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400 COMMONWEALTH DRIVE, WARRENDALE, PA 15096

AEROSPACE MATERIAL SPECIFICATION

AMS 5408

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Revised

ALLOY CASTINGS, CENTRIFUGAL, CORROSION AND HEAT RESISTANT
64Ni - 16Cr - 15Mo - 0.30Al - 0.05La
Solution Heat Treated

1. SCOPE:

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

1.2 Application: Primarily for parts such as turbine cases requiring relatively high strength up to 1800°F (980°C) and oxidation resistance up to 2000°F (1095°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 2268 - Chemical Check Analysis Limits, Cast Nickel and Nickel Alloys
AMS 2350 - Standards and Test Methods
AMS 2635 - Radiographic Inspection
AMS 2645 - Fluorescent Penetrant Inspection
AMS 2646 - Contrast Dye Penetrant Inspection
AMS 2694 - Repair Welding of Aerospace Castings
AMS 2804 - Identification, Castings

REAFFIRMED 10/91
5/95

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

ASTM E8 - Tension Testing of Metallic Materials
ASTM E10 - Brinell Hardness of Metallic Materials
ASTM E21 - Elevated Temperature Tension Tests of Metallic Materials
ASTM E354 - Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt 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 Military Specifications:

MIL-H-6875 - Heat Treatment of Steels (Aircraft Practice), Process for

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 or by spectrographic or other analytical methods approved by purchaser:

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	min	max
Carbon	---	0.02
Manganese	0.30	1.00
Silicon	0.20	0.75
Phosphorus	---	0.020
Sulfur	---	0.015
Chromium	14.50	17.00
Molybdenum	14.00	16.50
Aluminum	0.10	0.50
Cobalt	---	2.00
Tungsten	---	1.00
Boron	---	0.015
Iron	---	3.00
Lanthanum	---	0.10
Copper	---	0.35
Nickel	remainder	

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2268.

3.2 Condition: Solution heat treated.

3.3 Casting: A melt shall be the metal poured from a single furnace charge into rotating molds.

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 Specimens: Shall be machined from castings, if practicable, or from standard keel blocks or shall be cast to size; specimens shall conform to ASTM E8. Specimens shall be cast with each melt of metal and, when requested, shall be supplied with the castings. Standard keel blocks and cast-to-size specimens shall be poured from the same ladle as the castings, and shall be kept in the mold until black.

3.5 Solution Heat Treatment: Castings and representative tensile specimens shall be solution heat treated by heating to a temperature not lower than 1925°F (1050°C), holding at the selected temperature within ±25°F (±15°C) for 1 hr per inch (25 mm) of section thickness but not less than 30 min., and cooling at a rate equivalent to air cool or faster. Furnace surveys and calibration of temperature controllers and recorders shall be in accordance with MIL-H-6875.

3.6 Properties: Castings and representative tensile specimens produced in accordance with 3.4.2 shall conform to the following requirements:

3.6.1 Tensile Properties:

3.6.1.1 At Room Temperature: Shall be as follows, determined in accordance with ASTM E8:

Tensile Strength, min	72,000 psi (495 MPa)
Yield Strength at 0.2% Offset, min	35,000 psi (240 MPa)
Elongation in 4D, min	28%

3.6.1.2 At 1200°F (650°C): Shall be as follows, determined in accordance with ASTM E21 on specimens heated to 1200°F ± 5 (650°C ± 3), held at heat for 20 - 30 min. before testing, and tested at 1200°F ± 5 (650°C ± 3):

Tensile Strength, min	45,000 psi (310 MPa)
Yield Strength at 0.2% Offset, min	18,000 psi (125 Mpa)
Elongation in 4D, min	30%

3.6.2 Hardness: Castings should have hardness not higher than 241 HB, or equivalent, determined in accordance with ASTM E10, but shall not be rejected on the basis of hardness if the tensile property requirements of 3.6.1.1 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 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 fluorescent penetrant inspection in accordance with AMS 2645, or to contrast dye penetrant inspection in accordance with AMS 2646.

3.7.4 Radiographic, fluorescent penetrant, contrast dye penetrant, and other quality standards shall be as agreed upon by purchaser and vendor. ASTM E446 may be used to define radiographic inspection 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 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 prior to or on the first-article shipment of a casting to a purchaser, on each melt or lot as applicable, when a change in material, processing, or both requires reapproval as in 4.4.2 and when purchaser deems confirmatory testing to be required.

4.3 Sampling: Shall be in accordance with the following; a lot shall be all castings of a specific design, produced from a single melt, solution heat treated in a single batch, and presented for vendor's inspection at one time:

4.3.1 One chemical analysis specimen in accordance with 3.4.1 from each melt or a casting from each lot.

4.3.2 Two tensile specimens in accordance with 3.4.2 from each lot.

4.3.3 Each casting from each lot.

4.3.4 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 molds, the casting procedure, and substantiating test data 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 procedures 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, sample castings, test specimens, 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 tensile specimens and castings include, but are not limited to, the following:

Type of furnace and its capacity
Type and size of furnace charge
Furnace atmosphere
Fluxing or deoxidation procedure
Mold set up, parting agent, and rotational speed
Metal pouring temperature (variation of ±50°F (±30°C) from the established limit is permissible)
Solidification and cooling procedures
Solution heat treatment cycle
Cleaning operations
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.