



# AEROSPACE MATERIAL SPECIFICATION

**AMS5410™****REV. C**

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Revised 2017-06  
Reaffirmed 2022-05

Superseding AMS5410B

Nickel Alloy, Corrosion- and Heat Resistant, Investment Castings  
61Ni - 16Cr - 8.5Co - 1.8Mo - 2.6W - 0.85Cb (Nb) - 3.4Ti - 1.8Ta - 3.4Al - 0.010B - 0.05Zr  
Vacuum Melted, Vacuum Cast, As Cast, or Solution Treated,  
or Solution and Precipitation Hardened

## RATIONALE

AMS5410C revises classification of tests (4.2), reports (4.5.1), and identification (5.1.1), and is a Five-Year Review and update of this specification.

AMS5410C has been reaffirmed to comply with the SAE Five-Year Review policy.

### 1. SCOPE

#### 1.1 Form

This specification covers a corrosion and heat resistant vacuum melted nickel alloy in the form of investment castings.

#### 1.2 Application

These castings have been used typically for parts, such as turbine blades or vanes, requiring good strength and hot corrosion resistance up to 1800 °F (982 °C), but usage is not limited to such applications.

#### 1.3 Classification

Castings conforming to this specification are classified as follows:

Type A - Castings supplied in the as cast condition

Type B - Castings supplied in the solution heat treated condition

Type C - Castings supplied in the solution treated and precipitation heat treated condition

Class 1 - Trace element limits conforming to AMS2280-1

Class 2 - Trace element limits conforming to AMS2280-2

Class 3 - Trace element limits do not apply

1.3.1 Castings shall be supplied in the Type A condition unless Type B or Type C is specified by purchaser.

1.3.2 Castings shall conform to Class 1 unless Class 2 or Class 3 is specified by purchaser.

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Documents

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## 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).

|         |                                                                          |
|---------|--------------------------------------------------------------------------|
| AMS2175 | Castings, Classification and Inspection of                               |
| AMS2269 | Chemical Check Analysis Limits, Nickel, Nickel Alloys, and Cobalt Alloys |
| AMS2280 | Trace Element Control, Nickel Alloy Castings                             |
| AMS2360 | Room Temperature Tensile Properties of Castings                          |
| AMS2362 | Stress-Rupture Properties of Castings                                    |
| AMS2694 | In-Process Welding of Castings                                           |
| AMS2750 | Pyrometry                                                                |
| AMS2804 | Identification Castings                                                  |
| ARP1917 | Clarification of Terms Used in Aerospace Metals Specifications           |
| AS5491  | Calculation of Electron Vacancy Number in Superalloys                    |

### 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 E139         | Conducting Creep, Creep-Rupture, and Stress-Rupture Tests of Metallic Materials                                |
| ASTM E354         | Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys |
| ASTM E1417/E1417M | Liquid Penetrant Testing                                                                                       |
| ASTM E1742/E1742M | Radiographic Testing                                                                                           |

## 3. TECHNICAL REQUIREMENTS

### 3.1 Composition

Castings shall conform to the percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E354, by spectrochemical methods, or by other analytical methods acceptable to purchaser (see 8.2.1 and 8.2.2).

**Table 1 - Composition**

| Element                | Min       | Max   |
|------------------------|-----------|-------|
| Carbon (3.1.1)         | 0.09      | 0.20  |
| Manganese              | --        | 0.20  |
| Silicon                | --        | 0.30  |
| Phosphorus             | --        | 0.015 |
| Sulfur                 | --        | 0.015 |
| Chromium               | 15.70     | 16.30 |
| Cobalt                 | 8.00      | 9.00  |
| Molybdenum             | 1.50      | 2.00  |
| Tungsten               | 2.40      | 2.80  |
| Columbium (Niobium)    | 0.60      | 1.10  |
| Titanium               | 3.20      | 3.70  |
| Tantalum               | 1.50      | 2.00  |
| Aluminum               | 3.20      | 3.70  |
| Aluminum + Titanium    | 6.50      | 7.20  |
| Boron                  | 0.005     | 0.015 |
| Zirconium              | 0.025     | 0.08  |
| Iron                   | --        | 0.50  |
| Copper                 | --        | 0.10  |
| Other Elements (3.1.2) | --        | --    |
| Nickel                 | remainder |       |

3.1.1 The preferred range for carbon is 0.09 to 0.13.

3.1.2 Producer may test for any element not listed in Table 1 and include this analysis in the report of 4.5. Limits of acceptability may be specified by purchaser (see 8.2.3).

3.1.3 Trace Elements

Shall conform to AMS2280-1, unless AMS5410 Class 2 or Class 3 is specified by purchaser (see 1.3 and 8.5).

3.1.4 Check Analysis

Composition variations shall meet the applicable requirements of AMS2269.

3.1.5 Phacomp Electron Vacancy Number ( $N_v$ )

The phacomp electron vacancy number shall not exceed a value of 2.31 when calculated in accordance with AS5491.

3.2 Melting Practice

3.2.1 Master Heat Preparation

3.2.1.1 Revert (gates, sprues, risers, and rejected castings) may be used only in the preparation of master heats; revert shall not be remelted directly, without refining, for pouring of castings.

3.2.1.2 Master heat metal shall be melted and poured under vacuum without loss of vacuum between melting and pouring.

3.2.1.3 The master heat source shall establish effective control procedures including parameters for the critical variables that will consistently produce material suitable for remelting of castings meeting the requirements of this specification. Control procedures shall be acceptable to purchaser and casting producer.

### 3.2.2 Master Heat Qualification

- 3.2.2.1 Each master heat shall conform to the Phacomp Electron Vacancy Number of 3.1.5, and shall be qualified by evaluation of chemistry, tensile, and stress rupture specimens.

### 3.2.3 Remelt for Casting

- 3.2.3.1 Castings and specimens shall be poured at casting producer's facility either from a melt (see 8.2.4) of a master heat, or directly from a master heat (see 8.2.5).
- 3.2.3.2 The metal for castings shall be melted and poured under vacuum without loss of vacuum between melting and pouring. When authorized by purchaser (see 8.2.6), protective atmosphere may be used in lieu of vacuum for pouring of castings.
- 3.2.3.3 Portions of two or more qualified master heats (see 3.4.2) may be melted together and poured into castings using a procedure authorized by purchaser.
- 3.2.3.4 If modifications, such as alloy additions or replenishments, are made by the producer at remelt, producer shall have a written procedure acceptable to purchaser which defines the controls, test, and traceability criteria for both castings and separately-cast specimens. Control factors of 4.4.2.2 shall apply.

### 3.3 Condition

Castings shall be delivered in the as cast condition, unless Type B or Type C is specified (see 1.3 and 8.5).

### 3.4 Test Specimens

Specimens shall be separately-cast, integrally-cast (see 8.2.7), or machined from a casting, and shall conform to 3.2.

- 3.4.1 If specimens are separately-cast, producer shall have a written procedure acceptable to purchaser. Control factors of 4.4.2.2 shall apply.

### 3.4.2 Each master heat shall be qualified by evaluation of chemical, tensile, and stress rupture specimens.

- 3.4.2.1 If alloy additions or replenishments are made at remelt as in 3.2.3.4, the frequency of sampling and testing used by the producer for qualification to 3.4.2 shall be acceptable to purchaser.
- 3.4.2.2 The tensile tests of 3.4.2 are not required if these tests are conducted using integrally-cast specimens (4.3.3.2) or specimens machined from a casting (4.3.3.3).

### 3.4.3 Chemical Analysis Specimens

Shall be of any convenient size and shape.

### 3.4.4 Tensile and Stress Rupture Specimens

Shall be of standard proportions in accordance with ASTM E8/E8M (see 8.3), and ASTM E139, respectively.

- 3.4.4.1 Separately-cast and integrally-cast specimens may be either cast to size, or cast oversize and subsequently machined to 0.250 inch (6.35 mm) diameter.
- 3.4.4.2 When integrally-cast specimens and specimens machined from a casting are specified, specimen size and location shall be agreed upon by purchaser and producer (see 8.2.8 and 8.5).