Society of Automotive Engineers, Inc.
TWO PENNSYLVANIA PLAZA, NEW YORK, N.Y. 10001

AEROSPACE MATERIAL SPECIFICATION

AMS 5768F
Superseding AMS 5768E
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ALLOY BARS, FORGINGS, AND RINGS, CORROSION AND HEAT RESISTANT
21Cr - 20Ni - 20Co - 3.0Mo - 2.5W - 1.0(Cb+Ta) - 0.15N - 31Fe
Solution and Precipitation Heat Treated

1. SCOPE:

1.1 Form: This specification covers a corrosion and heat resistant iron-base alloy in the form of bars, wire, forgings, flash welded rings, and stock for forging, flash welded rings, or heading.

1.2 Application: Primarily for parts such as turbine rotors, shafts, blades, and bolts requiring high strength up to 1350° F (732° C) and oxidation resistance up to 1800° F (982° C).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from Society of Automotive Engineers, Inc., Two Pennsylvania Plaza, New York, New York 10001.

2.1.1 Aerospace Material Specifications:

AMS 2248 - Chemical Check Analysis Limits, Wrought Heat and Corrosion Resistant Steels and Alloys
AMS 2261 - Tolerances, Nickel, Nickel-Base, and Cobalt-Base Alloy Bars and Forging Stock
AMS 2350 - Standards and Test Methods
AMS 2371 - Quality Assurance Sampling of Corrosion and Heat Resistant Alloys, Wrought Products Except Forgings
AMS 2375 - Approval and Control of Critical Forgings
AMS 2808 - Identification, Forgings
AMS 7490 - Rings, Flash Welded, Corrosion and Heat Resistant Austenitic Steels and Austenitic-Type Alloys

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, Pennsylvania 19103.

ASTM E10 - Brinell Hardness of Metallic Materials
ASTM E139 - Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
ASTM E354 - Chemical Analysis of High Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel and Cobalt-Base Alloys

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

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E354, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other approved analytical methods:

	min	max
Carbon	0.08	0.16
Manganese	1.00	2.00
Silicon	--	1.00
Phosphorus	--	0.040
Sulfur	--	0.030
Chromium	20.00	22.50
Nickel	19.00	21.00
Cobalt	18.50	21.00
Molybdenum	2.50	3.50
Tungsten	2.00	3.00
Columbium + Tantalum	0.75	1.25
Nitrogen	0.10	0.20
Iron	remainder	

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:

3.2.1 Bars, Wire, Forgings and Flash Welded Rings: Solution and precipitation heat treated, and descaled.

3.2.1.1 Flash welded rings shall not be supplied unless specified or permitted on purchaser's part drawing. When supplied, they shall be manufactured in accordance with AMS 7490.

3.2.2 Stock for Forging, Flash Welded Rings, or Heading: As ordered by the forging, flash welded ring, or heading manufacturer.

3.3 Heat Treatment: Bars, wire, forgings, and flash welded rings shall be solution heat treated by heating to 2150° F ± 25 (1176.7° C ± 14), holding at heat for not less than 60 min., and quenching in water and precipitation heat treated by heating to 1500° F ± 25 (815.6° C ± 14), holding at heat for not less than 4 hr, and cooling in air.

3.4 Properties:

3.4.1 Bars, Wire, Forgings, and Flash Welded Rings: Shall conform to the requirements of 3.4.1.1 and shall be capable of meeting the requirements of 3.4.1.2.

3.4.1.1 Hardness: Shall be 192 - 241 HB or equivalent, determined in accordance with ASTM E10.

3.4.1.2 Stress-Rupture Test at 1350° F (732.2° C): A tensile specimen, maintained at 1350° F ± 3 (732.2° C ± 1.7) while a load sufficient to produce an initial axial stress of 32,000 psi (221 MPa) is applied continuously, shall not rupture in less than 23 hours. The test shall be continued to rupture without change of load. Elongation after rupture, measured at room temperature, shall be not less than 10% in 4D. Test shall be conducted in accordance with ASTM E139.

3.4.1.2.1 The test of 3.4.1.2 may be conducted using a load higher than required to produce an initial axial stress of 32,000 psi (221 MPa) but load shall not be changed while test is in progress. Time to rupture and elongation requirements shall be as specified in 3.4.1.2.

3.4.1.2.2 When permitted by purchaser, the test of 3.4.1.2 may be conducted using incremental loading. In such case the load required to produce an initial axial stress of 32,000 psi (221 MPa) shall be used to rupture or for 23 hr, whichever occurs first. After the 23 hr and at intervals of 8 - 16 hr, preferrably 8 - 10 hr thereafter, the stress shall be increased in increments of 2000 psi (13.8 MPa). Time to rupture and elongation requirements shall be as specified in 3.4.1.2.

3.4.2 Stock for Forging, Flash Welded Rings, or Heading: When a sample of stock is forged to a test coupon and solution and precipitation heat treated as in 3.3, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.1.1 and 3.4.1.2. If specimens taken from the stock after heat treatment as in 3.3 conform to the requirements of 3.4.1.1 and 3.4.1.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.5 Quality: The product shall be uniform in quality and condition, clean, sound, and free from foreign materials and from internal and external imperfections detrimental to fabrication or to performance of parts.

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

3.7 Tolerances: Tolerances for bars, wire, and forging stock shall conform to all applicable requirements of AMS 2261.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product shall supply all samples and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to perform such confirmatory testing as he deems necessary to assure that the product conforms to the requirements of this specification.

4.2 Classification of Tests:

4.2.1 Acceptance Tests: Tests of the product to determine conformance to composition (3.1) requirements, of bars, wire, forgings, and flash welded rings to determine conformance to hardness (3.4.1.1) requirements, and of bars, wire, and forging stock to determine conformance to tolerance (3.7) requirements are classified as acceptance or routine control tests.

4.2.2 Qualification Tests: Tests of bars, wire, forgings, and flash welded rings to determine conformance to stress-rupture test (3.4.1.2) requirements and of stock for forging, flash welded rings, or heading to demonstrate capability of developing required properties (3.4.2) are classified as qualification or periodic control tests.

4.3 Sampling: Bars, wire, flash welded rings, and stock for flash welded rings or heading shall be sampled in accordance with AMS 2371. Forgings and forging stock shall be sampled as agreed upon by purchaser and vendor.

4.4 Approval: When specified, approval and control of critical forgings shall be in accordance with AMS 2375.

4.5 Reports:

4.5.1 The vendor of the product shall furnish with each shipment three copies of a report of the results of tests for chemical composition of each heat in the shipment, the results of tests on each size from each heat to determine conformance to the hardness requirements, and a statement that the product conforms to the other technical requirements of this specification. This report shall include the purchase order number, heat number, material specification number and its revision letter, size, and quantity from each heat. If forgings are supplied, the part number and the size and melt source of stock used to make the forgings shall also be included.

4.5.2 The vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, material specification number and its revision letter, contractor or other direct supplier of material, part number, and quantity. When material for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of material to determine conformance to the requirements of this specification, and shall include in the report a statement that the material conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

4.6 Resampling and Retesting: If any specimen used in the above tests fails to meet the specified requirements, disposition of the product may be based on the results of testing three additional specimens for each original nonconforming specimen. Failure of any retest specimen to meet the specified requirements shall be cause for rejection of the product represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Identification: The product shall be identified as follows:

5.1.1 Bars and Wire:

5.1.1.1 Each straight bar and wire 0.500 in. (12.70 mm) and over in diameter or least width of flat surface shall be marked in a row of characters recurring at intervals not greater than 3 ft (914 mm) with AMS 5768F, heat number, and manufacturer's identification. The characters shall be of such size as to be clearly legible, shall be applied using a suitable marking fluid, and shall be capable of being removed in hot alkaline cleaning solution without rubbing. The markings shall have no deleterious effect on the material or its performance and shall be sufficiently stable to withstand normal handling.

5.1.1.2 Straight wire less than 0.500 in. (12.70 mm) in diameter or least width of flat surface shall be securely bundled and identified by a metal or plastic tag embossed with the purchase order number, AMS 5768F, heat number, nominal size, and manufacturer's identification and attached to each bundle or shall be boxed and the box marked with the same information.

5.1.1.3 Coiled bars and wire shall be securely bundled and identified by a metal or plastic tag embossed with the purchase order number, AMS 5768F, heat number, nominal size, and manufacturer's identification and attached to each coil or shall be boxed and the box marked with the same information.

5.1.2 Forgings: In accordance with AMS 2808.

5.1.3 Flash Welded Rings and Stock for Forging, Flash Welded Rings, or Heading: As agreed upon by purchaser and vendor.

5.2 Packaging: The product shall be prepared for shipment in accordance with commercial practice to assure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number and its revision letter in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Material not conforming to this specification or to authorized modifications will be subject to rejection.