



400 Commonwealth Dr., Warrendale, PA 15096

# AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 6351D  
Superseding AMS 6351C

Issued 12-1-53  
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STEEL SHEET, STRIP, AND PLATE  
0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)  
Spheroidized

UNS G41300

## 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 general use where deep drawing and forming are required. Product may be through-hardened to a minimum tensile strength of 180,000 psi (1240 MPa) in sections 0.125 in. (3.00 mm) and under in nominal thickness and proportionately lower strength in heavier section 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 shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

### 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 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 and Forging Stock

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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 E112 - Determining Average Grain Size

ASTM E350 - Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

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

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 E350 or by spectrographic or other analytical methods approved by purchaser:

	min	max
Carbon	0.28	0.33
Manganese	0.40	0.60
Silicon	0.15	0.35
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	0.80	1.10
Molybdenum	0.15	0.25
Nickel	--	0.25
Copper	--	0.35

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

3.2 Condition: Cold finished or hot rolled, annealed to develop a uniform microstructure of spheroidized cementite in ferrite matrix, and descaled, having hardness not higher than 85 HRB or equivalent, determined in accordance with ASTM A370.

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

3.3.2 Response to Heat Treatment: Product 0.249 in. (6.25 mm) and under in nominal thickness and thicker product reduced to 0.249 in.  $\pm 0.010$  (6.25 mm  $\pm 0.25$ ) in thickness shall have tensile strength not lower than 125,000 psi (860 MPa) or hardness not lower than 26 HRC or equivalent after being hardened by quenching in oil from 1600°F  $\pm 10$  (870°C  $\pm 5$ ) and tempered for not less than 30 min. at not lower than 900°F (480°C).

3.3.3 Decarburization:

3.3.3.1 Product Under 0.045 In. (1.15 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. (1.15 to 9.50 mm), Excl, in Nominal Thickness:

3.3.3.2.1 Specimens: Shall be the full thickness of the product except that specimens from plate 0.250 in. (6.25 mm) and over in nominal thickness shall be slices approximately 0.250 in. (6.25 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. (1.15 to 6.25 mm), excl, in nominal thickness and a portion of the specimen shall be ground to a depth of 0.050 in. (1.25 mm) or one-half thickness, whichever is less. Specimens from product 0.250 to 0.375 in. (6.25 to 9.50 mm), excl, in nominal thickness shall be ground to remove 0.020 in. (0.50 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. (1.15 to 6.25 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 3.3.3.2.2 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. (6.25 to 9.50 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.

- 3.3.3.3 Product 0.375 In. (9.50 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 Millimetres	Depth of Decarburization Millimetre
9.50 to 12.50, incl	0.38
Over 12.50 to 25.00, incl	0.62
Over 25.00 to 50.00, incl	0.88
Over 50.00	As agreed upon

- 3.3.4 Bending: Product 0.749 in. (18.75 mm) and under in nominal thickness shall withstand, without cracking, free bending through the angle indicated below around a diameter equal to the nominal thickness of the product with axis of bend parallel to the direction of rolling.

Nominal Thickness		Bend Angle Deg
Inch	Millimetres	
Up to 0.249, incl	Up to 6.25, incl	180
Over 0.249 to 0.749, incl	Over 6.25 to 18.75, incl	90

- 3.3.4.1 Bending requirements for plate over 0.749 in. (18.75 mm) in nominal thickness shall be as agreed upon by purchaser and vendor.

### 3.4 Quality:

- 3.4.1 Steel shall be aircraft quality conforming to AMS 2301.

- 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. Results of such tests shall be reported to the purchaser as required by 4.4. 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 to determine conformance to all technical requirements of this specification are classified as acceptance tests and shall be performed on each heat or lot as applicable.

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 a report showing the results of tests on each heat for chemical composition, grain size, and frequency-severity cleanliness rating and the results of tests on each lot to determine conformance to the other technical requirements of this specification. This report shall include the purchase order number, heat number, AMS 6351D, size, and quantity from each heat.

4.4.2 The vendor of finished or semi-finished parts shall furnish with each shipment a report showing the purchase order number, AMS 6351D, 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 either a statement that the material conforms or copies of laboratory reports showing the results of tests to determine conformance.

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 marked on one face, in the respective location indicated below, with AMS 6351D, heat number, manufacturer's identification, and nominal thickness. The characters shall be of such size as to be legible, shall be applied using a suitable marking fluid, and shall be 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 heat number may be included in the line marking or may be marked at only one location on each piece.