

AEROSPACE MATERIAL SPECIFICATION

SAE AMS-S-6758

REV. A

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Superseding AMS-S-6758

Steel, Chrome-Molybdenum (4130) Bars and
Reforging Stock (Aircraft Quality)

RATIONALE

AMS-S-6758A has been reaffirmed to comply with the SAE five-year review policy.

NONCURRENCY NOTICE

This specification has been declared "NONCURRENT" by the Aerospace Materials Division, SAE, as of September, 2003. It is recommended, therefore, that this specification not be specified for new designs.

"NONCURRENT" refers to those specifications that have been widely used and may be required on some existing designs in the future. The Aerospace Materials Division, however, does not recommend these specifications for future use in new designs. "NONCURRENT" specifications are available from SAE upon request.

Similar but not necessarily identical products are covered by the following specifications:

AMS 6346	Steel, Bars, 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130) Hardened and Tempered, 125 ksi (862 MPa) Tensile Strength
AMS 6348	Steel, Bars, 0.95Cr - 0.20Mo (0.28 - 0.33C) (SAE 4130) Normalized
AMS 6370	Steel, Bars, Forgings, and Rings, 0.95Cr - 0.20Mo (0.28 - 0.33C)
AMS 6528	Steel, Bars, 0.95Cr - 0.20Mo (0.28 - 0.33C) Special Aircraft-Quality, Normalized

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NOTICE

This document has been taken directly from U.S. Military Specification MIL-S-6758B and contains only minor editorial and format changes required to bring it into conformance with the publishing requirements of SAE technical standards. The initial release of this document is intended to replace MIL-S-6758B. Any part numbers established by the original specification remain unchanged.

The original Military Specification was adopted as an SAE standard under the provisions of the SAE Technical Standards Board (TSB) Rules and Regulations (TSB 001) pertaining to accelerated adoption of government specifications and standards. TSB rules provide for (a) the publication of portions of unrevised government specifications and standards without consensus voting at the SAE Committee level, and (b) the use of the existing government specification or standard format.

Under Department of Defense policies and procedures, any qualification requirements and associated qualified products lists are mandatory for DOD contracts. Any requirement relating to qualified products lists (QPL's) has not been adopted by SAE and is not part of this technical report.

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1. SCOPE:

1.1 Scope:

This specification covers chrome-molybdenum (4130) steel bars and forging stock of aircraft quality.

1.2 Classification:

The steel bars and rebar forging stock shall be as follows:

1.2.1 Physical condition: Materials shall be furnished in one of the following physical conditions, as specified (see 6.2c):

- a. As forged
- b. As rolled
- c. Annealed
- d. Normalized
- e. Normalized and tempered
- f. Hardened and tempered

1.2.2 Surface conditions: Materials shall be furnished in one of the following surface conditions, as specified (see 6.2c):

1. Black, as forged or rolled
2. Pickled or blast cleaned
3. Rough turned
4. Cold finished (drawn)
5. Turned, ground and polished

2. APPLICABLE DOCUMENTS:

The following publications, of the issues in effect on date of invitation for bids or request for proposal, form a part of this specification to the extent specified herein.

2.1 U.S. Government Publications:

Available from DODSSP Subscription Services Desk, Building 4D, 700 Robbins Avenue,
Philadelphia, PA 19111-5094.

MIL-STD-129 Marking for Shipment and Storage

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

FED-STD-183 Continuous Identification Marking of Iron and Steel Products

2.2 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

AMS 2251	Tolerances, Low-Alloy Steel Bars
AMS 2301	Aircraft Quality Steel Cleanliness, Magnetic Particle Inspection Procedure
AMS 2370	Quality Assurance Sampling and Testing Carbon and Low-Alloy Steel Wrought Products and Forging Stock

2.3 ASTM Publications:

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

ASTM A 255	End-Quench Test for Hardenability of Steel
ASTM A 700	Packaging, Marking and Loading Methods for Steel Products for Domestic Shipment
ASTM E 8	Test Methods of Tension Testing of Metallic Materials
ASTM E 10	Test Method for Brinell Hardness of Metallic Materials
ASTM E 18	Test Methods for Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E 112	Determining Average Grain Size
ASTM E 350	Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron
ASTM E 381	Macroetch Testing, Inspection, and Rating Steel Products Comprising Bars, Billets, Blooms, and Forgings
ASTM E 1077	Estimating the Depth of Decarburization of Steel Specimens

3. REQUIREMENTS:

3.1 Material:

3.1.1 Quality: The steel shall be of aircraft quality.

3.1.1.1 Cleanliness: When inspected magnetically in accordance with the procedures of AMS 2301, material shall not exceed the size and frequency rating limits specified in AMS 2301 (see 4.5).

3.1.2 Manufacturing process: The steel may be melted by one of the commercially acceptable types of melting including open hearth, basic oxygen or electric arc furnace. The steel may be ingot cast or continuous cast into billets. When ingot casting, sufficient discard shall be made to secure freedom from piping and undue segregation.

3.1.3 Physical/surface condition: Unless otherwise specified in the acquisition documents, (see 6.2c), bars 1.500 inches or less in diameter or thickness shall be furnished in conditions (C) (4), and bars over 1.500 inches in diameter or thickness shall be furnished in conditions (C) (2).

3.2 Chemical composition:

The chemical composition shall be within the limits specified in table I when tested in accordance with 4.6. The heat analysis shall conform to the column entitled "Analysis", and the semi-finished or finished product shall conform to the column entitled "Check analysis tolerance".

3.3 Hardenability:

The hardenability for all specified physical conditions shall be J5 = 34 HRC min, and J8 = 27 HRC min when tested in accordance with 4.7.

3.4 Grain size:

The austenitic grain size shall be predominately No. 5 or finer, with grains as large as No. 3 permissible when tested in accordance with 4.8.

3.5 Macrostructure:

Visual examination of transverse sections of stock in sizes up to and including 36 square inches shall be equal to or better than S-2, R-1, and C-2 of ASTM E 381; sizes over 36 square inches, up to and including 100 square inches, shall be equal to or better than S-2, R-2, and C-3 of ASTM E 381. In addition, the transverse sections shall show no pipe or cracks, and any porosity, segregations, inclusions, and other imperfections shall be no worse than the preceeding macrographs of ASTM E 381. Macroscopic examination of finished bars is required only if manufacturers inspection of the macrostructure at an earlier stage of processing such as forged bars, blooms or billets has not been accomplished (see 4.9).

3.6 Decarburization:

Unless otherwise specified (see 6.2f), when tested in accordance with 4.10, the depth of any decarburization shall be as follows:

- a. Materials furnished in surface conditions (2) and (4) shall not have decarburization greater than the limits in table II.
- b. Bars furnished in surface conditions (3) and (5) shall be free from decarburization.
- c. When bars are ordered for reforging purposes, or surface condition (1), any decarburization limits are waived.
- d. When determining the depth of decarburization, it is permissible to disregard local areas, provided the decarburization of such areas does not exceed the limits of table II by more than 0.005 inch and the width is 0.065 inch or less.

3.7 Hardness limits for conditions (C) and (E):

- a. The hardness for material in physical conditions (C) and (E) shall be no greater than Brinell 229 (or equivalent) when furnished in surface conditions (1), (2), (3), and (5), (see 4.11).
- b. The hardness for material in physical conditions (C) (E) shall be no greater than Brinell 241 (or equivalent) when furnished in surface condition (4) (see 4.11).

3.8 Tensile properties of condition (F) steel:

Unless otherwise specified (see 6.2.g), the mechanical properties of bar supplied in condition (F) in sizes up to and including 1.500 inches in diameter, or distance between parallel sides, shall be as specified in table III when tested in accordance with 4.12.

3.9 Identification of product:

Items shall be individually marked for identification in accordance with FED-STD-183, except that bar sizes less than 0.50 inch in diameter, or distance between parallel sides, shall be marked in like manner or bundled and identified by tags marked with the same identification code, the tags to be attached to each end of each bundle with an extra tag included in the bundle. The marking items shall include this specification number and the physical condition designator (see 1.2.1 and 4.4).

3.10 Tolerances:

The permissible variation in dimension of bars, produced in conformance with this specification, shall be as specified in AMS 2251 (see 4.4).

- 3.10.1 Mill lengths: When exact or multiple lengths are not ordered (see 6.2.h), bars will be acceptable in mill lengths of 6 to 20 feet, but not more than 10 percent of any order shall be furnished in lengths shorter than 10 feet.

3.11 Workmanship:

Material shall be sound, of uniform quality and condition, free from pipes, and shall not contain laps, cracks, twists, seams, or other defects detrimental to the fabrication or performance of parts (see 4.4).

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements (examinations and tests) as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in this specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance: All items shall meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of ensuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling inspection, as part of manufacturing operations, is an acceptable practice to ascertain conformance to requirements, however, this does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to accept defective material.

4.2 Classification of inspection:

The inspection requirements specified herein are classified as follows:

a. Quality conformance inspection (see 4.3).

4.3 Quality conformance inspection:

Quality conformance inspections shall consist of the examinations and tests specified in this specification. For each requirement specified in section 3, the corresponding test method of section 4 is shown in table IV.

4.3.1 Lot: The lot shall consist of all bars of the same size and configuration, physical condition, from the same heat, produced under the same processing conditions, and presented for inspection at one time.

4.3.2 Sampling: Sampling shall be as specified in each test method.

4.4 Visual examination:

Samples selected at random from each lot in accordance with table V shall be examined for compliance with identification of product (see 3.9), tolerances (see 3.10), and workmanship (see 3.11).

4.5 Cleanliness:

Specimens shall be selected, prepared, inspected, and rated in accordance with the procedures of AMS 2301 (see 3.1.1.1).

4.6 Chemical analysis:

4.6.1 Sampling: For the purpose of heat analysis, one sample shall be taken immediately before, or during, the pouring of a heat. When the finished or semi-finished product is a portion of a heat which was previously tested, and passed chemical analysis, then product check analysis is not required. If heat analysis was not performed, or if the sample was lost, then one sample shall be taken from semi-finished or finished product representing the lot.

- 4.6.1.1 Location: Samples for check chemical analysis shall be taken parallel to the axis of the bar selected, at a point midway between the center and surface, except that material less than 1.250 inches thick shall be sampled through the entire cross section. The sample shall consist of not less than 2 ounces of material.
- 4.6.2 Test method: Samples selected per 4.6.1 shall be tested in accordance with ASTM E 350, by spectrochemical methods, or other analytical methods acceptable to the purchaser. In the event of a dispute, the analysis shall be wet chemical methods in accordance with ASTM E 350. The analysis shall meet the limits specified in 3.2.
- 4.7 Hardenability:
- 4.7.1 Sampling: One or more samples for end-quench-hardness tests shall be selected from each heat of steel from which material is presented for acceptance. Cast, forged, or rolled samples are acceptable.
- 4.7.2 Test method: The end-quench-hardness test shall be performed in accordance with ASTM A 255. Test specimens shall be austenitized at $1600 \pm 10^{\circ}\text{F}$. The test results shall meet the limits specified in 3.3.
- 4.8 Grain size:
- 4.8.1 Sampling: One or more samples shall be selected to represent each lot of steel from which material is submitted for acceptance.
- 4.8.2 Test method: Specimens shall be sectioned and polished to the appropriate fineness by metallographic methods and suitably etched to reveal the grain structure. The polished area need not include more than 1 square inch of surface. The austenitic grain size shall be determined in accordance with ASTM E 112 and shall meet the requirements specified in 3.4.
- 4.9 Macrostructure:
- 4.9.1 Sampling: Samples for macrostructure rating shall be full cross-sectional specimens obtained from the billet, or rerolled product, representing the ingot or strand cast positions specified for heat qualification in AMS 2301. When ingot or strand cast billet location is not available, the lot shall be sampled on at least one end of 10 percent of the bars or billets.
- 4.9.2 Test method: The samples shall be etched using hot hydrochloric acid (160°F) in accordance with ASTM E 381 and shall meet the requirements specified in 3.5.
- 4.10 Decarburization:
- 4.10.1 Sampling: With the exception of material specifically ordered for re forging purposes or physical-surface condition (A) (1), one sample shall be selected from each lot.

4.10.2 Test method: The depth of hardness shall be determined using the microscopical or microhardness methods of ASTM E1077. In case of a dispute, the microhardness method shall be used by making a microhardness traverse at not less than X 250 magnification. The boundary of the decarburization shall be at the depth at which the hardness rises to 20 Knoop points (or equivalent) below the core hardness. The decarburization shall meet the limits specified in 3.6.

4.11 Hardness of bars in physical condition (C) and (E):

4.11.1 Sampling: At least five bars from each lot shall be tested to ascertain conformance with the permissible hardness values. When less than five bars are ordered, each bar shall be tested.

4.11.2 Test method: Hardness tests shall be conducted in accordance with ASTM E 10 or ASTM E 18, and shall meet the requirements specified in 3.7.

4.12 Tensile properties of steel in physical condition (F):

4.12.1 Sampling: For material furnished in condition (F), two tensile test samples shall be selected from bars from the same lot.

4.12.2 Specimen location: For bars up to 1.500 inches in diameter or thickness, the axis of the test specimen shall coincide with the central axis of the bar; for bars 1.500 inches and over, the axis shall be located midway between the center and surface of the bar. The axes of tensile test specimens shall be parallel to the direction of rolling or drawing.

4.12.3 Test method: The tensile test shall be conducted in accordance with ASTM E 8. Yield strength shall be determined by the offset or extension-under-load methods. The mechanical properties shall meet the requirements specified in 3.8.

4.13 Inspection of packaging:

The preservation, packing, and marking shall be inspected to verify conformance to the requirements of section 5.

4.14 Certified test reports:

Heats which have been tested and found to comply with the requirements of this specification shall be acceptable. Each shipment from these acceptable heats shall be acceptable. Each shipment from these acceptable heats shall be accompanied by test reports showing the results of tests for chemistry, hardenability, tensile properties, (condition F only), grain size, macrostructure, and magnetic particle frequency/severity ratings (see 6.3).

4.15 Resampling and retesting:

4.15.1 Chemical composition, cleanliness, macrostructure, and tensile properties: If the results of chemical composition, cleanliness, macrostructure and tensile properties do not conform to specified requirements, retest shall be permitted in accordance with the provisions specified in the resampling and retesting section of AMS 2370.

4.15.2 Visual examination: Lots rejected for identification of product (3.9), tolerances (3.10), and workmanship (3.11) discrepancies may be reinspected 100 percent at the discretion of the contractor.

5. PACKAGING:

5.1 Preservation and packing:

Preservation and packing shall be level A or commercial, as specified (see 6.2.1).

5.1.1 Level A: Bars shall be preserved and packed in accordance with MIL-STD-163. Bars in surface conditions 2 through 5 inclusive shall be coated with a type A preservative.

5.1.2 Commercial: Bars shall be preserved and packed in accordance with ASTM A 700.

5.2 Marking:

The exterior and interior containers shall be marked in accordance with MIL-STD-129. The nomenclature shall include the following:

Steels, Bars 4130

Cross-sectional shape and dimensions (as applicable)

Physical condition

Surface condition

Heat number

Quantity contained (as defined in contract)

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6. NOTES:

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use:

The material covered by this specification is intended for general use in the manufacture of parts and components hardened by heat treatment to tensile a strength of 180,000 psi or less. It is weldable by fusion methods. The hardenability and weldability of this material are considered equivalent to that of MIL-S-6050.

6.2 Acquisition requirements:

Acquisition documents must specify the following:

- a. Title, number and date of this specification, including amendments.
- b. Size and shape.
- c. Physical and surface conditions, when other than condition (C) (4) is desired for bars 1.500 inches or less, and when a condition other than (C) (2) is desired for bars over 1.500 inches.
- d. Whether bars are intended for reforging purposes.
- e. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1.1 and 2.2).
- f. Whether decarburization limits closer than those specified in 3.6 are desired.
- g. The tensile strength for physical condition (F) when sizes over 1.500 inches in least dimension are ordered, or whether tensile strengths, for physical condition (F), different than those specified in table III are desired.
- h. Exact lengths and length tolerances, if mill lengths are not acceptable (see 3.10.1).
- i. Applicable levels of preservation, packaging, and packing (see 5.1 and 5.2).
- j. Items of data required (see 6.3).

6.3 Data requirements:

The following Data Item Description (DID's) must be listed, as applicable, on the Contract Data Requirements List (DD Form 1423) when this specification is applied on a contract, in order to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

<u>Reference Paragraph</u>	<u>DID Number</u>	<u>DID Title</u>	<u>Suggested Tailoring</u>
4.14	DI-NDTI-80809A	Test/Inspection Reports	Use contractor format

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Subject term (key word) listing:

Annealed
Decarburization
Hardened
Macrostructure
Rods
Tempered