ADOPTION NOTICE

AMS 6407, "Steel, Bars, Forgings,and Tubing 1.2Cr-2.ONi -0.45Mo (0.27 - 0.33C)" was adopted on 17 January 1995 for use by the Department of Defense (DoD). Proposed changes by DoD activities must be submitted to the DoD Adopting Activity: AirForce, ASC/ENSI, Building 125, 2335 Seventh Street, Suite 6, Wright-Patterson AFB OH 45433-7809. DoDactivities may obtain copies of this standard from the Standardization Document Order Desk, 700 Robbins Avenue, Building 4D, Philadelphia, PA 19111-5094. The private sector and other Government agencies may purchase copies from the Society of Automotive Engineers Inc., 400 Commonwealth Drive, Wiarrendale, PA 15096-0001.

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AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 6407F

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Superseding AMS 6407E

STEEL, BARS, FORGINGS, AND TUBING
1.2Cr - 2.ONi - 0.45Mo (0.27 - 0.33C)

UNS K33020

1. SCOPE:

1.1 Form:

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

1.2 Application:

These products have been used primarily for parts requiring high tensile strength and hardness with good ductility and moderate impact strength, but usage is not limited to such applications.

2. APPLICABLE DOCUMENTS:

The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order.

2.1 SAE Publications:

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

AMS 2251	Tolerances, Low-Alloy Steel Bars
MAM 2251	Tolerances, Metric, Low-Alloy Steel Bars
AMS 2253	Tolerances, Carbon and Alloy Steel Tubing
MAM 2253	Tolerances, Metric, Carbon and Alloy Steel Tubing
AMS 2259	Chemical Check Analysis Limits, Wrought Low-Alloy and Carbon Steels
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
AMS 2372	Quality Assurance Sampling and Testing, Carbon and Low-Alloy Steel Forgings

2.1 (Continued)

AMS 2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat Resistant Steels and Alloys
AMS 2808 Identification, Forgings

AS1182 Standard Machining Allowance, Aircraft-Quality and Premium Aircraft-Quality Steel Bars and Mechanical Tubing

2.2 ASTM Publications:

Available from ASTM, 1916 Race Street, Philadelphia, PA 19103-1187.

ASTM A 255 End-Quench Test for Hardenability of Steel
ASTM A 370 Mechanical Testing of Steel Products
ASTM E 23 Notched Bar Impact Testing of Metallic Materials
ASTM E 112 Determining the Average Grain Size
ASTM E 350 Chemical Analysis of Carbon Steel, Low-Alloy Steel, Silicon Electrical Steel, Ingot Iron, and Wrought Iron
ASTM E 381 Macroetch Testing, Inspection, and Rating Steel Products, Comprising Bars, Billets, Blooms, and Forgings

2.3 U.S. Government Publications:

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

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

3. TECHNICAL REQUIREMENTS:

3.1 Composition:
(R)

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 350, by spectrochernical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	min	max
Carbon	0.27	0.33
Manganese	0.60	0.80
Silicon	0.40	0.70
Phosphorus	--	0.025
Sulfur	--	0.025
Chromium	1.00	1.35
Nickel	1.85	2.25
Molybdenum	0.35	0.55
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 and tensile strength shall be determined in accordance with ASTM A 370:

3.2.1 Bars:

3.2.1.1 Bars 0.500 Inch (12.70 mm) and Under in Nominal Diameter or Distance Between Parallel Sides: Cold finished having tensile strength not higher than 125 ksi (862 MPa).

3.2.1.2 Bars Over 0.500 Inch (12.70 mm) in Nominal Diameter or Distance Between Parallel Sides: Hot finished and annealed having hardness not higher than 241 HB, or equivalent, except that bars ordered cold finished may have hardness as high as 248 HB, or equivalent (See 8.2).

3.2.2 Forgings: As ordered.

3.2.3 Mechanical Tubing: Cold finished having hardness not higher than 25 HRC, or equivalent, except that tubing ordered hot finished and annealed shall have hardness not higher than 99 HRB, or equivalent (See 8.2).

3.2.4 Forging Stock: As ordered by the forging manufacturer.

3.3 Properties:

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

3.3.1 Macrostructure: Visual examination of transverse sections from bars, billets, tube rounds or tubes, and forging stock, etched in hot hydrochloric acid in accordance with ASTM E 381, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM E 381 shown in Table 2.

TABLE 2 - Macrostructure Limits

Cross-Sectional Area Square Inches	Cross-Sectional Area Square Centimeters	Macrographs
Up to 36, incl	Up to 232, incl	S2-R1-C2
Over 36 to 100, incl	Over 232 to 645, incl	S2-R2-C3

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

3.3.3 (R) Hardenability: Shall be J48=4 minimum and J47=20 minimum, determined on the standard end-quench test specimen in accordance with ASTM A 255 except that the steel shall be normalized at 1700 °F ±10 (927° C ±6) and the test specimen austenitized at 1600 °F ±10 (871 °C ±6).

3.3.4 Impact Strength: The Izod impact value shall be not less than 15 foot-pounds force (20 N·m), determined at room temperature in accordance with ASTM E 23 using a V-notched specimen as in 4.3.3. Specimens, before testing, shall have hardness not lower than 46 HRC after being quenched in oil from 1600 °F ±10 (871 °C ±6) and tempered at not lower than 400 °F (204 °C). Specimens, before heat treatment, shall be to size or approximately to size except for the notch.

3.3.5 Decarburization:

3.3.5.1 Bars and tubing ordered ground, turned, or polished shall be free from decarburization on the ground, turned, or polished surfaces.

3.3.5.2 Decarburization of bars to which 3.3.5.1 is not applicable shall be not greater than shown in Table 3.

TABLE 3A - Maximum Allowable Decarburization, Inch/Pound Units

Nominal Diameter or Distance Between Parallel Sides Inches	Depth of Decarburization Inch
Up to 0.375, incl	0.010
Over 0.375 to 0.500, incl	0.012
Over 0.500 to 0.625, incl	0.014
Over 0.625 to 1.000, incl	0.017
Over 1.000 to 1.500, incl	0.020
Over 1.500 to 2.000, incl	0.025
Over 2.000 to 2.500, incl	0.030
Over 2.500 to 3.000, incl	0.035
Over 3.000 to 4.000, incl	0.045

TABLE 3B - Maximum Allowable Decarburization, SI Units

Nominal Diameter or Distance Between Parallel Sides Millimeters	Depth of Decarburization Millimeters
Up to 9.52, incl	0.25
Over 9.52 to 12.70, incl	0.30
Over 12.70 to 15.88, incl	0.36
Over 15.88 to 25.40, incl	0.43
Over 25.40 to 38.10, incl	0.51
Over 38.10 to 50.80, incl	0.64
Over 50.80 to 63.50, incl	0.76
Over 63.50 to 76.20, incl	0.89
Over 76.20 to 101.60, incl	1.14

3.3.5.3 Decarburization of tubing to which 3.3.5.1 is not applicable shall be not greater than shown in Table 4.

TABLE 4A - Maximum Allowable Decarburization, Inch/Pound Units

Nominal Wall Thickness Inches	Depth of Decarburizaiton Inch ID	Depth of Decarburization Inch OD
Up to 0.109, incl	0.008	0.015
Over 0.109 to 0.203, incl	0.010	0.020
Over 0.203 to 0.400, incl	0.012	0.025
Over 0.400 to 0.600, incl	0.015	0.030
Over 0.600 to 1.000, incl	0.017	0.035
Over 1.000	0.020	0.040

TABLE 4B - Maximum Allowable Decarburization, SI Units

Nominal Wall Thickness Millimeters	Depth of Decarburizaiton Millimeters ID	Depth of Decarburization Millimeters OD
Up to 2.77, incl	0.20	0.38
Over 2.77 to 5.16, incl	0.25	0.51
Over 5.16 to 10.16,incl	0.30	0.64
Over 10.16 to 15.24, incl	0.38	0.76
Over 15.24 to 25.40, incl	0.43	0.89
Over 25.40	0.51	1.02

3.3.5.4 Decarburization shall be measured by the microscopic method or by HR30N scale or equivalent hardness testing method on hardened but untempered specimens protected during heat treatment to prevent changes in surface carbon content. Depth of decarburization, when measured by a hardness method, is defined as the perpendicular distance from the surface to the depth under that surface below which there is no further increase in hardness. Such measurements shall be far enough away from any adjacent surface to be uninfluenced by any decarburization or lack of decarburization thereon.

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

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.

3.4.2 Bars and tubing ordered hot rolled or cold drawn, or ground, turned, or polished, shall, after removal of the standard machining allowance in accordance with AS1182, be free from seams, laps, tears, and cracks open to the ground, turned, or polished surfaces.

3.4.3 Grain flow of die forgings, except in areas which contain flash-line end grain, shall follow the general contour of the forgings showing no evidence of re-entrant grain flow.

3.5 Tolerances:

Shall conform to all applicable requirements of the following:

3.5.1 Bars: In accordance with AMS 2251 or MAM 2251.

3.5.2 Mechanical Tubing: In accordance with AMS 2253 or MAM 2253.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection:

(R)

The vendor of the product shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to requirements of this specification.

4.2 Classification of Tests:

Tests for all technical requirements are acceptance tests and shall be performed on each heat or lot as applicable.

4.3 Sampling and Testing: Shall be as follows:

4.3.1 Bars, Mechanical Tubing, and Forging Stock: In accordance with AMS 2370.

4.3.2 Forgings: In accordance with AMS 2372.

4.3.3 Samples for impact testing (3.3.4) shall be taken longitudinally from sections rolled or forged from full cross-section or quarter-section to not over 2 inches (51 mm) round or square.

4.4 Reports:

The vendor of the product shall furnish with each shipment a report showing the results of tests for chemical composition, macrostructure, grain size, hardenability, impact strength, and frequency-severity cleanliness rating of each heat. This report shall include the purchase order number, lot number, AMS 6407F, size, and quantity. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.

4.5 Resampling and Retesting:

Shall be as follows:

4.5.1 Bars, Mechanical Tubing, and Forging Stock: in accordance with AMS 2370.

4.5.2 Forgings: In accordance with AMS 2372.

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:

Shall be as follows:

5.2.1 Bars and Mechanical Tubing: In accordance with AMS 2806.

5.2.2 Forgings: In accordance with AMS 2808.

5.2.3 Forging Stock: As agreed upon by purchaser and vendor.

5.3 Packaging:

5.3.1 Bars and tubing ordered cold drawn, cold rolled, ground, turned, or polished shall be coated with a suitable corrosion-preventive compound prior to shipment.