SAE The Engineering Society For Advancing Mobility Land Sea Air and Space®
INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

# AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

SAE AMS 4676D

Issued JAN 1964
Revised MAR 1996

Superseding AMS 4676C

## NICKEL-COPPER ALLOY, CORROSION RESISTANT, BARS AND FORGINGS
## 66.5Ni - 3.0Al - 0.62Ti - 28Cu
## Hot-Finished, Precipitation Hardenable

UNS N05500



1. SCOPE:

1.1 Form:

This specification covers a corrosion-resistant nickel-copper alloy in the form of bars, forgings, and forging stock.

1.2 Application:

These products have been used typically for parts requiring a combination of moderate strength, resistance to corrosion, and low magnetic permeability, 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, Corrosion and Heat Resistant Steels and Alloys |
| AMS 2808 | Identification, Forgings |

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 76 Chemical Analysis of Nickel-Copper 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:

(R)

Shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E 76, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

TABLE 1 - Composition

| Element | min | max |
|---|---|---|
| Nickel | 63.00 | 70.00 |
| Aluminum | 2.00 | 4.00 |
| Titanium | 0.25 | 1.00 |
| Iron | -- | 2.00 |
| Manganese | -- | 1.50 |
| Silicon | -- | 1.00 |
| Cobalt (3.1.1) | -- | 1.00 |
| Carbon | -- | 0.25 |
| Zinc (3.1.1) | -- | 0.02 |
| Phosphorus (3.1.1) | -- | 0.02 |
| Sulfur | -- | 0.010 |
| Tin (3.1.1) | -- | 0.006 |
| Lead (3.1.1) | -- | 0.006 |
| Copper | remainder | |

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 and Forgings: Hot finished.

3.2.1.1 Surface finish of bars shall be as ordered.

3.2.2 Forging Stock: As ordered by the forging manufacturer.

3.3 Properties:

The product shall conform to the following requirements:

3.3.1 Bars and Forgings:

3.3.1.1 As Hot-Finished:

3.3.1.1.1 Hardness: Shall be not higher than 248 HB, or equivalent (See 8.2), determined in accordance with ASTM E 10.

3.3.1.2 (R) After Precipitation Heat Treatment: The product shall conform to the following requirements after being precipitation heat treated by heating to 1100 to 1125 °F (593 to 607 °C), holding at heat for 8 to 16 hours, and furnace cooling at a rate of 15 to 25 F (8 to 14 C) degrees per hour to 900 °F (482 °C). Cooling from 900 °F (482 °C) may be accomplished without regard to cooling rate. As an alternate method, the precipitation heat treatment may be done by heating to 1100 °F (607 °C), holding at heat up to 16 hours, and furnace cooling in steps of 100 F (56 C) degrees to 1000 °F (538 °C), holding at heat for approximately 6 hours, furnace cooling to 900 °F (482 °C), holding at heat for approximately 8 hours, and air cooling to room temperature.

3.3.1.2.1 Tensile Properties: Shall be as shown in Table 2, determined in accordance with ASTM E 8 or ASTM E 8M.



TABLE 2 - Minimum Tensile Properties

| Property | Value |
|---|---|
| Tensile Strength | 140 ksi (965 MPa) |
| Yield Strength at 0.2% Offset | 100 ksi (689 MPa) |
| Elongation in 4D | 20% (3.3.1.2.1.1) |

3.3.1.2.1.1 Round bars over 4.25 inches (108 mm) in diameter and over 12 feet (3.7 m) in length may have elongation as low as 17%.

3.3.1.2.2 (R) Hardness: Shall be not lower than 262 HB, or equivalent (See 8.2), determined in accordance with ASTM E 10, but the product shall not be rejected on the basis of hardness if the tensile property requirements are met.

3.3.2 Forging Stock: When a sample of stock is forged to a test coupon, and heat treated as in 3.3.1.2, specimens taken from the heat treated coupon shall conform to the requirements of 3.3.1.2.1 and 3.3.1.2.2. If specimens taken from the stock and heat treated as in 3.3.1.2 conform to the requirements of 3.3.1.2.1 and 3.3.1.2.2, the tests shall be accepted as equivalent to tests of a forged coupon.

3.4 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.

3.4.1 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.

3.5 Tolerances:

(R) Bars shall confor m 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 (3.3.1.1.1) of each lot of bars and forgings as hot finished.

4.2.1.3 Tensile properties (3.3.1.2.1) and hardness (3.3.1.2.2) of each lot of bars and forgings after precipitation heat treatment.

4.2.1.4 (R) Tolerances (3.5) of bars.