Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS6350E
Superseding AMS 6350D
Issued 12-1-42
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STEEL SHEET, STRIP, AND PLATE
0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)

1. SCOPE:

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

1.2 Application: Primarily for use where welding and moderate tensile properties are required. Sheet and strip are extensively used where minimum tensile strength of 180,000 psi (1241 MPa) is required in sections up to 0.125 in. (3.18 mm) thick and proportionately lower strength is required in heavier thicknesses.

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., Two Pennsylvania Plaza, New York, New York 10001.

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 Steel
AMS 2301 - 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

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM A370 - Mechanical Testing of Steel Products
ASTM E112 - Estimating Average Grain Size of Metals
ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

2.3 Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, Pennsylvania 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

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	0.28	0.33
Manganese	0.40	0.60
Silicon	0.20	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	0.80	1.10
Molybenum	0.15	0.25
Nickel	--	0.25
Copper	--	0.35

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2259, paragraph titled "Low Alloy Steels".

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

3.2.1 Sheet and Strip: Cold finished, bright or atmosphere annealed, and descaled if necessary, 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.

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

3.3.1 Response to Heat Treatment: Product 0.249 in. (6.32 mm) and under in nominal thickness and thicker product reduced to 0.249 in. (6.32 mm) in thickness, hardened by quenching in oil from 1600 F ± 10 (871.1 C ± 5.6), and tempered for not less than 30 min. at not lower than 900 F (482 C), shall have tensile strength not lower than 125,000 psi (862 MPa) or hardness not lower than 26 HRC or equivalent.

3.3.2 Grain Size: Predominantly 5 or finer with occasional grains as large as 3 permissible, ASTM E112, McQuaid-Ehn test.

3.3.3 Decarburization:

3.3.3.1 Product Under 0.045 In (1.14 mm) Thick: 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 (1.14 to 9.52 mm), Excl, in 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 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 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), excl, in 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 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 1/3 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, Thick: Unless otherwise specified, the product shall show no layer of complete decarburization as determined microscopically at a magnification not exceeding 100 X. 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, Thick: 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.

3.3.3.3 Product 0.375 In. (9.52 mm) and Over Thick: The total decarburization, determined microscopically at a magnification not exceeding 100 X, on the plate as supplied 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 Millimeter
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 Bending: The product shall withstand, without cracking, free bending through the angle indicated in Table II around a diameter equal to the nominal thickness of the product with axis of bend parallel to the direction of rolling:

TABLE II

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

TABLE II (SI)

Nominal Thickness Millimeters	Angle rad, min
Up to 6.32, incl	3.14
Over 6.32 to 19.02, incl	1.57

3.4 Quality: Steel shall be aircraft quality conforming to AMS 2301. The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.

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

4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance or routine control tests.

4.3 Sampling: Shall be in accordance with AMS 2370.

4.4 Reports:

4.4.1 The vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition, grain size, and AMS 2301 frequency-severity rating of each heat in the shipment and the results of tests on each size from each heat to determine conformance to the response to heat treatment, decarburization, and bending requirements. This report shall include the purchase order number, heat number, material specification number and its revision letter, thickness, size, and quantity from each heat.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.5 Resampling and Retesting: If any specimen used in the above test fails to meet the specified requirements, disposition of the product may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification: Each sheet, strip, and plate shall be marked as in 5.1.1 unless purchaser permits a method from 5.1.2.

5.1.1 Each sheet, strip, and plate shall be marked on one face, in the respective location indicated below, with AMS 6350E, heat number, manufacturer's identification, and nominal thickness. The characters shall be of such size as to be clearly legible, shall be applied using a suitable marking fluid, and shall be capable of being removed in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the material 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 heat number may be included in the line marking or may be marked at one location on each piece.

5.1.1.1 Flat Strip 6 In. (152 mm) and Under in Width: Shall be marked in one or more lengthwise rows of characters recurring at intervals not greater than 3 ft (914 mm).

5.1.1.2 Flat Sheet, Flat Strip Over 6 In. (152 mm) in Width, and Plate: Shall be marked in lengthwise rows of characters recurring at intervals not greater than 3 ft (914 mm), the rows being spaced not more than 6 in. (152 mm) apart and alternately staggered.