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SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
400 Commonwealth Dr., Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5632F

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Superseding AMS 5632E

STEEL BARS AND FORGINGS, CORROSION RESISTANT 17Cr - 0.50Mo (0.95 - 1.20C) (SAE 51440F) Free-Machining

UNS S44020 (Type I)
UNS S44023 (Type II)

1. SCOPE:

1.1 Form: This specification covers two types of corrosion-resistant steel in the form of bars, wire, forgings, and forging stock.

1.2 Application: Primarily for parts requiring resistance to both corrosion and wear with hardness up to 58 HRC, where the amount of machining warrants use of a free-machining steel.

1.3 Classification: The steel compositions covered by this specification are classified as follows:

Type I - 17Cr - 0.50Mo - 0.22S (0.95 - 1.20C)
Type II - 17Cr - 0.50Mo - 0.20Se (0.95 - 1.20C)

1.3.1 Unless a specific type is ordered, either Type I or Type II may be supplied.

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 documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

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2.1.1 Aerospace Material Specifications:

AMS 2241 - Tolerances, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium, and Titanium Alloy Bars and Wire
MAM 2241 - Tolerances, Metric, Corrosion and Heat Resistant Steel, Iron Alloy, Titanium and Titanium Alloy Bars and Wire
AMS 2248 - Chemical Check Analysis Limits, Wrought Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels, and Iron Alloys
AMS 2350 - Standards and Test Methods
AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Wrought Products Except Forgings and Forging Stock
AMS 2374 - Quality Assurance Sampling of Corrosion and Heat Resistant Steels and Alloys, Forgings and Forging Stock
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

2.1.2 Aerospace Standards:

AS1182 - Standard Machining Allowance, Aircraft Quality and Premium Quality Steel Products

2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

ASTM A370 - Mechanical Testing of Steel Products
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E381 - Macroetch Testing, Inspection, and Rating Steel Products Comprising Bars, Billets, Blooms, and Forgings

2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Military Standards:

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

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3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, Ø determined by wet chemical methods in accordance with ASTM E353, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

	Type I		Type II	
	min	max	min	max
Carbon	0.95 -	1.20	0.95 -	1.20
Manganese	--	1.25	--	1.25
Silicon	--	1.00	--	1.00
Phosphorus	--	0.040	--	0.040
Sulfur	0.10 -	0.35	--	0.030
Chromium	16.00 -	18.00	16.00 -	18.00
Molybdenum	0.40 -	0.60	0.40 -	0.60
Selenium	--	--	0.15 -	0.25
Nickel	--	0.75	--	0.75
Nitrogen	--	0.08	--	0.08
Copper	--	0.75	--	0.75
Tin	--	0.05	--	0.05

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2248.

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

3.2.1 Bars: Annealed having hardness not higher than 285 HB, or equivalent.

3.2.1.1 Bars 2.750 Inches (69.85 mm) and Under in Nominal Diameter or Distance Between Parallel Sides and All Hexagons: Cold finished. Round bars may be centerless ground.

3.2.1.2 Bars, Other Than Hexagons, Over 2.750 Inches (69.85 mm) in Nominal Diameter or Distance Between Parallel Sides: Hot finished.

3.2.2 Wire: Annealed and cold finished having tensile strength not higher than 140,000 psi (965 MPa).

3.2.3 Forgings: As ordered.

3.2.4 Forging Stock: As ordered by the forging manufacturer.

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

3.3.1 Macrostructure: Visual examination of transverse sections as in 4.3.3 from bars, billets, and forging stock, etched in accordance with ASTM E381, shall show no pipe or cracks. Porosity, segregation, inclusions, and other imperfections shall be no worse than the macrographs of ASTM E381 agreed upon by purchaser and vendor.

3.3.2 Decarburization:

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

3.3.2.2 Allowable decarburization of bars, wire, and billets ordered for forging or to specified microstructural requirements shall be as agreed upon by purchaser and vendor.

3.3.2.3 Decarburization of bars and wire to which 3.3.2.1 or 3.3.2.2 is not applicable shall be not greater than shown in Table I.

TABLE I

Nominal Diameter or Distance Between Parallel Sides Inches	Depth of Decarburization Inch
Up to 0.500, incl	0.015
Over 0.500 to 1.000, incl	0.020
Over 1.000 to 1.500, incl	0.025
Over 1.500 to 2.000, incl	0.030
Over 2.000 to 2.500, incl	0.035
Over 2.500 to 3.000, incl	0.040

TABLE II (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Depth of Decarburization Millimetres
Up to 12.70, incl	0.38
Over 12.70 to 25.40, incl	0.51
Over 25.40 to 38.10, incl	0.64
Over 38.10 to 50.80, incl	0.76
Over 50.80 to 63.50, incl	0.89
Over 63.50 to 76.20, incl	1.02

3.3.2.3.1 Limits for depth of decarburization of bars over 3.000 inches (76.20 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

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3.3.2.4 Decarburization shall be measured by the microscopic method or by Rockwell Superficial 30-N 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.

3.3.2.4.1 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.

3.3.3 Response to Heat Treatment: Product 0.375 inch (9.52 mm) and under in nominal cross-section and 0.375 inch ± 0.015 (9.52 mm ± 0.38) thick specimens cut from larger product shall have hardness not lower than 58 HRC or equivalent after being heated to 1875°F ± 10 (1024°C ± 6), held at heat for 30 minutes ± 3, and cooled in still air.

3.4 Quality: The product, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign material and, consistent with the type of steel involved, from imperfections detrimental to usage of the product.

3.4.1 Bars and wire ordered ground, turned, or polished shall be free from seams, laps, tears, and cracks open to the ground, turned, or polished surfaces.

3.4.2 Product ordered to surface conditions other than ground, turned, or polished shall, after removal of the standard machining allowance, be free from seams, laps, tears, cracks, and other defects exposed to the machined surfaces. Standard machining allowance shall be in accordance with AS1182.

3.4.3 Ø Forgings shall have substantially uniform macrostructure. Standards for acceptance shall be as agreed upon by purchaser and vendor.

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

3.6 Tolerances: Bars and wire shall conform to all applicable requirements of AMS 2241 or MAM 2241.

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4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests to determine conformance to requirements for composition (3.1), macrostructure (3.3.1), and response to heat treatment (3.3.3) are classified as acceptance tests and shall be performed on each heat or lot as applicable.

4.2.2 Periodic Tests: Tests to determine conformance to requirements for decarburization (3.3.2) are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling: Shall be in accordance with the following:

4.3.1 Bars and Wire: AMS 2371.

4.3.2 Forgings and Forging Stock: AMS 2374.

4.3.3 Samples for macrostructure rating (3.3.1) shall be full cross-sectional specimens obtained from the finished billet or suitable rerolled product representing the top and bottom of at least the first, middle, and last usable ingot of each heat.

4.4 Reports:

4.4.1 The vendor of bars, wire, and forgings shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and the results of tests on each lot to determine conformance to the other acceptance test requirements and, when performed, to the periodic test requirements of this specification. This report shall include the purchase order number, lot number, AMS 5632F, 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.

4.4.2 Ø The vendor of forging stock shall furnish with each shipment a report showing the results of tests for chemical composition of each heat. This report shall include the purchase order number, heat number, AMS 5632F, size, and quantity.

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