



# AEROSPACE MATERIAL SPECIFICATION

**AMS4676™****REV. F**

Issued 1964-01  
Revised 2017-01  
Reaffirmed 2022-02

Superseding AMS4676E

Nickel-Copper Alloy, Corrosion-Resistant, Bars and Forgings  
66.5Ni - 3.0Al - 0.62Ti - 28Cu  
Hot-Finished, Precipitation Hardenable

(Composition similar to UNS N05500)

## RATIONALE

AMS4676F revises Composition (3.1), Condition (3.2.2), and Reports (4.4), and is a Five-Year Review and update of this specification.

### 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 issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

#### 2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), [www.sae.org](http://www.sae.org).

AMS2261 Tolerances Nickel, Nickel Alloy, and Cobalt Alloy Bars, Rods, and Wire

AMS2269 Chemical Check Analysis Limits Nickel, Nickel Alloys, and Cobalt Alloys

AMS2371 Quality Assurance Sampling and Testing Corrosion and Heat-Resistant Steels and Alloys Wrought Products and Forging Stock

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|         |                                                                                                                                         |
|---------|-----------------------------------------------------------------------------------------------------------------------------------------|
| AMS2374 | Quality Assurance Sampling and Testing Corrosion and Heat-Resistant Steel and Alloy Forgings                                            |
| AMS2806 | Identification Bars, Wire, Mechanical Tubing, and Extrusions Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys |
| AMS2808 | Identification Forgings                                                                                                                 |
| ARP1917 | Clarification of Terms Used in Aerospace Metals Specifications                                                                          |

## 2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, [www.astm.org](http://www.astm.org).

|             |                                                                                                                                                                                              |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| ASTM E8/E8M | Tension Testing of Metallic Materials                                                                                                                                                        |
| ASTM E10    | Brinell Hardness of Metallic Materials                                                                                                                                                       |
| ASTM E140   | Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness Rockwell Hardness |
| ASTM E1473  | Chemical Analysis of Nickel, Cobalt, and High-Temperature Alloys                                                                                                                             |

## 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 E1473, by spectrochemical methods, or by other analytical methods acceptable to purchaser.

**Table 1 – Composition**

| Element            | Min       | Max   |
|--------------------|-----------|-------|
| Carbon             | --        | 0.25  |
| Manganese          | --        | 1.50  |
| Silicon            | --        | 1.00  |
| Phosphorus (3.1.1) | --        | 0.02  |
| Sulfur             | --        | 0.010 |
| Copper             | 27.00     | 33.00 |
| Aluminum           | 2.00      | 4.00  |
| Titanium           | 0.25      | 1.00  |
| Iron               | --        | 2.00  |
| Zinc (3.1.1)       | --        | 0.02  |
| Tin (3.1.1)        | --        | 0.006 |
| Lead (3.1.1)       | --        | 0.006 |
| Nickel             | remainder |       |

3.1.1 Determination not required for routine acceptance.

#### 3.1.2 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

### 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 Bars shall not be cut from plate (also see 4.4.1).

### 3.2.3 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 E10.

#### 3.3.1.2 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) 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) 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 cooling to room temperature at a rate equivalent to air cooling.

##### 3.3.1.2.1 Tensile Properties

Shall be as shown in Table 2, determined in accordance with ASTM E8/E8M.

**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 Hardness

Shall be not lower than 262 HB, or equivalent (see 8.2), determined in accordance with ASTM E10. Product shall not be rejected on the basis of hardness if the tensile property requirements are acceptable, determined on specimens taken from the same sample as that with nonconforming hardness or from another sample with similar nonconforming hardness.

### 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 reentrant grain flow.

### 3.5 Tolerances

#### 3.5.1 Bars

Shall conform to all applicable requirements of AMS2261.

#### 3.5.2 Forging Stock

Shall be as agreed upon by purchaser and producer.

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1 Responsibility for Inspection

The producer of the product shall supply all samples for producer'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 Tolerances (3.5) of bars.

#### 4.2.2 Periodic Tests

Tests of forging stock (3.3.2) to demonstrate ability to develop required properties and of grain flow of die forgings (3.4.1) are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.