



AEROSPACE MATERIAL SPECIFICATION

AMS5412™**REV. B**

Issued 1990-07
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Revised 2019-05

Superseding AMS5412A

Steel Castings, Vacuum Melted, Vacuum Cast, Investment, Corrosion-Resistant
13Cr - 8.0Ni - 2.2Mo - 1.1Al
195 ksi (1344 MPa) Tensile Strength (Condition H1000)
Homogenized, Solution, and Precipitation Heat Treated
(Composition similar to UNS N13800)

RATIONALE

AMS5412B revises quality (3.8.3) to update applicable standards and reports (4.5), prohibits unauthorized exceptions (3.9), and results from a Five-Year Review and update of this specification.

1. SCOPE

1.1 Form

This specification covers a corrosion-resistant steel in the form of investment castings.

1.2 Application

Primarily for parts requiring corrosion resistance and strength up to 600 °F (316 °C).

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 Castings
AMS2759	Heat Treatment of Steel Parts, General Requirements

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Documents
Document Sharing Hub

AMS2804 Identification, Castings

AMS-H-6875 Heat Treatment of Steel Raw Materials

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 A370 Mechanical Testing of Steel Products

ASTM E192 Reference Radiographs of Investment Steel Castings for Aerospace Applications

ASTM E353 Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys

ASTM E1417/E1417M Liquid Penetrant Testing

ASTM E1444/E1444M Magnetic Particle Testing

ASTM E1742/E1742M Radiographic Inspection

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the following percentages by weight shown in Table 1, determined by wet chemical methods in accordance with ASTM E353, by spectrochemical methods, or by other analytical methods acceptable to purchaser:

Table 1 - Composition

Element	Min	Max
Carbon	--	0.05
Manganese	--	0.15
Silicon	--	0.10
Phosphorus	--	0.010
Sulfur	--	0.008
Chromium	12.25	13.25
Nickel	7.50	8.50
Molybdenum	2.00	2.50
Aluminum	0.90	1.35
Nitrogen	--	0.010

3.2 Condition

Homogenized, solution heat treated, refrigerated, and precipitation heat treated.

3.3 Casting

3.3.1 The metal for castings shall be melted and poured under vacuum without loss of vacuum between melting and pouring. When permitted by purchaser, high purity argon may be used in lieu of vacuum for pouring of castings but not for the melting operation.

3.3.2 Castings shall be poured either from remelted metal from a master heat or directly from a master heat. In either case, metal for casting shall be qualified as in 3.4.

- 3.3.3 A master heat is refined metal of a single furnace charge, melted and cast into ingots under vacuum. Gates, sprues, riser, and rejected castings shall be used only in preparation of master heats; they shall not be remelted directly, without refining, for pouring of castings.
- 3.3.4 Unless prohibited by purchaser, metal from two or more master heats may be blended provided that the composition of each master heat to be blended is within the limits of 3.1 and that the total weight of metal blended does not exceed 15000 pounds (6804 kg). When two or more master heats are blended, the resultant blend shall be considered a master heat.

3.4 Master Heat Qualification

Each master heat shall be qualified by evaluation of chemical analysis and tensile specimens conforming to 3.4.1 and 3.4.2, respectively. A master heat may be considered conditionally qualified if producer's test results show conformance to all applicable requirements of this specification. However, except when purchaser waives confirmatory testing, final qualification shall be based on purchaser's test results. Conditional qualification of a master heat shall not be construed as a guarantee of acceptance of castings poured from the master heat.

3.4.1 Chemical Analysis Specimens

Shall be of any convenient size, shape, and form.

3.4.2 Tensile Specimens

Separately cast specimens shall be cast from remelted metal from each master heat, except that when castings are poured directly from a master heat the specimens shall also be poured directly from the master heat. Specimens shall be of standard proportions in accordance with ASTM A370 with 0.250 inch (6.35 mm) diameter at the reduced parallel gage section. They shall be cast to size or shall be cast oversize and subsequently machined to 0.250 inch (6.35 mm) diameter. Center gating may be used.

- 3.4.2.1 Integrally-cast coupons (see 8.3.1) or specimens excised from the body of a cast part may be used for evaluating acceptance of the master heat in lieu of separately-cast specimens.

3.5 Part Acceptance Test Coupons

For cast part acceptance, specimens excised from the body of a cast part shall be used. Integrally-cast coupons shall be used when specified on the engineering drawing. Separately-cast tensile specimens are to be used only when permitted and specified by purchaser. Specimen proportions shall be in accordance with ASTM A370 and the largest size possible shall be used. Specimens excised from the body of a cast part are preferred and take precedence over other test specimens.

3.6 Heat Treatment

Castings and representative separately-cast or integrally-cast tensile specimens shall be heat treated together as follows; all thermal treatments above 1200 °F (649 °C) shall be performed in a protective atmosphere of vacuum, argon, or equivalent. Heat treating equipment shall conform to AMS2759 or AMS-H-6875.

3.6.1 Homogenization

Heat to 2100 °F $\pm$ 25 °F (1149 °C $\pm$ 14 °C), hold at heat for 60 minutes per inch (25 mm) maximum cross-section but not less than 90 minutes, and force air cool to room temperature.

3.6.2 Solution

Heat to 1700 °F $\pm$ 25 °F (927 °C $\pm$ 14 °C), hold at heat for 60 minutes per inch (25 mm) of maximum cross-section but not less than 30 minutes, and cool to below 90 °F (32 °C) at a rate equivalent to an air cool or faster. Below 1200 °F (649 °C), a rapid air cool is acceptable.