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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 6345A

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Superseding AMS 6345

Steel, Sheet, Strip, and Plate
0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130)
Normalized or Otherwise Heat Treated

(Composition similar to 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:

These products have been used typically where welding and moderate tensile properties are required, but usage is not limited to such applications. Sheet and strip are extensively used where a minimum tensile strength of 180 ksi (1241 MPa) is required in sections up to 0.125 inch (3.18 mm) in nominal thickness and proportionately lower strength is required in heavier 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 canceled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

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	Steel Cleanliness, Aircraft Quality, Magnetic Particle Inspection Procedure
MAM 2301	Steel Cleanliness, Aircraft Quality, Magnetic Particle Inspection Procedure, Metric (SI) Measurement

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.1 (Continued):

AMS 2370 Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel 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, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM A 370 Mechanical Testing of Steel Products
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
ASTM E 384 Microindentation 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 E 350, 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 Check Analysis: Composition variations shall meet the applicable requirements of AMS 2259.

3.2 Condition:

The product shall be supplied in the following condition:

3.2.1 Sheet and Strip: Cold rolled, normalized or otherwise heat treated, and descaled if necessary, or hot rolled, normalized or otherwise heat treated, and descaled.

3.2.2 Plate: Hot rolled and normalized or otherwise heat treated.

3.3 Properties:

The product shall conform to the following requirements; hardness, tensile, and bend testing shall be performed in accordance with ASTM A 370.

3.3.1 Tensile Properties: The long-transverse tensile properties of the as-supplied product shall be as shown in Table 2 (See 8.2).

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

Thickness Inches	Tensile Strength ksi	Yield Strength 0.2% Offset ksi	Elongation in 2 inches or 4D Percent
Up to 0.062, excl	95	75	8
0.062 to 0.125, incl	95	75	10
Over 0.125 to 0.1874, incl	95	75	12
Over 0.1874 to 0.250, incl	90	70	15
Over 0.250 to 0.750, incl	90	70	16
Over 0.750 to 1.500, incl	90	70	18

TABLE 2B - Minimum Tensile Properties, SI Units

Thickness Millimeters	Tensile Strength MPa	Yield Strength 0.2% Offset MPa	Elongation in 50.8 mm or 4D Percent
Up to 1.57, excl	655	517	8
1.57 to 3.18, incl	655	517	10
Over 3.18 to 4.760, incl	655	517	12
Over 4.760 to 6.35, incl	621	483	15
Over 6.35 to 19.05, incl	621	483	16
Over 19.05 to 38.10, incl	621	483	18

3.3.2 Average Austenitic Grain Size: Shall be ASTM No. 5 or finer, determined in accordance with ASTM E 112.

3.3.3 Decarburization: Depending on thickness of the product, decarburization may be measured by a HR30N hardness step test method, or by the microhardness traverse method. Additionally, the metallographic method shall be used, in part (See 3.3.3.4.1), to inspect product 0.025 to 0.250 inch (0.64 to 6.35 mm) thick, and it may be used to inspect product with thickness 0.375 inch (9.52 mm) and over.

3.3.3.1 In the case of dispute, the microhardness method, conducted in accordance with ASTM E 384, shall govern. The allowance for decarburization shall be that which would have been applicable had the step method been used (See 3.3.3.4.1 or 3.3.3.5.1, as applicable).

3.3.3.2 Specimens: Shall be full thickness of the product except that specimens from plate 0.250 inch (6.35 mm) and over in nominal thickness may be slices approximately 0.250 inch (6.35 mm) thick cut parallel to and preserving one original surface of the plate. Recommended minimum specimen size is 1 x 4 inches (25 x 102 mm). For product 0.025 to 0.250 inch (0.64 to 6.35 mm), a full cross section metallographic sample shall be prepared to inspect for presence of complete decarburization (ferrite).

3.3.3.3 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.

3.3.3.4 Product 0.025 to 0.250 Inch (0.64 to 6.35 mm) Exclusive, in Nominal Thickness: Protective plating, if used to prevent any decarburization during hardening, shall be removed, and a portion of the specimen shall be ground with copious coolant to prevent thermal or mechanical effects to a depth of 0.050 inch (1.27 mm) or one-half thickness, whichever is less.

3.3.3.4.1 Allowance: The product shall show no layer of complete decarburization (ferrite) determined metallographically at a magnification not exceeding 100X. It shall also be free from any partial decarburization to the extent that the difference in hardness between the original surface and the surface (depth) generated by grinding as in 3.3.3.4 shall not be greater than two units on the HRA scale, or equivalent (See 8.3). Also, refer to 3.3.3.1.

3.3.3.5 Product 0.250 to 0.375 Inch (6.35 to 9.52 mm), Exclusive, in Nominal Thickness: Specimens shall be ground to remove 0.010 inch (0.25 mm) of metal to create a test reference surface, and a portion of the specimen shall be further ground to a depth of at least one-third the original thickness of the specimen.

3.3.3.5.1 Allowance: Shall be free from decarburization to the extent that the difference in hardness between the two prepared steps shall be not greater than three units in the HRA scale, or equivalent (See 8.3). Also, refer to 3.3.3.1.

3.3.3.6 Product 0.375 inch (9.52 mm) and Over in Nominal Thickness:

3.3.3.6.1 Allowance: The total depth of the decarburization, determined metallographically at a magnification not exceeding 100X, on the as-supplied plate, shall be not greater than that shown in Table 3. Also, refer to 3.3.3.1. The depth of decarburization shall be that which is defined as the perpendicular distance from the surface to the depth under that surface below which there is not further increase in hardness.

TABLE 3A - Maximum Decarburization, Inch/Pound Units

Nominal Thickness Inches	Total 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

TABLE 3B - Maximum Decarburization, SI Units

Nominal Thickness Millimeters	Total 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

3.3.4 Bending: Product shall withstand, without cracking, free bending at ambient temperature through the angle shown in Table 4, around a diameter equal to three times the nominal thickness of the product with axis of bend transverse to the direction of rolling.

TABLE 4 - Bending Parameters

Nominal Thickness Inch	Nominal Thickness Millimeters	Angle Degrees, minimum
Up to 0.090, excl	Up to 2.29, excl	180
0.090 to 0.1874, incl	2.29 to 4.760, incl	135
Over 0.1874 to 0.250, incl	Over 4.760 to 6.35, incl	90
Over 0.250 to 0.750, incl	Over 6.35 to 19.05, incl	90

3.3.5 Response to Heat Treatment:

3.3.5.1 Tensile Strength: Product, 0.249 inch (6.32 mm) and under in nominal thickness, shall have tensile strength not lower than 125 ksi (862 MPa) or equivalent hardness (See 8.3) after being hardened by quenching in oil from 1600 °F ± 10 (871 °C ± 6) and tempered for not less than 30 minutes at not lower than 900 °F (482 °C).

3.3.5.2 Hardness: Product shall develop the applicable minimum center hardness shown in Table 5, or equivalent (See 8.4), when hardened by quenching in oil from 1600 °F ± 10 (871 °C ± 6).

TABLE 5 - Minimum Hardness, As Quenched

Nominal Thickness Inches	Nominal Thickness Millimeters	Hardness HRC
Over 0.249 to 0.375, incl	Over 6.32 to 9.52, incl	42
Over 0.375 to 0.500, incl	Over 9.52 to 12.70, incl	38
Over 0.500 to 0.625, incl	Over 12.70 to 15.88, incl	32
Over 0.625 to 0.750, incl	Over 15.88 to 19.05, incl	29
Over 0.750 to 0.875, incl	Over 19.05 to 22.22, incl	27
Over 0.875 to 1.500, incl	Over 22.22 to 38.10, incl	26

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 AMS 2301 or MAM 2301.

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 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.

4.2 Classification of Tests:

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.