SAE Aerospace
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AEROSPACE MATERIAL SPECIFICATION

SAE AMS-S-6098A

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Cancelled JAN 2003

Steel, Chrome-Nickel-Molybdenum (8735) Bars and Reforging Stock (Aircraft Quality)

CANCELLATION NOTICE

This specification has been declared “CANCELLED” by the Aerospace Materials Division, SAE, as of January, 2003, and has been superseded by AMS 6320. The requirements of the latest issue of AMS 6320 shall be fulfilled whenever reference is made to the cancelled AMS-S-6098. By this action, this document will remain listed in the Numerical Section of the Index of Aerospace Material Specifications, noting that it has been superseded by AMS 6320.

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This document has been taken directly from Military Specification MIL-S-6098A, Notice 1, 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-6098A, Notice 1. 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 SAE technical document.

1. SCOPE:

1.1 Scope:

This specification covers steel bars and reforging stock of aircraft quality.

1.2 Classification:

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

(A) As forged
(B) As rolled
(C) Annealed
(D) Normalized
(E) Tempered
(F) Hardened and tempered

1.2.2 Surface Condition: Material shall be in one of the following physical conditions, as specified (see 6.2):

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

2. APPLICABLE DOCUMENTS:

The following publications, of the issue 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 SAE Publications:

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

AMS 2251	Tolerances, Alloy Steel Bars
AMS 2301	Aircraft Quality Steel Cleanliness--Magnetic Particle Inspection Procedure
AMS 2640	Magnetic Particle Inspection

2.2 U.S. Government Publications:

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

MIL-I-6868 Inspection Process, Magnetic Particle

FED-STD-151 Metals; Test Methods
FED-STD-183 Continuous Identification Marking of Iron and Steel Products

MIL-STD-163 Steel Mill Products, Preparation for Shipment and Storage
MIL-STD-430 Macrograph Standards for Steel Bars, Billets, and Blooms

3. REQUIREMENTS:

3.1 Material:

The steel shall be of aircraft quality. The material shall be magnetically inspected in accordance with the procedures of AMS 2301, and shall not exceed the size and frequency rating limits indicated in the paragraph entitled “Disposition” of AMS 2301 (see 4.4).

3.2 Chemical composition:

The chemical composition shall be as specified in table I.

TABLE I - Chemical composition

Element	Analysis (percent)	Check analysis tolerance 1/ (percent)
Carbon	0.33 - 0.38	±0.02
Manganese	0.75 - 1.00	±0.04
Phosphorus	0.025 (max)	+0.005
Sulfur	0.025 (max)	+0.005
Silicon	0.20 - 0.35	± 0.02
Nickel	0.40 - 0.70	± 0.03
Chromium	0.40 - 0.60	± 0.03
Molybdenum	0.20 - 0.30	± 0.03
Copper	0.35 (max)	+ 0.02

1/ Individual determinations may vary from the specified range to the extent shown in the check analysis column, except that elements in any heat shall not vary both above and below the specified range. For sizes over 100 square inches in cross-sectional area, the check analysis shall be negotiated.

3.3 Hardenability:

End-quench hardenability values for the steel in all specified conditions shall be Rockwell C-45 minimum at 5/16 inch and Rockwell C-35 minimum at 8/16 inch.

3.4 Grain size:

The austenitic grain size shall be predominately No. 5 or finer, with grains as large as No. 3 permissible.

3.5 Macrostructure:

Visual examination of deep-acid-etched reforging bars in sizes up to 36 square inches, inclusive, shall be equal to or better than S-2, R-1 and C-2 of MIL-STD-430. Bars in sizes over 36 to 100 square inches, inclusive, should be equal to or better than S-2, R-2 and C-3 of MIL-STD-430.

3.6 Decarburization:

Unless otherwise specified (see 6.2.2), the depth of decarburization of products in surface conditions (2) and (4) shall be not greater than the following limits:

Nominal diameter or distance between opposite faces (inches)	Maximum depth of decarburization (inches) 1/
Up to 0.375 incl.	0.010
Over 0.375 to 0.500 incl.	.012
Over 0.500 to 0.625 incl.	.014
Over 0.625 to 1.000 incl.	.017
Over 1.00 to 1.50 incl.	.020
Over 1.50 to 2.00 incl.	.025
Over 2.00 to 2.50 incl.	.030
Over 2.50 to 3.00 incl.	.035

1/ The value specified as the maximum depth of decarburization is the sum of the complete plus the partial decarburization.

3.6.1 When determining the depth of decarburization, it is permissible to disregard local areas provided the decarburization of such areas does not exceed the limits specified in 3.6 by more than 0.005 inch and the width is 0.065 inch or less.

3.6.2 Products furnished in surface conditions (3) and (5) shall be free from decarburization.

3.6.3 When material is intended for reforging purposes, the decaburization limits specified herein are waived.

3.7 Surface and physical condition:

Unless otherwise specified, bars 1-1/2 inches or less in diameter or thickness shall be furnished in condition (C)(4), and bars over 1-1/2 inches in diameter or thickness shall be furnished in condition (C)(2).

3.8 Hardness limits for condition (C) and (E) material:

3.8.1 The hardness for material in physical conditions (C) and (E) shall be not more than Brinell 229 (Rockwell C-21) when furnished in surface conditions (1), (2), or (3).

3.8.2 The hardness for material in physical conditions (C) and (E) shall be not more than Brinell 241 (Rockwell C-23) when furnished in surface condition (4).

3.9 Mechanical properties of condition (F) steel:

Unless otherwise specified, the mechanical properties of products supplied in condition (F) in sizes up to and including 1-1/2 inches in the least dimension shall be as specified in table II.

TABLE II - Mechanical properties of condition (F) steel

Tensile strength (min psi)	Yield strength at 0.2 percent offset or extension indicated		Elongation in 2 inches or 4 times diameter (min %)	Reduction of area (min %)
	(min psi)	Extension under load inches in 2 inches		
125,000	100,000	0.0107	17	55

3.9.1 When products in condition (F) are ordered with mechanical properties differing from those specified in table II or when products in condition (F) are ordered in sizes larger than 1-1/2 inches in the least dimension, the mechanical properties shall be as agreed upon between the supplier and the purchaser.

3.10 Identification of product:

Each bar shall be identified in accordance with FED-STD-183. The markings shall include the heat number of the metal and the number of this specification.

3.11 Tolerances:

Tolerances shall confirm to the limits of AMS 2251 applicable to hot rolled or cold rolled, respectively, alloy steel bars.

3.12 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.

3.12.1 Cold drawn bars: Cold drawn bars shall be free from scale or surface imperfections. Drawing shall be accomplished after all heat-treating operations have been completed; however, stress relieving may be accomplished after drawing.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for inspection:

Unless otherwise specified in the contract or purchase order, the supplier is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified, the supplier may utilize his own facilities or any commercial laboratory acceptable to the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.2 Quality conformance inspection:

All the examinations and tests of steel are classified as quality conformance inspection, for which necessary sampling techniques and methods of testing are specified in this section.

4.2.1 Inspection lot: An inspection lot shall consist of mill forms of one heat, condition, and size presented for acceptance at one time, and when heat treated, from the same process and the same batch.

4.3 Examination of product:

Samples selected in accordance with table III shall be examined for compliance with surface condition, identification, dimensional, and preparation for delivery requirements.

TABLE III - Sampling for examination of product

Lot size	Sample size	Acceptance number
1 to 15	All	0
16 to 180	15	0
181 to 300	35	0
301 to 500	50	1
Over 500	75	2

4.4 Magnetic inspection quality:

Specimens shall be selected and rated in accordance with the procedures of AMS 2301. Inspection shall be in accordance with MIL-I-6868 or AMS 2640.

4.5 Chemical analysis:

4.5.1 Sampling: At least one sample shall be selected to represent each heat of steel in accordance with FED-STD-151. The sample shall consist of not less than 2 ounces.

4.5.1.1 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 1-1/4 inches thick shall be sampled through the entire cross-section.

4.5.2 Analysis: Chemical analysis shall be by wet chemical or spectrochemical analysis in accordance with method 111 or 112, respectively, of FED-STD-151, or other analytical methods. In the event of dispute, analysis shall be by wet chemical methods.

4.6 Hardenability:

4.6.1 Sampling: One or more samples shall be selected from each heat of steel from which material is presented for acceptance. Cast, forged, or rolled samples are acceptable.

4.6.2 Preparation of specimens: Specimens for the end-quench-hardenability test shall conform to method 711, FED-STD-151. The steel shall be normalized prior to machining the test specimen by heating to 1600° ± 25°F, holding at this temperature for 1 hour and cooling in still air.

4.6.3 Test method: End-quench-hardenability tests shall be conducted in accordance with method 711 of FED-STD-151 to ensure compliance with 3.3. Specimens shall be austenitized at 1550° ± 25°F.

4.7 Grain size:

4.7.1 Sampling: One or more samples shall be selected to represent each heat of steel from which material is submitted for acceptance.

4.7.2 Test method: Specimens shall be sectioned and polished to appropriate fineness by metallographic methods and suitably etched to reveal the grain structure. The austenitic grain size shall be determined in accordance with procedure B, C, or D, method 311 of FED-STD-151.

4.8 Macrostructure:

4.8.1 Sampling: Two or more samples shall be selected to represent each heat of steel from which material is submitted for acceptance.