



400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION



AMS 6356E

Issued JAN 1962
Revised SEP 2001

Superseding AMS 6356D

Steel, Sheet, Strip, and Plate
0.95Cr - 0.20Mo - (0.30 - 0.35C)

(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 for heat treated parts and structures that may require welding during fabrication, but usage is not limited to such applications. Product, 0.375 inch (9.52 mm) and under in nominal thickness, may be through-hardened to a minimum tensile strength of 180 ksi (1241 MPa) and proportionately 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 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.

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

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SAE WEB ADDRESS:

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2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

| | |
|------------|--|
| ASTM A 255 | Determining the Hardenability of Steel |
| 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 | 0.30 | 0.35 |
| Manganese | 0.40 | 0.60 |
| Silicon | 0.15 | 0.50 |
| 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; 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 if necessary, and descaled; having hardness not higher than 95 HRB, or equivalent (See 8.2).

3.2.2 Plate: Hot rolled, annealed if necessary, and descaled, having hardness not higher than 95 HRB, or equivalent (See 8.2).

3.2.3 If product is ordered spheroidize annealed, the degree of spheroidization shall be as agreed upon by purchaser and vendor.

3.3 Properties:

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

3.3.1 Average Grain Size: Shall be ASTM No. 5 or finer determined in accordance with ASTM E 112 (See 8.3).

3.3.2 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 3.3.2.4.1) 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.

3.3.2.1 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 3.3.2.4.1 or 3.3.2.5.1 as applicable).

3.3.2.2 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 to 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).

3.3.2.3 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.

3.3.2.4 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.

3.3.2.4.1 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 3.3.2.4 shall not be greater than two units on the HRA scale or equivalent (see 8.2). Also, refer to 3.3.2.1.

3.3.2.5 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.

3.3.2.5.1 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 8.2). Also, refer to 3.3.2.1.

3.3.2.6 Product 0.375 Inch (9.52 mm) and Over in Nominal Thickness:

3.3.2.6.1 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 2. Also, refer to 3.3.2.1. 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 no further increase in hardness.

TABLE 2A - Maximum Decarburization Limits, 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 2B - Maximum Decarburization Limits, 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 |

3.3.3 Hardenability: Shall be J1/16 inch (1.6 mm) = 57 HRC maximum and J3/16 inch (4.8 mm) = 46 HRC minimum, determined on the standard end-quench test specimen in accordance with ASTM A 255 except that the steel shall be normalized at $1700^{\circ}\text{F} \pm 10$ ($927^{\circ}\text{C} \pm 6$) and the test specimen austenitized at $1600^{\circ}\text{F} \pm 10$ ($871^{\circ}\text{C} \pm 6$). (See 8.4).

3.3.4 Bending: Product 0.749 inch (19.02 mm) and under in nominal thickness shall withstand, without cracking, bending through the angle shown in Table 3 around a diameter equal to the nominal thickness of the product, with axis of bend parallel to the direction of rolling.

TABLE 3 - Bending Parameters

| Nominal Thickness Inch | Nominal Thickness Millimeters | Bend Angle Degrees |
|---------------------------|----------------------------------|-----------------------|
| Up to 0.249, incl | Up to 6.32, incl | 180 |
| Over 0.249 to 0.749, incl | Over 6.32 to 19.02, incl | 90 |

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 the specified requirements.

4.2 Classification of Tests:

All technical requirements of this specification 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.