

# AEROSPACE MATERIAL SPECIFICATION



AMS 5667K

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Superseding AMS 5667J

Nickel Alloy, Corrosion and Heat Resistant, Bars, Forgings, and Rings  
72Ni - 15.5Cr - 0.95Cb - 2.5Ti - 0.70Al - 7.0Fe  
Equalized, Precipitation Hardenable

UNS N07750

## 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:

These products have been used typically for parts, such as bolts and turbine rotors, requiring high strength in the range of 800 to 1100 °F (427 to 593 °C), but usage is not limited to such applications.

## 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.

### 2.1 SAE Publications:

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

|          |                                                                                                                                           |
|----------|-------------------------------------------------------------------------------------------------------------------------------------------|
| AMS 2261 | Tolerances, Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire                                                                   |
| MAM 2261 | Tolerances, Metric, Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire                                                           |
| AMS 2269 | Chemical Check Analysis Limits, Nickel, Nickel Alloys, and Cobalt Alloys                                                                  |
| AMS 2371 | Quality Assurance Sampling and Testing, Corrosion and Heat Resistant Steels and Alloys, 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                                                                                                                  |
| AMS 7490 | Rings, Flash Welded, Corrosion and Heat Resistant Austenitic Steels and Austenitic-Type Alloys, or Precipitation Hardenable Alloys        |

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## 2.2 ASTM Publications:

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

ASTM E 8 Tension Testing of Metallic Materials  
 ASTM E 8M Tension Testing of Metallic Materials (Metric)  
 ASTM E 10 Brinell Hardness of Metallic Materials  
 ASTM E 354 Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

## 2.3 U.S. Government Publications:

Available from DODSSP, Subscription Services Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.

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

## 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 354, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

| Element         | min   | max   |
|-----------------|-------|-------|
| Carbon          | --    | 0.08  |
| Manganese       | --    | 1.00  |
| Silicon         | --    | 0.50  |
| Sulfur          | --    | 0.01  |
| Chromium        | 14.00 | 17.00 |
| Nickel + Cobalt | 70.00 | --    |
| Columbium       | 0.70  | 1.20  |
| Titanium        | 2.25  | 2.75  |
| Aluminum        | 0.40  | 1.00  |
| Iron            | 5.00  | 9.00  |
| Cobalt (3.1.1)  | --    | 1.00  |
| Tantalum        | --    | 0.05  |
| (3.1.1)         | --    | 0.50  |
| Copper          |       |       |

3.1.1 Determination not required for routine acceptance.

3.1.2 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: Hot finished and equalized.

3.2.1.1 Round bars shall be ground or turned except that bars under 0.50 inch (12.7 mm) in nominal diameter, when so ordered, shall be cold drawn.

#### 3.2.2 Forgings and Flash Welded Rings: Equalized.

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

3.2.3 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 equalized by heating to  $1625^{\circ}\text{F} \pm 25$  ( $885^{\circ}\text{C} \pm 14$ ), holding at heat for  $24 \text{ hours} \pm 0.5$ , and cooling in 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 Hardness After Equalization Heat Treatment: Shall be not higher than 302 HB, or equivalent (See 8.2), determined in accordance with ASTM E 10.

3.4.1.2 After Precipitation Heat Treatment: The product shall have the following properties after being precipitation heat treated by heating to  $1300^{\circ}\text{F} \pm 25$  ( $704^{\circ}\text{C} \pm 14$ ), holding at heat for  $20 \text{ hours} \pm 1$ , and cooling in air to room temperature.

3.4.1.2.1 Tensile Properties: Shall be as specified in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M. Requirements apply in both the longitudinal and transverse directions but tests in the transverse direction need be made only on product from which a specimen not less than 2.50 inches (63.5 mm) in length can be obtained. Tests in the longitudinal direction are not required on product tested in the transverse direction.

TABLE 2A - Minimum Tensile Properties, Inch/Pound Units

| Nominal Diameter or<br>Distance Between<br>Parallel Sides<br>Inches | Tensile<br>Strength<br>ksi | Yield Strength<br>at 0.2% Offset<br>ksi | Elongation<br>in 4D<br>% | Reduction<br>of Area<br>% |
|---------------------------------------------------------------------|----------------------------|-----------------------------------------|--------------------------|---------------------------|
| Up to 4.0, excl                                                     | 165                        | 105                                     | 20                       | 25                        |
| 4.0 to 10.0, incl                                                   | 160                        | 100                                     | 15                       | 17                        |

TABLE 2B - Minimum Tensile Properties, SI Units

| Nominal Diameter or<br>Distance Between<br>Parallel Sides<br>Millimeters | Tensile<br>Strength<br>MPa | Yield Strength<br>at 0.2% Offset<br>MPa | Elongation<br>in 4D<br>% | Reduction<br>of Area<br>% |
|--------------------------------------------------------------------------|----------------------------|-----------------------------------------|--------------------------|---------------------------|
| Up to 102, excl                                                          | 1138                       | 724                                     | 20                       | 25                        |
| 102 to 254, incl                                                         | 1103                       | 689                                     | 15                       | 17                        |

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-inch (102-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: Shall be 302 to 363 HB, or equivalent (See 8.2), determined in accordance with ASTM E 10. Product shall not be rejected on the basis of hardness if the tensile properties of 3.4.1.2.1, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness, are acceptable.

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 and 3.4.1.2.2. 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 and 3.4.1.2.2, 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 and 3.4.1.2.2.

### 3.5 Quality:

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.

3.5.1 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.

### 3.6 Tolerances:

Bars 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 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: The following requirements are 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 Hardness (3.4.1.1) of each lot of bars, forgings, and flash welded rings as equalization heat treated.

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

4.2.1.4 Tolerances of bars (3.6).

4.2.2 Periodic Tests: Tests of forging stock (3.4.2) and stock for flash welded rings and heading (3.4.3) to demonstrate ability to develop required properties and grain flow of die forgings (3.5.1) are periodic tests 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 as follows:

4.3.1 Bars, Flash Welded Rings, and Stock for Forging, Flash Welded Rings, or Heading: In accordance with AMS 2371.

4.3.2 Forgings: In accordance with AMS 2374.