AEROSPACE MATERIAL SPECIFICATION

AMS6495™	REV. C

Issued 2009-10
Revised 2022-11

Superseding AMS6495B

Steel Bars, Forgings, Mechanical Tubing, and Forging Stock
1.0Cr - 2.50Ni - 2.0Mo - 1.10Si (0.10 - 0.20C)
Premium Aircraft-Quality
Electroslag Remelted or Consumable Electrode Vacuum Remelted
(Composition similar to UNS K51570)

RATIONALE

AMS6495C is the result of a Five-Year Review and update of the specification. The revision updates the title to match the scope, adds detail to applications (1.2), prohibits unauthorized exceptions (3.7, 4.4.4, 5.2.1.1), updates macrostructure requirements (3.4.1, 8.7), adds pyrometry control (3.4.3), adds strain rate to tensile tests (3.4.3.1), provides guidance on stock removal (8.4), and allows the use of prior revisions (8.6).

1. SCOPE

1.1 Form

This specification covers a premium aircraft-quality, low-alloy steel in the form of bars, forgings, mechanical tubing, and forging stock.

1.2 Application

These products have been used typically for carburized parts requiring a hardened case with a relatively strong core, reduced distortion and subject to stringent magnetic particle inspection standards, but usage is not limited to such applications.

1.3 Classification

Steel covered by this specification is classified by melting practice as follows:

Type 1 - Electroslag remelted (ESR)
Type 2 - Consumable electrode vacuum remelted (VAR)

1.3.1 Unless a specific type is ordered, either type may be supplied.

TO PLACE A DOCUMENT ORDER: **Tel: 877-606-7323 (inside USA and Canada)**
Tel: +1 724-776-4970 (outside USA)
Fax: 724-776-0790
Email: CustomerService@sae.org
SAE WEB ADDRESS: **http://www.sae.org**

For more information on this standard, visit
https://www.sae.org/standards/content/AMS6495C/

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.

AMS2251 Tolerances Low-Alloy Steel Bars

AMS2253 Tolerances Carbon and Alloy Steel Tubing

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

AMS2300 Steel Cleanliness, Premium Aircraft-Quality Magnetic Particle Inspection Procedure

AMS2370 Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Wrought Products and Forging Stock

AMS2372 Quality Assurance Sampling and Testing Carbon and Low-Alloy Steel Forgings

AMS2750 Pyrometry

AMS2806 Identification Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys

AMS2808 Identification Forgings

AS1182 Standard Stock Removal Allowance Aircraft-Quality and Premium Aircraft-Quality Steel Bars and Mechanical 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 A370 Mechanical Testing of Steel Products

ASTM A604 Macroetch Testing of Consumable Electrode Remelted Steel Bars and Billets

ASTM A751 Chemical Analysis of Steel Products

ASTM E112 Determining Average Grain Size

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

2.3 Definitions

Terms used in AMS are defined in AS7766.

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the following percentages by weight shown in Table 1, determined in accordance with ASTM A751 or by other analytical methods acceptable to purchaser.

Table 1 - Composition

Element	Min	Max
Carbon	0.10	0.20
Manganese	--	1.00
Silicon	0.90	1.30
Phosphorus	--	0.020
Sulfur	--	0.015
Chromium	0.80	1.20
Nickel	2.30	2.70
Molybdenum	1.70	2.20
Vanadium	--	0.50

3.1.1 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.

3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2259.

3.2 Melting Practice

Steel shall be multiple melted using either electroslag remelt practice (ESR) or vacuum arc consumable electrode practice (VAR) in the remelt cycle (see 1.3).

3.3 Condition

The product shall be supplied in the following condition; hardness and tensile strength shall be determined in accordance with ASTM A370:

3.3.1 Bars

Bar shall not be cut from plate (also see 4.4.2).

3.3.1.1 Bars 0.500 Inch (12.70 mm) and Under in Nominal Diameter or Least Distance Between Parallel Sides

Cold finished having tensile strength not higher than 138 ksi (950 MPa) or hardness not higher than 285 HB or equivalent (see 8.2).

3.3.1.2 Bars Over 0.500 Inch (12.70 mm) in Nominal Diameter or Least Distance Between Parallel Sides

Hot finished and annealed, unless otherwise ordered, having hardness not higher than 285 HB or equivalent (see 8.2). Bars ordered cold finished may have hardness as high as 310 HB or equivalent (see 8.2).

3.3.2 Forgings

As ordered.

3.3.3 Mechanical Tubing

Cold finished, unless otherwise ordered, having hardness not higher than 285 HB or equivalent (see 8.2). Tubing ordered hot finished and annealed or tempered shall have hardness not higher than 285 HB or equivalent (see 8.2).

3.3.4 Forging Stock

As ordered by the forging manufacturer.

3.4 Properties

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

3.4.1 Macrostructure

Visual examination of transverse full cross-sections from bars, billets, tube rounds, (solid not hollow) and forging stock, etched in hot hydrochloric acid in accordance with ASTM A604, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM A604 shown in Table 2.

Table 2 - Macrostructure limits

Class	Condition	Severity
1	Freckles	A
2	White Spots	A
3	Radial Segregation	B
4	Ring Pattern	B

3.4.1.1 Macrostructure examination is not required for bored/hollow forgings (including ring forgings) and mechanical tubing that is produced directly from ingots or large blooms unless otherwise agreed upon by purchaser and producer (see 8.7).

3.4.1.2 If mechanical tubing is produced directly from ingots or large blooms, transverse sections may be taken from the tubing. Macrostructure standards for such tubes shall be as agreed upon by purchaser and producer (see 8.7).

3.4.2 Average Grain Size of Bars, Mechanical Tubing and Forgings

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

3.4.3 Response to Heat Treatment

Specimens from product shall have the properties shown in Table 3 after being austenitized by heating to 1760 °F ± 25 °F (960 °C ± 14 °C), holding at heat for a time commensurate with section thickness, heating equipment, and procedure used, oil quenched to below 90 °F (32 °C) followed by tempering for 2 hours minimum at 570 °F ± 10 °F (299 °C ± 6 °C). Pyrometry shall be in accordance with AMS2750.

Table 3 - Minimum longitudinal mechanical properties

Property	Value
Tensile Strength	181 ksi (1250 MPa)
Yield Strength 0.2%	138 ksi (950 MPa)
Elongation in 4D	12%
Charpy V–Notch	52 ft-lb (70 J)

3.4.3.1 Unless otherwise specified, the strain rate shall be set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ±0.002 in/in/min (0.002 mm/mm/min) through 0.2% offset yield strain. After the yield strain, the speed of the testing machine shall be set between 0.05 and 0.5 in/in (0.05 and 0.5 mm/mm) of the length of the reduced section (or distance between the grips for specimens not having a reduced section) per minute. Alternatively, an extensometer and strain rate indicator may be used to set the strain rate between 0.05 and 0.5 in/in/min (0.05 and 0.5 mm/mm/min).

3.5 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.

3.5.1 Steel shall be premium aircraft-quality conforming to AMS2300.

3.5.2 Bars and mechanical tubing shall be free from seams, laps, tears, and cracks after removal of the standard stock removal allowance in accordance with AS1182.

3.5.3 Grain flow of die forgings, except in areas that contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of reentrant grain flow.

3.6 Tolerances

3.6.1 Bars

In accordance with AMS2251.

3.6.2 Mechanical Tubing

In accordance with AMS2253.

3.7 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.4.

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.

4.2 Classification of Tests

4.2.1 Acceptance Tests

Composition (3.1), condition (3.3), macrostructure (3.4.1), average grain size (3.4.2), response to heat treatment (3.4.3), and tolerances (3.6) are acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests

Frequency-severity cleanliness rating (3.5.1) and grain flow of die forgings (3.5.3) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing

4.3.1 Bars, Mechanical Tubing, and Forging Stock

In accordance with AMS2370.

4.3.2 Forgings

In accordance with AMS2372.

4.4 Reports

4.4.1 The producer of bars, forgings and mechanical tubing shall furnish with each shipment a report showing producer identity, country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations), the results of tests for composition, and macrostructure of each heat, and for condition, average grain size, and response to heat treatment of each lot, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS6495C, melt practice, product form and size or part number, and quantity. If forgings are supplied, the size and melt source of stock used to make the forgings shall also be included.

4.4.2 Report the nominal metallurgically worked cross sectional size and the cut size, if different (also see 3.3.1).

4.4.3 The producer of forging stock shall furnish with each shipment a report showing producer identity, country where the metal was melted (e.g., final melt in the case of metal processed by multiple melting operations) and the results of tests for composition, macrostructure, and frequency-severity rating of each heat and the results of any additional property requirements imposed by the purchase order (see 8.7). This report shall include the purchase order number, heat number, AMS6495C, size, and quantity.

4.4.4 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 AMS6495C(EXC) because of the following exceptions:" and the specific exceptions shall be listed (also see 5.2.1.1).

4.5 Resampling and Retesting

4.5.1 Bars, Mechanical Tubing, and Forging Stock

In accordance with AMS2370.

4.5.2 Forgings

In accordance with AMS2372.

5. PREPARATION FOR DELIVERY

5.1 Sizes

Except when exact lengths or multiples of exact lengths are ordered, straight bars and tubing will be acceptable in mill lengths of 6 to 20 feet (1.8 to 6.1 m) but not more than 10% of any shipment shall be supplied in lengths shorter than 10 feet (3 m).

5.2 Identification

5.2.1 Bars and Mechanical Tubing

In accordance with AMS2806.

5.2.1.1 When technical exceptions are taken (see 4.4.4), the material shall be identified with AMS6495C(EXC).