



# AEROSPACE MATERIAL SPECIFICATION

AMS6351™

REV. K

Issued 1953-12  
Revised 2015-12

Superseding AMS6351J

Steel, Sheet, Strip, and Plate  
0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)  
Spheroidized  
(Composition similar to UNS G41300)

## RATIONALE

AMS6351K revises the macrostructure, grain size requirements, decarburization testing methods and reporting.

### 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

These products have been used typically for general use where deep drawing and forming are required, but usage is not limited to such applications. Product may be through-hardened to a minimum tensile strength of 180 ksi (1241 MPa) in sections 0.125 inch (3.18 mm) and under in nominal thickness and lower strength in heavier section thicknesses.

### 2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

#### 2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AMS2252 Tolerances, Low-Alloy Steel Sheet, Strip, and Plate

AMS2259 Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels

AMS2301 Steel Cleanliness, Aircraft Quality, Magnetic Particle Inspection Procedure

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<http://www.sae.org/technical/standards/AMS6351K>

- AMS2370 Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock
- AMS2807 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 International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, [www.astm.org](http://www.astm.org).

ASTM A370 Mechanical Testing of Steel Products

ASTM E112 Determining Average Grain Size

ASTM E290 Bend Testing of Material for Ductility

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

ASTM E384 Knoop and Vickers Hardness of Materials

## 3. TECHNICAL REQUIREMENTS

### 3.1 Composition

Shall conform to the percentages by weight, shown in Table 1, determined by wet chemical methods in accordance with ASTM E350, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

**Table 1 - Composition**

Element	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 Aluminum, vanadium and columbium are optional grain refining elements and need not be determined or reported unless used to satisfy the average grain size requirements of 3.3.2.2.

### 3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2259.

### 3.2 Condition

The product shall be supplied in the following condition; hardness shall be not higher than 85 HRB, or equivalent (see 8.2), determined in accordance with ASTM A370.

#### 3.2.1 Sheet and Strip

Cold rolled or hot rolled, annealed to develop a uniform microstructure of spheroidized cementite in ferrite matrix, and descaled.

### 3.2.2 Plate

Hot rolled, annealed to develop a uniform microstructure of spheroidized cementite in ferrite matrix, and descaled.

#### 3.2.2.1 If allowed by the purchaser, cold rolled, annealed to develop a uniform microstructure of spheroidized cementite in ferrite matrix, and descaled.

## 3.3 Properties

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

### 3.3.1 Response to Heat Treatment

Product 0.249 inch (6.32 mm) and under in nominal thickness and thicker product reduced to 0.249 inch  $\pm$  0.010 inch (6.32 mm  $\pm$  0.25 mm) in thickness shall have tensile strength not lower than 125 ksi (862 MPa) or hardness not lower than 26 HRC, or equivalent (see 8.2), after being hardened by quenching in oil from 1600 °F  $\pm$  10 °F (871 °C  $\pm$  6 °C), and tempered for not less than 30 minutes at not lower than 900 °F (482 °C).

### 3.3.2 Average Grain Size

Average grain size shall be determined by either 3.3.2.1 or 3.3.2.2.

#### 3.3.2.1 Shall be ASTM No. 5 or finer, determined in accordance with ASTM E112.

#### 3.3.2.2 The heat shall be considered to have fine austenitic grain size if one or more of the following are determined by heat analysis (see 8.5):

##### 3.3.2.2.1 A total aluminum content of 0.020 to 0.050%.

##### 3.3.2.2.2 An acid soluble aluminum content of 0.015 to 0.050%.

##### 3.3.2.2.3 A vanadium content of 0.02 to 0.08%.

##### 3.3.2.2.4 A columbium content of 0.02 to 0.05%.

### 3.3.3 Decarburization

Decarburization shall be evaluated by one of the methods of 3.3.3.1 or 3.3.3.2.

#### 3.3.3.1 Metallographic Method

A cross section taken perpendicular to the surface shall be prepared, etched, and visually examined metallographically at a magnification not to exceed 100X. The product shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 2.

#### 3.3.3.2 Hardness Traverse Method

The total depth of decarburization shall be determined by a traverse method using microhardness testing in accordance with ASTM E384, at a magnification not exceeding 100X, conducted on a hardened but untempered specimen protected during heat treatment to prevent changes in surface carbon content. Tempering is generally not recommended, but if tempered, the tempering temperature shall be not higher than 300 °F (149 °C). Depth of decarburization is defined as the perpendicular distance from the surface to the depth under that surface where there is not further increase in hardness. Such measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization on the adjacent surface. Acceptance shall be as listed in Table 2.

**Table 2A - Maximum total depth of decarburization, inch/pound units**

Nominal Thickness Inches	Total Depth of Decarburization Inch
Up to 0.500, incl	0.015
Over 0.500 to 1.000, incl	0.025
Over 1.000	0.035

**Table 2B - Maximum total depth of decarburization, SI units**

Nominal Thickness Millimeters	Total Depth of Decarburization Millimeter
Up to 12.70, incl	0.38
Over 12.70 to 25.40, incl	0.64
Over 25.40	0.89

- 3.3.3.3 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the above limits by more than 0.005 inch (0.13 mm) and the width is 0.065 inch (1.65 mm) or less.
- 3.3.3.4 In the case of dispute, the total depth of decarburization determined using the microhardness traverse method shall govern.

### 3.3.4 Bending

Product 0.749 inch (19.02 mm) and under in nominal thickness shall be tested in accordance with ASTM E290 using a sample prepared nominally 0.75 inch (19.0 mm) in width with its axis of bending parallel to the direction of rolling and shall withstand without cracking when bending at room temperature through the angle and bend radius shown in Table 3. In case of dispute, the results of tests using the guided bend test of ASTM E290 shall govern.

**Table 3 - Bend angle requirements**

Nominal Thickness Inch	Nominal Thickness Millimeters	Bend Angle Degrees	Bend Radius $t = \text{nominal thickness}$
Up to 0.249, incl	Up to 6.32, incl	180	1/2t
Over 0.249 to 0.749, incl	Over 6.32 to 19.02, incl	90	1/2t

### 3.4 Quality

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.

- 3.4.1 Steel shall be aircraft-quality conforming to AMS2301.

### 3.5 Tolerances

Shall conform to all applicable requirements of AMS2252.

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer's tests and shall be responsible for the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.