

ALLOY POWDER, CORROSION AND HEAT RESISTANT
55Ni - 15Cr - 17Co - 5.0Mo - 3.5Ti - 4.0Al - 0.025B
As Fabricated

UNS N13017

1. SCOPE:

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

1.2 Application: Primarily for compaction into net or near net shapes and into forging stock in the form of billets or preforms for use up to 1400°F (760°C) in highly-stressed parts such as rotating parts of gas turbine engines.

2. APPLICABLE DOCUMENTS: The following publications form a part of this specification to the extent specified herein. The latest issue of SAE publications 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 2269 - Chemical Check Analysis Limits, Wrought Nickel Alloys and Cobalt Alloys

AMS 2350 - Standards and Test Methods

AMS 2635 - Radiographic Inspection

2.1.2 Aerospace Recommended Practices:

ARP1313 - Determination of Trace Elements in High Temperature Alloys

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2.2 ASTM Publications: Available from ASTM, 1916 Race Street, Philadelphia, PA 19103.

ASTM B214 - Sieve Analysis of Granular Metal Powders

ASTM B215 - Sampling Finished Lots of Metal Powders

ASTM B311 - Density of Cemented Carbides

ASTM B527 - Tap Density of Powders of Refractory Metals and Compounds by Tap-Pak Volumeter

ASTM E354 - Chemical Analysis of High-Temperature, Electrical, Magnetic, and Other Similar Iron, Nickel, and Cobalt Alloys

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 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 spectrochemical methods, or by other analytical methods acceptable to purchaser except that lead and bismuth shall be determined in accordance with ARP1313 and oxygen and nitrogen shall be determined by Leco gas analyzer or equivalent:

	min	max
Carbon	0.02	0.06
Manganese	--	0.15
Silicon	--	0.20
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	14.00	16.00
Cobalt	16.00	18.00
Molybdenum	4.50	5.50
Titanium	3.35	3.65
Aluminum	3.85	4.15
Boron	0.020	0.030
Tungsten	--	0.05
Iron	--	0.50
Copper	--	0.10
Zirconium	--	0.06
Lead	--	0.0002 (2 ppm)
Bismuth	--	0.00003 (0.3 ppm)
Oxygen	--	0.010 (100 ppm)
Nitrogen	--	0.0050 (50 ppm)
Nickel	remainder	

- 3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2269; no variation over maximum will be permitted for lead, bismuth, oxygen, and nitrogen.
- 3.2 Condition: As manufactured.
- 3.3 Powder Production: Powder shall be produced in lots by a suitable process in an appropriate noncontaminating atmosphere. A lot shall be all powder produced from common feed material (an ingot, billet, or cast electrode from a common ingot) in one production run of the equipment. When approved by purchaser, a lot may be the powder produced from common feed material in a series of consecutive runs in the same equipment under essentially the same fixed parameters; the powder from all such runs shall be thoroughly blended. The total weight of powder blended in one lot shall not exceed 10,000 pounds (4540 kg).
- 3.4 Properties: The powder shall conform to the following requirements:
- 3.4.1 Particle Size: The particles shall pass through a No. 80 (177 μm) sieve, with not more than 40% by weight passing through a No. 400 (37 μm) sieve, determined in accordance with ASTM B214 or other method acceptable to purchaser.
- 3.4.2 Powder Tap Density: Shall be not less than 60% of the density value obtained in 3.4.3, determined in accordance with ASTM B527 or other procedure agreed upon by purchaser and vendor.
- 3.4.3 Powder Compaction and Evaluation: A sample of suitable size from each powder lot shall be hot-compacted using a method which will not contaminate the powder particles during compaction. The density of the compacted sample shall be determined in accordance with ASTM B311. The compacted sample shall be free of any deleterious high- or low-density inclusions, determined by radiographic inspection in accordance with AMS 2635 and by macroetching in accordance with 3.4.3.1.
- 3.4.3.1 Visual examination of transverse sections from the compacted sample of 3.4.3, macroetched by a procedure agreed upon by purchaser and vendor, shall show a macrostructure conforming to standards specified by purchaser.
- 3.5 Quality:
- 3.5.1 Alloy from which the powder is made shall be produced by vacuum induction melting. The powder shall be produced in an inert atmosphere or in vacuum.
- 3.5.2 Powder, as received by purchaser, shall be uniform in color and quality, dry, essentially free from splat and large agglomerated masses, and free from foreign materials and from imperfections detrimental to usage of the powder.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of powder 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 powder conforms 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 initial shipment of powder to a purchaser, on each lot, when a change in material and/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, contracting officer, or request for procurement.
- 4.3 Sampling: Shall be in accordance with ASTM B215; sufficient powder shall be taken from each lot to perform all required tests. The number of determinations for each requirement shall be as specified in the applicable test procedure or, if not specified therein, not less than three.
- 4.3.1 When a statistical sampling plan and acceptance quality level (AQL) have been agreed upon by purchaser and vendor, sampling shall be in accordance with such plan in lieu of sampling as in 4.3 and the report of 4.5.1 shall state that such plan was used.
- 4.4 Approval:
- 4.4.1 Sample powder shall be approved by purchaser before powder for production use is supplied, unless such approval be waived by purchaser. Results of tests on production powder shall be essentially equivalent to those on the approved sample.
- 4.4.2 Vendor shall use materials, processing techniques, and methods of inspection on production powder which are essentially the same as those used on the approved sample powder. If necessary to make any change in ingredients, processing techniques, or methods of inspection, vendor shall submit for reapproval a statement of the proposed changes in material and/or processing and, when requested, sample powder. Production powder made by the revised procedure shall not be shipped prior to receipt of reapproval.