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AEROSPACE MATERIAL SPECIFICATION

AMS 5398C
Superseding AMS 5398B

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STEEL CASTINGS, SAND AND CENTRIFUGAL, CORROSION RESISTANT
16Cr - 4.1Ni - 0.22(Cb + Ta) - 2.8Cu
Solution Heat Treated

UNS J92170

1. SCOPE:

1.1 Form: This specification covers a corrosion-resistant steel in the form of sand or centrifugal castings.

1.2 Application: Primarily for parts such as accessory components requiring corrosion resistance and strength up to 600°F (315°C). Certain processing procedures and service conditions may cause these castings to become subject to stress-corrosion cracking. Where stress-corrosion may be a factor in service, precipitation heat treatment should be performed at a temperature not lower than 1000°F (540°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 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 2360 - Room Temperature Tensile Properties of Castings
AMS 2633 - Ultrasonic Inspection, Centrifugally-Cast, Corrosion-Resistant Steel Tubular Cylinders
AMS 2635 - Radiographic Inspection
AMS 2640 - Magnetic Particle Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2694 - Repair Welding of Aerospace Castings
AMS 2804 - Identification, Casting

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

ASTM A370 - Mechanical Testing of Steel Products
ASTM E353 - Chemical Analysis of Stainless, Heat-Resisting, Maraging, and Other Similar Chromium-Nickel-Iron Alloys
ASTM E446 - Reference Radiographs for Steel Castings up to 2 in. (51 mm) in Thickness

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 Specifications:

MIL-H-6875 - Heat Treatment of Steels, Process for

2.3.3 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 E353, by spectrographic methods in accordance with Federal Test Method Standard No. 151, Method 112, or by other analytical methods approved by purchaser:

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	min	max
Carbon	--	0.06
Manganese	--	0.70
Silicon	0.50	1.00
Phosphorus	--	0.04
Sulfur	--	0.03
Chromium	15.50	16.70
Nickel	3.60	4.60
Columbium + Tantalum	0.10	0.35
Copper	2.50	3.20
Aluminum	--	0.05
Tin	--	0.02
Nitrogen	--	0.05

3.2 Condition: Solution heat treated.

3.3 Casting: A melt shall be the metal poured from a single furnace charge of 15,000 lb (6800 kg) or less.

3.4 Test Specimens:

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.

3.4.2 Tensile Coupons: Shall be attached to castings, if practicable, or shall Ø be standard keel blocks conforming to ASTM A370, unless purchaser permits use of cast-to-size specimens. Coupons shall be cast with each melt of metal for castings, shall be cast in molds made of suitable core sand, shall be poured from the same ladles as the castings, and shall be kept in the mold until black. Metal for the coupons shall be part of the melt which is used for the castings. Tensile specimens in accordance with ASTM A370 shall be machined from the coupons after heat treatment as in 3.5.

3.5 Heat Treatment: Castings and representative tensile coupons shall be heat Ø treated as follows; castings and coupons may be given a homogenization heat treatment prior to solution heat treatment or may be given two solution heat treatments when permitted by purchaser, and shall be so treated when specified by purchaser; furnace surveys and calibration of temperature controllers and recorders shall be in accordance with MIL-H-6875. At least one set of tensile coupons shall, during each stage of heat treatment be put into a batch type furnace or into a continuous furnace at intervals of not longer than three hours.

3.5.1 Homogenization Heat Treatment: Heat to 2100°F ± 25 (1150°C ± 15), hold at heat for not less than 90 min., and cool as required to below 70°F (20°C).

3.5.2 Solution Heat Treatment: Heat to 1900°F ± 25 (1040°C ± 15), hold at heat Ø for 60 min. per inch (25 mm) of maximum cross-section but not less than 30 min., and cool as required to below 70°F (20°C).

3.6 Properties: Castings and representative tensile specimens produced in accordance with 3.4.2 shall conform to the following requirements; hardness and tensile testing shall be performed in accordance with ASTM A370:

3.6.1 As Solution Heat Treated:

3.6.1.1 Hardness of Castings: Shall be not higher than 363 HB or equivalent.

3.6.2 After Precipitation Heat Treatment: Castings and representative tensile specimens shall have the following properties after being heated to 925°F ± 15 (495°C ± 10), held at heat for not less than 90 min., and cooled in air to room temperature. Properties after precipitation heat treatment at temperatures other than 925°F ± 15 (495°C ± 10) shall be as agreed upon by purchaser and vendor.

3.6.2.1 Separately-Cast Coupons or Integrally-Cast Coupons:

3.6.2.1.1 Tensile Properties:

Tensile Strength, min	180,000 psi (1240 MPa)
Yield Strength at 0.2% Offset, min	150,000 psi (1035 MPa)
Elongation in 4D, min	6%
Reduction of Area, min	12%

3.6.2.1.2 Hardness: Shall be not lower than 375 HB or equivalent.

3.6.2.2 Castings:

3.6.2.2.1 Tensile Properties: When specified on the drawing or when agreed upon by purchaser and vendor, tensile specimens conforming to ASTM A370 shall be machined from castings selected at random from each melt. Property requirements for such specimens shall be as shown on the drawing or as agreed upon by purchaser and vendor and may be defined as specified in AMS 2360.

3.6.2.2.2 Hardness: Should be not lower than 375 HB, or equivalent, but castings shall not be rejected on the basis of hardness if the tensile property requirements of 3.6.2.2.1 are met.

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 well cleaned. Metallic shot or grit shall not be used for final cleaning, unless otherwise permitted by purchaser.

3.7.2 Castings shall be produced under radiographic control. 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.

3.7.3 When specified, castings shall be subjected to magnetic particle inspection in accordance with AMS 2640, to fluorescent penetrant inspection in accordance with AMS 2645, or to both. Centrifugal castings shall be ultrasonically tested in accordance with AMS 2633 and shall conform to the requirements of ultrasonic discontinuity Grade A for longitudinal and shear modes.

3.7.4 Radiographic, magnetic particle, fluorescent penetrant, and other quality standards shall be as agreed upon by purchaser and vendor. ASTM E446 may be used to define radiographic acceptance standards.

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, defects in castings may be Ø 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 Ø 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 except that, for acceptance tests, when tensile properties are determined on specimens cut from castings, separately-cast test coupons or integrally-cast specimens need not be tested.

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 Ø castings from a single melt solution and precipitation heat treated as a heat treat batch.

4.3.1 Two chemical analysis specimens in accordance with 3.4.1 from each melt or a casting from each lot.

4.3.2 Three tensile coupons in accordance with 3.4.2 or three integrally-cast Ø specimens representing each lot.

4.3.3 Two preproduction castings in accordance with 4.4.1 of each part number.

4.3.4 One or more castings from each lot when properties of specimens machined from castings are required. Size, location, and number of specimens machined from castings shall be as specified on the drawing or as agreed upon by purchaser and vendor. When size, location, and number of specimens are not specified, not less than two tensile specimens, one from the thickest section and one from the thinnest section, shall be cut from a casting or castings from each lot.

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 Vendor 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, vendor shall submit for reapproval a statement of the proposed changes in processing and, when requested, tensile coupons, sample castings, or both. 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:

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Type of furnace
Furnace atmosphere
Fluxing or deoxidation procedure
Gating and risering practices (for sand castings)
Mold set-up and rotational speed (for centrifugal castings)
Metal pouring temperature (variation of ±50°F (±30°C) from the established limit is permissible)
Solidification and cooling procedures
Cleaning operations
Heat treatment cycles
Methods of inspection

4.4.2.1.1 Any of the above process control factors 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 a report showing the results of tests for chemical composition of at least one casting, or of specimens as in 3.4.1 from each melt and for tensile properties of separately-cast coupons or integrally-cast specimens representing each lot, and stating that the castings conform to the other technical requirements of this specification. When properties of specimens cut from castings are specified, the report shall include the results of tests to determine conformance to such requirements. This report shall include the purchase order number, melt number, AMS 5398C, precipitation heat treatment temperature if other than 925°F ± 15 (495°C ± 10), part number, and quantity from each melt.