

AEROSPACE  
MATERIAL  
SPECIFICATION

**AMS 5756C**  
Superseding AMS 5756B

Issued 6-30-60  
Revised 7-1-84

ALLOY BARS, FORGINGS, AND RINGS, CORROSION AND HEAT RESISTANT  
54Ni - 19Cr - 10Co - 10Mo - 2.6Ti - 1.0Al - 0.006B  
Vacuum Melted, Solution Heat Treated UNS N07252

1. SCOPE:

- 1.1 Form: This specification covers a corrosion and heat resistant nickel alloy in the form of bars, 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 1500°F (815°C) and oxidation resistance up to 1800°F (980°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 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 2261 - Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars and Forging Stock
- MAM 2261 - Tolerances, Metric, Nickel, Nickel Alloy, and Cobalt Alloy Bars and Forging Stock
- AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel Alloys and Cobalt 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 2375 - Control of Forgings Requiring First Article Approval
- AMS 2806 - Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Heat and Corrosion Resistant Steels and Alloys
- 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, PA 19103.

- ASTM E8 - Tension Testing of Metallic Materials
- ASTM E10 - Brinell Hardness of Metallic Materials
- ASTM E112 - Determining Average Grain Size
- ASTM E139 - Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials
- ASTM E292 - Conducting Time-for-Rupture Notch Tension Tests of Materials
- ASTM E354 - Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

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

### 2.3.1 Federal Standards:

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

### 2.3.2 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 E354, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

|            | min   | - | max       |
|------------|-------|---|-----------|
| Carbon     | 0.10  | - | 0.20      |
| Manganese  | --    |   | 0.75      |
| Silicon    | --    |   | 0.75      |
| Phosphorus | --    |   | 0.015     |
| Sulfur     | --    |   | 0.015     |
| Chromium   | 18.00 | - | 20.00     |
| Cobalt     | 9.00  | - | 11.00     |
| Molybdenum | 9.00  | - | 11.00     |
| Titanium   | 2.25  | - | 3.00      |
| Aluminum   | 0.75  | - | 1.30      |
| Boron      | 0.003 | - | 0.010     |
| Iron       | --    |   | 5.00      |
| Nickel     |       |   | remainder |

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2269.

3.2 Condition: The product shall be supplied in the following condition:

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

3.2.1.1 Bars shall be hot finished; round bars shall be ground or turned except  $\emptyset$  that bars under 0.50 in. (12.5 mm) in nominal diameter shall be cold drawn when so ordered.

3.2.1.2 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, forgings, and flash welded rings shall be solution heat treated by heating to  $1950^{\circ}\text{F} \pm 25$  ( $1065^{\circ}\text{C} \pm 15$ ), holding at heat for 4 hr  $\pm 0.5$ , and quenching in oil, water, or air.

3.4 Properties: The product shall conform to the following requirements:

3.4.1 Bars, Forgings, and Flash Welded Rings:

## 3.4.1.1 As Solution Heat Treated:

3.4.1.1.1 Grain Size: Shall be predominantly 3 or finer with occasional grains as large as 1 permissible, determined by comparison of a polished and etched specimen with the chart in ASTM E112.

3.4.1.2 After Precipitation Heat Treatment: Product 3.250 in. (81.25 mm) and under in nominal diameter or distance between parallel sides shall meet the requirements of 3.4.1.2.1, 3.4.1.2.2, and 3.4.1.2.3 after being precipitation heat treated by heating to  $1400^{\circ}\text{F} \pm 25$  ( $760^{\circ}\text{C} \pm 15$ ), holding at heat for  $15 \text{ hr} \pm 0.5$ , and cooling in air; properties of product over 3.250 in. (81.25 mm) in nominal diameter or distance between parallel sides shall be as agreed upon by purchaser and vendor:

3.4.1.2.1 Tensile Properties: Shall be as follows, determined in accordance with ASTM E8 on specimens in either the longitudinal or transverse direction except that testing in the transverse direction applies only to product from which a tensile specimen not less than 2.50 in. (62.5 mm) in length can be obtained; testing in the longitudinal direction is not required on product tested in the transverse direction:

|                                    |                        |
|------------------------------------|------------------------|
| Tensile Strength, min              | 165,000 psi (1140 MPa) |
| Yield Strength at 0.2% Offset, min | 110,000 psi ( 760 MPa) |
| Elongation in 4D, min              | 15%                    |
| Reduction of Area, min             | 18%                    |

3.4.1.2.1.1 When tensile specimens are machined from the center area of disc and hub forgings and this area lies within a 4 in. (100 mm) radius or 25% of the forging radius, whichever is the smaller dimension, elongation may be as low as 10% and reduction of area as low as 12%.

3.4.1.2.2 Hardness: Should be 321 - 363 HB, or equivalent, determined in accordance with ASTM E10 but the product shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.4.1.2.3 Stress-Rupture Properties at 1500°F (815°C): Shall be as follows; testing of notched specimens and of combination smooth-and-notched specimens shall be performed in accordance with ASTM E292 and of smooth specimens in accordance with ASTM E139:

3.4.1.2.3.1 A combination smooth-and-notched specimen, machined to the dimensions shown in Fig. 1 and Table I, maintained at  $1500^{\circ}\text{F} \pm 3$  ( $815^{\circ}\text{C} \pm 2$ ) while a load sufficient to produce an initial axial stress of 40,000 psi (275 MPa) is applied continuously, shall not rupture in less than 25 hours. The test shall be continued to rupture without change of load. Rupture shall occur in the smooth section; if rupture occurs in the notched section, the product is not acceptable. Elongation of the smooth section after rupture, measured at room temperature, shall be reported.

- 3.4.1.2.3.2 As an alternate procedure, separate smooth and notched specimens, machined from adjacent sections of the same piece with gage sections conforming to the respective dimensions of Table I, may be tested individually under the conditions of 3.4.1.2.3.1. The smooth specimen shall not rupture in less than 25 hr and elongation after rupture, measured at room temperature, shall be reported. The notched specimen shall not rupture in less time than the companion smooth specimen but need not be tested to rupture.
- 3.4.1.2.3.3 The tests of 3.4.1.2.3.1 and 3.4.1.2.3.2 may be conducted using a load higher than required to produce an initial axial stress of 40,000 psi (275 MPa) but load shall not be changed while test is in progress. Time to rupture, rupture location, and elongation requirements shall be as specified in 3.4.1.2.3.1 and 3.4.1.2.3.2.
- 3.4.1.2.3.4 When permitted by purchaser, the tests of 3.4.1.2.3.1 and 3.4.1.2.3.2 may be conducted using incremental loading. In such case, the load required to produce an initial axial stress of 40,000 psi (275 MPa) shall be used to rupture or for 25 hr, whichever occurs first. After the 25 hr and at intervals of 8 - 16 hr, preferably 8 - 10 hr, thereafter, the stress shall be increased in increments of 5000 psi (35 MPa). Time to rupture, rupture location, and elongation requirements shall be as specified in 3.4.1.2.3.1 and 3.4.1.2.3.2.
- 3.4.2 Forging Stock: When a sample of stock is forged to a test coupon and heat treated as in 3.3 and 3.4.1.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.4.1.2.1, 3.4.1.2.2, and 3.4.1.2.3. If specimens taken from the stock after heat treatment as in 3.3 and 3.4.1.2 conform to the requirements of 3.4.1.2.1, 3.4.1.2.2, and 3.4.1.2.3, the tests shall be accepted as equivalent to tests of a forged coupon.
- 3.4.3 Stock for Flash Welded Rings or Heading: Specimens taken from the stock after heat treatment as in 3.3 and 3.4.1.2 shall conform to the requirements of 3.4.1.2.1, 3.4.1.2.2, and 3.4.1.2.3.
- 3.5 Quality:
- 3.5.1 Alloy shall be produced by vacuum induction melting or by double vacuum melting.
- 3.5.2 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.
- 3.5.2.1 Except in areas of forgings which contain end grain, the grain flow shall follow the general contour of the forging showing no evidence of re-entrant flow. Standards for acceptance shall be as agreed upon by purchaser and vendor.

- 3.6 Sizes: Except when exact lengths or multiples of exact lengths are ordered, ∅ straight bars will be acceptable in mill lengths of 6 - 24 ft (2 - 7.5 m) but not more than 25% of any shipment shall be supplied in lengths of 6 - 9 ft (2 - 3 m) except that for bars weighing over 25 lb per ft (37 kg/m), short lengths down to 2 ft (600 mm) may be supplied.
- 3.7 Tolerances: Unless otherwise specified, tolerances for bars and forging stock shall conform to all applicable requirements of AMS 2261 or MAM 2261.

#### 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 4.5. 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 the following ∅ requirements are classified as acceptance tests and shall be performed on each heat or lot as applicable:

4.2.1.1 Composition (3.1) of each heat.

4.2.1.2 Grain size (3.4.1.1.1) of each lot of bars, forgings, and flash welded rings as solution heat treated.

4.2.1.3 Tensile properties (3.4.1.2.1), hardness (3.4.1.2.2), and stress-rupture properties (3.4.1.2.3) of each lot of bars, forgings, and flash welded rings after precipitation heat treatment.

4.2.1.4 Tolerances (3.7) of bars and forging stock.

4.2.2 Periodic Tests: Tests of forging stock (3.4.2) and of stock for flash ∅ welded rings or heading (3.4.3) to demonstrate ability to develop required properties are classified as periodic tests and shall be performed at a frequency selected by the vendor unless frequency of testing is specified by purchaser.

4.2.3 Preproduction Tests: Tests of forgings to determine conformance to all ∅ applicable technical requirements of this specification when AMS 2375 is specified are classified as preproduction tests and shall be performed prior to or on the first-article shipment of a forging to a purchaser, when a change in material or processing requires reapproval as in 4.4, and when purchaser deems confirmatory testing to be required.

- 4.2.3.1 For direct U.S. Military procurement of forgings, substantiating test data and, when requested, preproduction forgings shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.
- 4.3 Sampling: Shall be in accordance with the following; a heat shall be the  
∅ consumable electrode remelted ingots produced from alloy originally melted as a single furnace charge or the ingots produced from a single vacuum induction melt:
- 4.3.1 Bars, Flash Welded Rings, and Stock for Flash Welded Rings or Heading:  
AMS 2371.
- 4.3.2 Forgings and Forging Stock: AMS 2374.
- 4.3.2.1 Specimens for tensile and stress-rupture tests of forgings shall be taken  
∅ from any plane perpendicular to the axis of the forging with axis of specimen in the selected plane perpendicular to a radius. Size, location, and number of specimens shall be as agreed upon by purchaser and vendor.
- 4.4 Approval: When specified, approval and control of forgings shall be in accordance with AMS 2375.
- 4.5 Reports:
- 4.5.1 The vendor of the product 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 of this specification. This report shall include the purchase order number, heat number, AMS 5756C, 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 a report showing the purchase order number, AMS 5756C, 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 either a statement that the material conforms or copies of laboratory reports showing the results of tests to determine conformance.
- 4.6 Resampling and Retesting: Shall be in accordance with the following:
- 4.6.1 Bars, Flash Welded Rings, and Stock for Flash Welded Rings or Heading:  
AMS 2371.

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4.6.2 Forgings and Forging Stock: AMS 2374.

## 5. PREPARATION FOR DELIVERY:

5.1 Identification: The product shall be identified as follows:

5.1.1 Bars: In accordance with AMS 2806.

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:

5.2.1 The product shall be prepared for shipment in accordance with commercial practice and in compliance with applicable rules and regulations pertaining to the handling, packaging, and transportation of the product to ensure carrier acceptance and safe delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

5.2.2 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-163, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.2.1 will be acceptable if it meets the requirements of Level C.

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 modifications authorized by purchaser will be subject to rejection.

## 8. NOTES:

8.1 Marginal Indicia: The phi ( $\phi$ ) symbol is used to indicate technical changes from the previous issue of this specification.

8.2 Dimensions and properties in inch/pound units and the Fahrenheit temperatures are primary; dimensions and properties in SI units and the Celsius temperatures are shown as the approximate equivalents of the primary units and are presented only for information.

8.3 For direct U.S. Military procurement, purchase documents should specify not less than the following:

Title, number, and date of this specification  
Form and size or part number of product desired  
Quantity of product desired  
Standards for acceptance of grain flow of forgings  
(See 3.5.2.1)  
Applicable level of packaging (See 5.2.2)