# AEROSPACE MATERIAL SPECIFICATION

| AMS4893™ | REV. D |
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Issued 1959-01
Revised 2017-08
Reaffirmed 2022-05

Superseding AMS4893C

# Alloy Castings, Corrosion- and Heat-Resistant 66Ni - 29Cu - 4.0Si Solution Treated

(Composition similar to UNS N04019)

RATIONALE

AMS4893D revises composition (3.1) to replace a withdrawn chemical analysis standard, radiographic acceptance (3.7.4.1), quality (3.7.5.1), reports (4.5), and control factors (4.4.2.1), and results from a Five-Year Review and update of this specification.

AMS4893D has been reaffirmed to comply with the SAE Five-Year Review policy.

## 1. SCOPE

### 1.1 Form

This specification covers a nickel-copper alloy in the form of castings.

### 1.2 Application

These castings have been used typically for parts requiring resistance to wear and galling under light-to-medium loads against dissimilar materials of higher hardness, and retention of hot hardness up to 1000 °F (538 °C), and where improved machinability or grinding over that of as-cast material is desired, 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.

AMS2175 Castings, Classification and Inspection of

AMS2694 In-Process Welding of Aerospace Castings

AMS2750 Pyrometry





**TO PLACE A DOCUMENT ORDER:** **Tel: 877-606-7323 (inside USA and Canada)**
**Tel: +1 724-776-4970 (outside USA)**
**Fax: 724-776-0790**
**Email: CustomerService@sae.org**
**SAE WEB ADDRESS:** **http://www.sae.org**

**For more information on this standard, visit**
https://www.sae.org/standards/content/AMS4893D/

AMS2804 Identification, Castings

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.

ASTM E10 Brinell Hardness of Metallic Materials

ASTM E76 Chemical Analysis of Nickel-Copper Alloys

ASTM E140 Hardness Conversion Tables for Metals Relationship Among Brinell Hardness, Vickers Hardness, Rockwell Hardness, Superficial Hardness, Knoop Hardness, Scleroscope Hardness, and Leeb Hardness

ASTM E272 Reference Radiographs for High-Strength Copper-Base and Nickel-Copper Alloy Castings

ASTM E478 Chemical Analysis of Copper Alloys

ASTM E1417/E1417M Liquid Penetrant Testing

ASTM E1742E1742M Radiographic Examination

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 E478, by spectrochemical methods or by other analytical methods acceptable to purchaser.

***Table 1 - Composition***

| Element | Min | Max |
|---|---|---|
| Nickel | 60.0 | -- |
| Copper | 27.0 | 31.0 |
| Silicon | 3.5 | 4.5 |
| Iron | -- | 2.5 |
| Manganese | -- | 1.5 |
| Cobalt | -- | 1.0 |
| Carbon | -- | 0.25 |
| Sulfur | -- | 0.015 |



3.2 Condition

Solution heat treated (see 3.5).

3.2.1 Centrifugal Castings

Shall be rough turned and bored.

3.2.2 Sand Castings

Solid round bars shall be rough turned.

3.3 Casting

Castings shall be produced in lots from metal conforming to 3.1. A lot shall be all castings produced from one furnace melt or crucible melt. When two or more furnace melts or crucible melts or combination thereof are used to charge a ladle for pouring, the castings therefrom shall constitute a lot. A lot shall be not more than 2000 pounds (907 kg) of castings.

3.4 Chemical Analysis Specimens

Shall be cast from each melt and shall be of any convenient size, shape, and form. When chemical analysis specimens are required by purchaser, specimens shall be cast to a size, shape, and form agreed upon by purchaser and producer.

3.5 Heat Treatment

Castings shall be solution heat treated by heating from 1600 °F to 1650 °F (871 °C to 899 °C), holding at heat for 1 hour per inch (25 mm) of thickness for sections 1 inch (25 mm) and under plus an additional 1 hour per inch (25 mm) of cross section over 1 inch (25 mm), rapid furnace cooling to or transferring to another furnace held at 1200 °F to 1300 °F (649 °C to 704 °C), holding at heat for 30 minutes or until uniform temperature has been attained, and quenching in low-sulfur oil. For complicated sections, parts should be charged into a furnace which is at a temperature not higher than 600 °F (316 °C). Pyrometry shall be in accordance with AMS2750.

3.6 Response to Heat Treatment

Castings shall conform to the following requirements:

3.6.1 Hardness as Solution Heat Treated

Shall be not higher than 269 HB or equivalent (see 8.4) determined in accordance with ASTM E10.

3.6.2 Hardness after Precipitation Heat Treatment

Shall be not lower than 302 HB, or equivalent, determined in accordance with ASTM E10, after being precipitation heat treated by heating to 1100 °F ± 25 °F (593 °C ± 14 °C), holding at heat for 4 to 6 hours, and air or furnace cooling.

3.7 Quality

3.7.1 Castings, 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 castings.

3.7.1.1 Castings shall have smooth surfaces and shall be sufficiently cleaned to permit fluorescent penetrant inspection. Metallic shot or grit shall not be used for final cleaning.

3.7.2 Castings shall be produced under radiographic control. This control shall consist of radiographic examination of castings in accordance with ASTM E1742 until proper foundry technique, which will produce castings free from harmful internal imperfections, is established for each part number and of production castings as necessary to ensure maintenance of satisfactory quality.

3.7.3 Castings, when specified, shall be subjected to fluorescent penetrant inspection in accordance with ASTM E1417 or other inspection procedure designated by purchaser.

3.7.4 Acceptance standards for radiographic, fluorescent penetrant, and other quality standards shall be as agreed upon by purchaser and producer. AMS2175 may be used to specify acceptance standards (casting grade) and frequency of inspection (casting class).

3.7.4.1 When acceptance standards are not specified, castings shall meet Grade C of AMS2175 and radiographic indications of gas holes, sand spots, and inclusions shall be cause for rejection when closer to the edge than twice their maximum dimension.

3.7.5 Castings shall not be repaired by peening, plugging, welding, or other methods without written permission from purchaser.

3.7.5.1 When permitted in writing by purchaser, castings may be welded in accordance with AMS2694.

## 4. QUALITY ASSURANCE PROVISIONS

### 4.1 Responsibility for Inspection

The producer of castings 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 castings conform to specified requirements.

### 4.2 Classification of Tests

#### 4.2.1 Acceptance Tests

Composition (3.1) and hardness of castings as solution treated (3.6.1) are acceptance tests and shall be performed on each heat or lot as applicable.

#### 4.2.2 Periodic Tests

Hardness of castings after precipitation heat treatment (3.6.2) and radiographic soundness 3.7.4 are periodic tests and shall be performed at a frequency selected by the producer unless frequency of testing is specified by purchaser.

#### 4.2.3 Preproduction Tests

All technical requirements are preproduction tests and shall be performed on sample castings (4.3.2), when a change in control factors occurs (4.4.2.1), and when purchaser deems confirmatory testing to be required.

### 4.3 Sampling and Testing

The minimum testing performed by producer shall be in accordance with the following:

4.3.1 One chemical analysis specimen in accordance with 3.4 from each melt or a casting from each lot.

4.3.2 One preproduction casting in accordance with 4.4 shall be tested to the requirements of the casting drawing and to all technical requirements.

### 4.4 Approval

4.4.1 Sample castings from new or reworked patterns or molds and the casting procedure shall be approved by purchaser before castings for production use are supplied, unless such approval be waived by purchaser.

4.4.2 Producer shall establish for production of sample castings of each part number, parameters for the process control factors which will produce acceptable castings; these shall constitute the approved casting procedure and shall be used for producing production castings. If necessary to make any change in parameters for the process control factors, producer shall submit for reapproval a statement of the proposed changes in processing and, when requested, test specimens and/or sample castings. Production castings incorporating the revised operations shall not be shipped prior to receipt of reapproval.

4.4.2.1 Control factors for producing castings include, but are not limited to, the following:

Type of furnace
Furnace atmosphere
Fluxing or deoxidation procedure
Gating and risering practices
Metal pouring temperature; variation of ±50 F degrees (±28 C degrees) from the established limit is permissible
Mold setup, parting agent, and rotational speed for centrifugal castings
Solidification and cooling procedures
Cleaning operations
Methods of inspection