

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard



AMS 5620F

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Superseding AMS 5620E

Steel, Corrosion and Heat Resistant, Bars, Wire, and Forgings 13Cr (0.30 - 0.40C) (SAE 51420F, 51420FSe) Free-Machining Grade

UNS S42020 (Type 2)
S42023 (Type 1)

1. SCOPE:

1.1 Form:

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

1.2 Application:

These products have been used typically 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 to 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, but usage is not limited to such applications. 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 1 - 13Cr - 0.26Se (0.30 - 0.40C)

Type 2 - 13Cr - 0.25S (0.30 - 0.40C)

1.3.1 Unless a specific type is ordered, either Type 1 or Type 2 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 publications shall be the issue in effect on the date of the purchase order.

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2.1 SAE Publications:

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

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, Corrosion and Heat Resistant Steels and Alloys, Maraging and Other Highly-Alloyed Steels and Iron Alloys
AMS 2371	Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steel and Alloy, Wrought Products and Forging Stock
AMS 2374	Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steel and Alloy Forgings
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
ARP1110	Minimizing Stress Corrosion Cracking in Wrought Forms of Steels and Corrosion Resistant Steels and Alloys

2.2 ASTM Publications:

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

ASTM A 370	Mechanical Testing of Steel Products
ASTM E 353	Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E 381	Macroetch Testing Steel Bars, Billets, Blooms, and Forgings

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 353, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

Element	Type 1 min	Type 1 max	Type 2 min	Type 2 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 A 370:

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 Least Distance Between Parallel Sides and All Hexagons: Cold finished having hardness not higher than 241 HB, or equivalent (See 8.2).

3.2.1.2 Bars, Other than Hexagons, Over 2.750 Inches (69.85 mm) in Nominal Diameter or Least Distance Between Parallel Sides: Hot finished having hardness not higher than 241 HB, or equivalent (See 8.2).

3.2.2 Wire: Cold finished having tensile strength not higher than 125 ksi (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 A 370:

- 3.3.1 Macrostructure: Visual examination of transverse full cross-sections from bars, billets, and forging stock, etched in hot hydrochloric acid in accordance with ASTM E 381, shall show no imperfections such as pipe or cracks.
- 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 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 2.

TABLE 2A - Maximum Decarburization Limits, 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 2B - Maximum Decarburization Limits, 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

3.3.2.4 Decarburization shall be measured by the microscopic method, by the HR30N scale hardness testing method or by the microhardness traverse method on a hardened but untempered specimen 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 decarburization on the adjacent surface. In case of dispute, the depth of decarburization determined using the microhardness traverse method shall govern.

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 (See 8.2), after being heated to 1825 °F \pm 10 (996 °C \pm 6), held at heat for 25 to 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 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 surface.

3.4.2 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:

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

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 the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests:

- 4.2.1 Acceptance Tests: Composition (3.1), hardness or tensile strength as received (3.2), macrostructure (3.3.1), decarburization (3.3.2), response to heat treatment (3.3.3), and tolerances (3.5) are acceptance tests and shall be performed on each heat or lot as applicable.
- 4.2.2 Periodic Tests: Grain flow of die forgings (3.4.2) is a periodic test and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.3 Sampling and Testing:

Shall be in accordance with the following:

- 4.3.1 Bars, Wire, and Forging Stock: In accordance with AMS 2371.
- 4.3.2 Forgings: In accordance with AMS 2374.

4.4 Reports:

The vendor of the product shall furnish with each shipment a report showing the results of tests for chemical composition of each heat and for hardness or tensile strength, macrostructure, and response to heat treatment of each lot, and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, heat and lot numbers, AMS 5620F, 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 in accordance with the following:

- 4.5.1 Bars and Forging Stock: In accordance with AMS 2371.
- 4.5.2 Forgings: In accordance with AMS 2374.

5. PREPARATION FOR DELIVERY:

5.1 Sizes:

Except when exact lengths or multiples of exact lengths are ordered, straight bars and wire 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).