



400 Commonwealth Dr., Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

AMS 5620E

Issued 7-1-45
Revised 4-1-89

Superseding AMS 5620D

STEEL BARS AND FORGINGS, CORROSION AND MODERATE HEAT RESISTANT
13Cr (0.30 - 0.40C) (SAE 51420F)
Free-Machining

UNS S42020 (Type II)
S42023 (Type I)

1. SCOPE:

- 1.1 Form: This specification covers two types of corrosion and moderate heat resistant steel in the form of bars, wire, forgings, and forging stock.
- 1.2 Application: Primarily for parts on which the amount of machining warrants use of a free-machining grade of steel and requiring hardness within the range of 40 - 50 HRC with corrosion resistance and oxidation resistance up to 1000°F (538°C), but useful at the higher temperatures only when stresses are moderately low. Certain design and processing procedures may cause these products to become susceptible to stress-corrosion cracking. ARP1110 recommends practices to minimize such conditions.
- 1.3 Classification: The steel compositions covered by this specification are classified as follows:
- Type I - 13Cr - 0.26Se (0.30 - 0.40C)
Type II - 13Cr - 0.25S (0.30 - 0.40C)
- 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.

SAE Technical Board Rules provide that: "This report is published by SAE to advance the state of technical and engineering sciences. The use of this report is entirely voluntary, and its applicability and suitability for any particular use, including any particular infringement arising therefrom, is the sole responsibility of the user."

AMS documents are protected under United States and international copyright laws. Reproduction of these documents by any means is strictly prohibited without the written consent of the publisher.

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

2.1.3 Aerospace Recommended Practices:

- ARP1110 -- Minimizing Stress Corrosion Cracking in Heat Treatable Wrought Low Alloy and Martensitic Corrosion Resistant Steels

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

3. TECHNICAL REQUIREMENTS:

- 3.1 Composition: Shall conform to the following percentages by weight, 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	0.30	0.40	0.30	0.40
Manganese	--	1.25	--	1.25
Silicon	--	1.00	--	1.00
Phosphorus	--	0.060	--	0.060
Sulfur	--	0.030	0.15	0.35
Chromium	12.00	14.00	12.00	14.00
Selenium	0.18	0.35	--	--
Nickel	--	0.50	--	0.50
Molybdenum and/or Zirconium	--	0.60	--	0.60

- 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:

- 3.2.1.1 Bars Over 0.500 to 2.750 Inches (12.70 to 69.85 mm), Inclusive, in Nominal Diameter or Distance Between Parallel Sides and All Hexagons: Cold finished having hardness not higher than 241 HB, or equivalent.

- 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 having hardness not higher than 241 HB, or equivalent.

- 3.2.2 Wire: Cold finished having tensile strength not higher than 125,000 psi (862 MPa).

- 3.2.3 Forgings: As ordered.

- 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 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 imperfections such as 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 decarburination of bars, wire, and billets ordered for redrawing or 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 0.375, 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 I (SI)

Nominal Diameter or Distance Between Parallel Sides Millimetres	Depth of Decarburization Millimetres
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

- 3.3.2.3.1 Limits for depth of decarburization of bars over 4.000 inches (101.06 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor.

- 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 0.500 inch (12.70 mm) and under in nominal thickness and 0.500-inch $\pm$ 0.010 (12.70-mm $\pm$ 0.25) thick specimens cut from larger bars and forgings shall have hardness not lower than 50 HRC, or equivalent, after being heated to 1825°F $\pm$ 10 (996°C $\pm$ 6), held at heat for 25 - 30 minutes, and cooled in still air to room temperature.
- 3.4 Quality: The product, as received by purchaser, shall be uniform in quality and condition, sound, and, consistent with the type of steel involved, free from foreign materials and 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 imperfections exposed to the machined surfaces. Standard machining allowance shall be in accordance with AS1182.
- 3.4.3 Forgings shall have substantially uniform macrostructure. Standards for acceptance shall be as agreed upon by purchaser and vendor.
- 3.4.4 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.