

UNS R30006

ALLOY CASTINGS, INVESTMENT, CORROSION AND HEAT RESISTANT
60Co - 29Cr - 4.5W
As Cast

1. SCOPE:

1.1 Form: This specification covers a corrosion and heat resistant cobalt alloy in the form of investment castings.

1.2 Application: Primarily for parts, such as nozzles, rubbing seals, rollers, guides, and supports requiring wear and/or erosion resistance in combination with corrosion and oxidation resistance for use up to 1600°F (870°C).

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of Aerospace Material Specifications (AMS) shall apply. The applicable issue of other documents shall be as specified in AMS 2350.

2.1 SAE Publications: Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2350 - Standards and Test Methods
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2694 - Repair Welding of Aerospace Castings
AMS 2804 - Identification, Castings

2.2 ASTM Publications: Available from American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
ASTM E192 - Reference Radiographs of Investment Steel Castings for Aerospace Applications
ASTM E354 - Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

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2.3 U.S. Government Publications: Available from Commanding Officer, Naval Publications and Forms Center, 5801 Tabor Avenue, Philadelphia, PA 19120.

2.3.1 Federal Standards:

Federal Test Method Standard No. 151 - Metals; Test Methods

2.3.2 Military Standards:

MIL-STD-794 - Parts and Equipment, Procedures for Packaging and Packing of

3. TECHNICAL REQUIREMENTS:

3.1 Composition: Shall conform to the following percentages by weight, determined by wet chemical methods in accordance with ASTM E354, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

	min	max
Carbon	0.9	1.4
Manganese	--	1.0
Silicon	--	1.5
Phosphorus	--	0.04
Sulfur	--	0.04
Chromium	27.0	31.0
Tungsten	3.5	5.5
Nickel	--	3.0
Molybdenum	--	1.5
Iron	--	3.0
Cobalt		remainder

3.2 Condition: As cast.

3.3 Casting: 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.

3.3.1 A master heat is refined metal of a single furnace charge or is metal blended as in 3.3.2. Gates, sprues, risers, and rejected castings shall be used only in preparation of master heats; they shall not be remelted directly, without refining, for pouring of castings.

- 3.3.2 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 10,000 lb (4500 kg). Ingot and pig may be blended together, shot may be blended, but shot shall not be blended with ingot or pig. 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 specimens conforming to 3.4.1. A master heat may be considered conditionally qualified if vendor'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 therefrom.
- 3.4.1 Chemical Analysis Specimens: Shall be of any convenient size, shape, and form for vendor's tests. When chemical analysis specimens are required by purchaser, specimens shall be cast to a size, shape, and form agreed upon by purchaser and vendor.
- 3.5 Properties: Castings shall conform to the following requirements:
- 3.5.1 Hardness: Shall be not lower than 37 HRC or equivalent, determined in accordance with ASTM E18.
- 3.6 Quality:
- 3.6.1 Castings, as received by purchaser, shall be uniform in quality and condition, sound, and free from foreign materials and from internal and external imperfections detrimental to usage of the castings.
- 3.6.1.1 Castings shall have smooth surfaces and shall be well cleaned. Metallic shot or grit shall not be used for final cleaning, unless otherwise permitted by purchaser.
- 3.6.2 Castings shall be produced under radiographic control, unless otherwise specified. This control shall consist of radiographic examination of castings in accordance with AMS 2635 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.

- 3.6.3 When specified, castings shall be subjected to fluorescent penetrant inspection in accordance with AMS 2645.
- 3.6.4 Radiographic, fluorescent penetrant, and other quality standards shall be as agreed upon by purchaser and vendor. ASTM E192 may be used to define radiographic acceptance standards.
- 3.6.5 Castings shall not be repaired by peening, plugging, welding, or other methods without written permission from purchaser.
- 3.6.5.1 When permitted in writing by purchaser, defects in castings may be removed and the castings repaired by welding in accordance with AMS 2694.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of castings shall supply all samples for vendor's tests and shall be responsible for performing all required tests. Results of such tests shall be reported to the purchaser as required by 4.5. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the castings conform to the requirements of this specification.
- 4.2 Classification of Tests: Tests to determine conformance to all technical requirements of this specification are classified as acceptance tests and as preproduction tests and shall be performed on the first-article shipment of a casting to a purchaser, on each lot or master heat as applicable, when a change in material or processing requires reapproval as in 4.4.2, and when purchaser deems confirmatory testing to be required.
- 4.2.1 For direct U.S. Military procurement, substantiating test data and, when requested, preproduction test material shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement
- 4.3 Sampling: Shall be in accordance with the following; a lot shall be all castings of the same part number from one master heat presented for vendor's inspection at one time:
- 4.3.1 Two chemical analysis specimens in accordance with 3.4.1, and/or a casting from each master heat.
- 4.3.2 Two preproduction castings in accordance with 4.4.1 of each part number.

4.4 Approval:

- 4.4.1 Sample castings from new or reworked master patterns and the casting procedure shall be approved by purchaser before castings for production use are supplied, unless such approval be waived.
- 4.4.2 Vendor shall establish for production of sample castings of each part number parameters for the control factors of processing 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 control factors of processing, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, 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 and its capacity
 - Size of furnace charge
 - Furnace atmosphere
 - Fluxing or deoxidation procedure
 - Mold refractory formulation
 - Mold back-up material
 - Gating practices
 - Mold preheat and pouring temperatures (variations of $\pm 25^{\circ}\text{F}$ ($\pm 15^{\circ}\text{C}$) from established limits are permissible)
 - Solidification and cooling procedures
 - Cleaning operations
 - Methods of inspection
- 4.4.2.1.1 Any of the above control factors of processing for which parameters are considered proprietary by the vendor may be assigned a code designation. Each variation in such parameters shall be assigned a modified code designation.

4.5 Reports:

- 4.5.1 The vendor of castings shall furnish with each shipment three copies of a report showing the results of tests for chemical composition of at least one casting, or of specimens as in 3.4.1 cast in a mold with parts, from each master heat represented and the results of tests on each master heat to determine conformance to the other acceptance test requirements of this specification. This report shall include the purchase order number, master heat number and/or code symbol, AMS 5387A, part number, and quantity from each master heat.