.

4.2 Classification of Tests: Tests for all technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing: Shall be in accordance with AMS 2370 and the following:

4.3.1 Samples for macrostructure rating (3.3.1) shall be full cross-sectional specimens obtained from the finished billet, slab, or suitable rerolled product representing the top and bottom of at least the first, middle, and last usable ingot of each heat.

4.3.2 Samples for micro-inclusion rating (3.3.2) shall be obtained from the finished billet, slab, or suitable rerolled product and shall consist of not less than four specimens representing the top and bottom of the first and last ingot from a heat yielding 10 or fewer ingots or not less than six specimens representing the top and bottom of the first, middle, and last-usable ingot from a heat yielding more than 10 ingots.

4.4 Reports: The vendor of the product shall furnish with each shipment a report showing the results of tests for chemical composition, macrostructure, micro-inclusion rating, grain size, hardenability, and frequency-severity cleanliness rating of each heat and the results of tests on each lot to determine conformance to the decarburization and bending requirements. This report shall include the purchase order number, lot number, AMS 6454B, size, and quantity.

4.5 Resampling and Retesting: Shall be in accordance with AMS 2370.

5. PREPARATION FOR DELIVERY:

5.1 Identification: The product shall be identified as in 5.1.1 unless purchaser permits a method from 5.1.2.

5.1.1 Each sheet, strip, and plate shall be legibly marked on one face, in the respective location indicated below, with AMS 6454B, lot number, manufacturer's identification, and nominal thickness. The characters shall be applied using a suitable marking fluid removable in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the product or its performance and shall be sufficiently stable to withstand normal handling. The specification number, manufacturer's identification, and nominal thickness shall be continuously line marked; the lot number may be included in the line marking or may be marked at one location on each piece.