AEROSPACE MATERIAL SPECIFICATION

AMS6356™	REV. K

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Revised 2024-12

Superseding AMS6356J

(R) Steel, Sheet, Strip, and Plate
0.95Cr - 0.20Mo - (0.30 - 0.35C) (SAE 4132),
Aircraft Quality
(Composition similar to UNS G41300)

RATIONALE

AMS6356 is the result of a Five-Year Review and update of the specification. The revision updates the title to reflect the quality, clarifies composition reporting (see 3.1.2), revises decarburization test requirements (see 3.3.2), updates hardenability (see 3.3.3), clarifies bending (see 3.3.4), addresses updates to AMS2301 (see 4.2.1, 4.4.1, and 4.4.3), and updates the exceptions requirements (see 4.4.2).

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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 can 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 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.

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

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

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AMS2301 Steel Cleanliness, Aircraft Quality, Magnetic Particle Inspection Procedure

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

AS7766 Terms Used in Aerospace Metals Specifications

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.

ASTM A255 Determining the Hardenability of Steel

ASTM A370 Mechanical Testing of Steel Products

ASTM A751 Chemical Analysis of Steel Products

ASTM E112 Determining Average Grain Size

ASTM E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

ASTM E290 Bend Testing of Material for Ductility

ASTM E1077 Estimating the Depth of Decarburization of Steel Specimens

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Composition shall conform to the percentages by weight shown in Table 1, determined in accordance with ASTM A751, by spectrochemical methods, or by other analytical methods acceptable to the 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 Aluminum, vanadium, and columbium (niobium) are optional grain refining elements and need not be determined or reported unless used to satisfy the average grain size requirements of 3.3.1.2.

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3.1.2 The producer may test for any element not listed in Table 1 and include this analysis in the report of 4.4. Reporting of any element not listed in the composition table is not a basis for rejection unless limits of acceptability are specified by the purchaser.

3.1.3 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 determined in accordance with ASTM A370:

3.2.1 Sheet and Strip

Sheet and strip shall be 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

Plate shall be hot rolled, annealed if necessary, and descaled, having hardness not higher than 95 HRB, or equivalent (see 8.2).

3.2.2.1 If allowed by the purchaser, cold 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 the purchaser and producer.

3.3 Properties

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

3.3.1 Average Grain Size

Average grain size shall be determined by either 3.3.1.1 or 3.3.1.2.

3.3.1.1 Average grain size shall be ASTM No. 5 or finer, determined in accordance with ASTM E112.

3.3.1.2 The product of a heat shall be considered to have an ASTM No. 5 or finer austenitic grain size if one or more of the following are determined by heat analysis (see 8.4):

- A total aluminum content of 0.020 to 0.050%.
- An acid soluble aluminum content of 0.015 to 0.050%.
- A vanadium content of 0.02 to 0.08%.
- A columbium (niobium) content of 0.02 to 0.05%.

3.3.2 Decarburization

Decarburization shall be evaluated by one of the two methods of 3.3.2.1 or 3.3.2.2.

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3.3.2.1 Metallographic (Microscopic) Method

A cross section taken perpendicular to the surface shall be prepared in accordance with ASTM E1077, etched, and visually examined metallographically at a magnification not to exceed 200X. The sample shall not show a layer of complete (ferrite) or partial decarburization exceeding the limits of Table 2.

3.3.2.2 Hardness Traverse (Microindentation) Method

The total depth of decarburization shall be determined by a traverse method using microindentation hardness testing in accordance with ASTM E1077. Samples shall be hardened in a protective atmosphere to prevent changes in surface carbon content. Samples may be tempered at the option of the producer. 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.

3.3.2.3 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the limits in Table 2 by more than 0.005 inch (0.13 mm) and the width is 0.065 inches (1.65 mm) or less.

3.3.2.4 In case of dispute, the total depth of decarburization determined using the microindentation hardness traverse method shall govern.

Table 2A - Maximum total depth of 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 total depth of 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

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3.3.3 Hardenability of Each Heat

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 A255 except that the steel shall be normalized at 1700 °F ± 10 °F (927 °C ± 6 °C) and the test specimen austenitized at 1600 °F ± 10 °F (871 °C ± 6 °C). Cast specimens do not need to be normalized.

3.3.4 Bending

Product 0.749 inch (19.02 mm) and under in nominal thickness shall be tested in accordance with ASTM E290. Testing shall be performed at room temperature. Bend requirements shall be in accordance with Table 3. When visually examined, the specimen shall exhibit no cracking. In case of dispute, the results of tests using the guided bend test of ASTM E290 shall govern.

Table 3 - Bend requirements

Nominal Thickness Inch	Nominal Thickness Millimeters	Bend Angle Degrees	Bend Radius(1)
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 min	1/2t

(1) Bend radius is defined as a bend factor multiplied by the nominal thickness (t).

3.4 Quality

The product, as received by the 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

Tolerances shall conform to all applicable requirements of AMS2252.

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.2.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The 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

4.2.1 Acceptance Tests

Composition (see 3.1), hardness (see 3.2), average grain size (see 3.3.1), decarburization (see 3.3.2), hardenability (see 3.3.3), bending (see 3.3.4), frequency and severity (see 3.4.1), and tolerances (see 3.5) are classified as acceptance tests and shall be performed on each heat or lot as applicable. If grain refining elements (see 3.3.1.2) are not present, the ASTM E112 grain size test (see 3.3.1.1) shall be conducted on each lot. If process qualification in accordance with AMS2301 has been met, the frequency-severity cleanliness rating shall be conducted on a periodic basis as defined in AMS2301.

4.2.2 Periodic Tests

If grain refining elements (see 3.3.1.2) are present, the ASTM E112 grain size test (see 3.3.1.1) shall be conducted on a periodic basis and shall be performed at a frequency selected by the producer (not to exceed 1 year) unless frequency of testing is specified by the purchaser.

4.3 Sampling and Testing

Sampling and testing shall be in accordance with AMS2370.

4.4 Reports

4.4.1 The producer of the product shall furnish with each shipment a report showing: the producer's identity; country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations); results of tests for composition, hardenability, and frequency-severity cleanliness rating (see 4.4.3) of each heat; and results of tests for condition and, if measured, average grain size of each lot. The report shall state that the product conforms to the other technical requirements and shall include the purchase order number, heat and lot numbers, AMS6356K, product form, size, and quantity. If the grain size requirement of 3.3.1.2 is met by the aluminum, vanadium, and/or columbium (niobium) content, the aluminum, vanadium, and/or columbium (niobium) content shall be reported and a statement that the chemistry satisfies the grain size requirement shall be included.

4.4.2 When material produced to this specification has exceptions taken to the technical requirements listed in Section 3, the report shall contain a statement "This material is certified as AMS6356K(EXC) because of the following exceptions:" and the specific exceptions shall be listed (see 5.1).

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