

# AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard



AMS 6524D

Issued NOV 1970  
Revised SEP 1996

Superseding AMS 6524C

STEEL, SHEET, STRIP, AND PLATE  
1 0Cr - 7 5Ni - 4 5Co - 1 0Mo - 0 09V (0 29 - 0 34C)  
Consumable Electrode Vacuum Melted, Annealed

UNS K91313

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of September 1996. It is recommended, therefore, that this specification not be specified for new designs.

This cover sheet should be attached to the "C" 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.

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# AEROSPACE MATERIAL SPECIFICATION

**SAE**

**AMS 6524C**

Issued 1 NOV 1970  
Revised 1 OCT 1991  
Superseding AMS 65246

Submitted for recognition as an American National Standard

STEEL SHEET, STRIP, AND PLATE  
1 0Cr - 7 5Ni - 4 5Co - 1 0Mo - 0 09V (0 29 - 0 34C)  
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## 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

These products have been used typically for parts, such as pressure vessels, requiring through-hardening to high strength levels and where such parts may require welding during fabrication, 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.

REAFFIRMED  
MAY 1995

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## 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

AMS 2370 Quality Assurance Sampling and Testing of Carbon and Low-Alloy Steels, Wrought Products and Forging 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, Philadelphia, PA 19103-1187

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 338 Sharp-Notch Tension Testing of High-Strength Sheet Materials

ASTM E 350 Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron

ASTM E 399 Plane-Strain Fracture Toughness of Metallic Materials

## 2 3 U S Government Publications

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

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

## 3 TECHNICAL REQUIREMENTS

## 3 1 Composition

(R)

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

TABLE 1 - Composition

Element	min	max
Carbon	0.29	0.34
Manganese	0.10	0.35
Silicon	--	0.20
Phosphorus	--	0.01
Sulfur	--	0.01
Chromium	0.90	1.10
Nickel	7.00	8.00
Cobalt	4.25	4.75
Molybdenum	0.90	1.10
Vanadium	0.06	0.12
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, and descaled, having hardness not higher than 36 HRC, or equivalent

3 2 2 Plate Hot rolled annealed and descaled having hardness not higher than 36 HRC, or equivalent

3 2 3 When normalized and tempered product is ordered, hardness shall be not higher than 40 HRC, or equivalent

## 3 3 Properties

The product shall conform to the following requirements, tensile testing shall be performed in accordance with ASTM A 370

3 3 1 Macrostructure Visual examination of specimens, etched in hot hydrochloric acid in accordance with ASTM A 604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than standards agreed upon by purchaser and vendor.

3 3 2 Micro-Inclusion Rating No specimen shall exceed the limits of Table 2, (R) determined in accordance with ASTM E 45, Method D.

TABLE 2 - Micro-Inclusion Rating Limits

Type	A		A		B		B		C		C		D		D	
	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy	Thin	Heavy
Worst Field Severity	1	5	1	0	1	0	1	0	1	0	1	0	1	5	1	0
Worst Field Frequency	•	1			*		1		*		1		3		1	
Total Rateable Fields Frequency, maximum	**	1			**		1		**		1		8		1	

• Combined A + B + C, not more than 3 fields

\*\* Combined A + B + C, not more than 8 fields

3 3 2 1 A rateable field is defined as one which has a type A, B, C, or D inclusion rating of at least No 10 thin or heavy in accordance with the Jernkontoret Chart, Plate III, ASTM E 45.

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 Decarburization

3 3 4 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 4 2 Product 0.045 to 0.375 Inch (1.14 to 9.52 mm), Exclusive, in Nominal Thickness

3 3 4 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 1 1/2 x 4 inches (25 x 102 mm).

3 3 4 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 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, whichever 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 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 4 2 3 Allowance

3 3 4 2 3 1 Product 0 045 to 0 250 Inch (1 14 to 6 35 mm), Exclusive, 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 4 2 2 shall be not greater than 2 units on the Rockwell "A" Scale

3 3 4 2 3 2 Product 0 250 to 0 375 Inch (6 35 to 9 52 mm), Exclusive, 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 4 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 3

TABLE 3A - Decarburization, Maximum, Inches

Nominal Thickness	Depth of Decarburization
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 3B - Decarburization, Maximum, Millimeters

Nominal Thickness	Depth of Decarburization
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 5 Properties After Heat Treatment Product shall meet the following requirements after being normalized by heating to  $1650^{\circ}\text{F} \pm 25$  ( $899^{\circ}\text{C} \pm 14$ ), holding at heat for 1 hour per inch (25 mm) of maximum cross-section, and cooling in air to room temperature, hardened by heating to  $1550^{\circ}\text{F} \pm 25$  ( $843^{\circ}\text{C} \pm 14$ ), holding at heat for 1 hour per inch (25 mm) of maximum cross-section but not less than 1 hour, and quenching in oil or water, cooling to  $-100^{\circ}\text{F} \pm 10$  ( $-73^{\circ}\text{C} \pm 6$ ), holding at  $-100^{\circ}\text{F} \pm 10$  ( $-73^{\circ}\text{C} \pm 6$ ) for not less than 2 hours, warming to room temperature, and double tempered by heating to  $975^{\circ}\text{F} \pm 15$  ( $524^{\circ}\text{C} \pm 8$ ), holding at heat for 2 hours per inch (25 mm) of maximum cross-section but not less than 2 hours, cooling to approximately  $125^{\circ}\text{F}$  ( $52^{\circ}\text{C}$ ), reheating to  $975^{\circ}\text{F} \pm 15$  ( $524^{\circ}\text{C} \pm 8$ ), holding at heat for 2 hours per inch (25 mm) of maximum cross-section but not less than 2 hours, and cooling in air to room temperature

3 3 5 1 Tensile Properties Shall be as specified in Table 4

TABLE 4A - Tensile Properties

Nominal Thickness Inches	Tensile Strength ksi, min	Yield Strength at 0 2% Offset ksi, min	Elongation In 2 Inches or 4D %, min	Reduction of Area %, min
Up to 0 250, excl	220	185	6	--
0 250 and over	220	190	10	35

TABLE 4B - Tensile Properties (SI)

Nominal Thickness Millimeters	Tensile Strength MPa, min	Yield Strength at 0.2% Offset MPa, min	Elongation In 50.8 mm or 4D %, min	Reduction of Area %, min
Up to 6.35, excl	1517	1276	6	--
6.35 and over	1517	1310	10	35

3.3.5.2 Hardness Should be not lower than 46 HRC. or equivalent, but the product shall not be rejected on the basis of hardness if the tensile property requirements of 3.3.5.1 are met

3.3.5.3 Fracture Toughness When specified, the product shall be subjected to fracture toughness testing and the results reported. Sheet and strip shall be tested in accordance with ASTM E 338 and plate shall be tested in accordance with ASTM E 399. Acceptance standards 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. It shall be multiple melted using consumable electrode vacuum practice 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 (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 requirements of this specification.