



AEROSPACE MATERIAL SPECIFICATION

Society of Automotive Engineers, Inc.
400 COMMONWEALTH DRIVE, WARRENDALE, PA. 15096

AMS 5855

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Revised

ALLOY POWDER, CORROSION AND HEAT RESISTANT

59.5Ni - 12Cr - 10Co - 3.0Mo - 6.0W - 3.0Ti - 1.5Ta - 4.5Al - 0.015B - 0.10Zr (0.30 - 0.35C)

1. SCOPE:

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

1.2 Application: Primarily for consolidating into forging stock in the form of billets or preforms.

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 Society of Automotive Engineers, Inc., 400 Commonwealth Drive, Warrendale, PA 15096.

2.1.1 Aerospace Material Specifications:

AMS 2269 - Chemical Check Analysis Limits, Wrought Nickel and Nickel Base Alloys

AMS 2350 - Standards and Test Methods

AMS 2635 - Radiographic Inspection

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

ASTM A604 - Macroetch Testing of Consumable Electrode Vacuum Arc Remelted Steel Bars and Billets

ASTM B214 - Sieve Analysis of Granular Metal Powders

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

2.3 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, except that oxygen and nitrogen shall be determined by Leco Gas Analyzer, or by other approved analytical methods:

SAE Technical Board rules provide that: "All technical reports, including standards approved and practices recommended, are advisory only. Their use by anyone engaged in industry or trade is entirely voluntary. There is no agreement to adhere to any SAE standard or recommended practice, and no commitment to conform to or be guided by any technical report. In formulating and approving technical reports, the Board and its Committees will not investigate or consider patents which may apply to the subject matter. Prospective users of the report are responsible for protecting themselves against liability for infringement of patents."

3.1 (Continued)

	min	max
Carbon	0.30 -	0.35
Manganese	--	0.10
Silicon	--	0.10
Phosphorus	--	0.015
Sulfur	--	0.015
Chromium	11.50 -	12.50
Cobalt	9.50 -	10.50
Molybdenum	2.50 -	3.50
Tungsten	5.50 -	6.50
Titanium	2.75 -	3.25
Tantalum	1.00 -	2.00
Aluminum	4.20 -	4.80
Boron	0.01 -	0.02
Zirconium	0.05 -	0.15
Oxygen	--	0.010 (100 ppm)
Nitrogen	--	0.005 (50 ppm)
Iron	--	1.00
Lead	--	0.0002 (2 ppm)
Bismuth	--	0.00005 (0.5 ppm)
Nickel	remainder	

3.1.1 Check Analysis: Composition variations shall meet the requirements of AMS 2269; check analysis limits for zirconium shall be 0.01 under min or over maximum.

3.2 Condition: As manufactured.

3.3 Properties: The powder shall conform to the following requirements:

3.3.1 Particle Size: The particles shall all pass through a No. 100 (150 μ m) sieve, with not more than 20% passing through a No. 400 (38 μ m) sieve, determined in accordance with ASTM B214 or by an approved optical method.

3.3.2 Powder Compaction Evaluation: A sample of powder shall be hot compacted using a method which will avoid contamination of the powder during consolidation. The compacted sample shall be free of any deleterious high- or low-density inclusions, determined by radiographic examination in accordance with AMS 2635 and macroetching in accordance with 3.3.2.1.

3.3.2.1 Macrostructure: Visual examination of transverse sections of the compacted sample, etched in accordance with ASTM A604 in hot hydrochloric acid (1:1) at 160° - 180° F (71.1° - 82.2° C) for sufficient time to develop a well-defined macrostructure, shall show no imperfections, such as pipe, cracks, porosity, segregation, and inclusions, detrimental to fabrication of parts. Macrostructure shall be equal to or better than the following macrographs of ASTM A604:

Class	Condition	Severity
1	Freckles	B
2	White Spots	C
3	Radial Segregation	C

3.4 Quality:

- 3.4.1 Alloy from which the powder is made shall be produced by vacuum induction melting. The powder shall be produced and handled in an inert atmosphere or in vacuum.
- 3.4.2 The powder 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 its performance during compaction or in resultant forgings.

4. QUALITY ASSURANCE PROVISIONS:

- 4.1 Responsibility for Inspection: The vendor of powder shall supply all samples 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 perform such confirmatory testing as he deems 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.
 - 4.2.1 For direct U.S. Military procurement, preproduction test material and supporting test data shall be submitted to the cognizant agency as directed by the procuring activity, the contracting officer, or the request for procurement.
- 4.3 Sampling: Sufficient material shall be taken from each lot to perform each test in duplicate; a lot shall be all powder produced in a single production run under the same fixed conditions from the same heat of alloy.
- 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.
 - 4.4.2 Vendor shall use ingredients, processing techniques, and methods of routine inspection on production powder which are essentially the same as those used on the approved sample powder. If any change is necessary in ingredients, in processing techniques, or in methods of routine inspection, vendor shall submit for reapproval a statement of the proposed changes and, when requested, sample revised powder. No production powder made by the revised procedure shall be shipped prior to receipt of reapproval.
- 4.5 Reports:
 - 4.5.1 The vendor of powder shall furnish with each shipment three copies of a report of the results of tests for chemical composition and particle size of each lot in the shipment and stating that the powder conforms to the other technical requirements of this specification. This report shall include the purchase order number, material specification number, vendor's product designation, lot number, and quantity.
 - 4.5.2 When parts requiring use of this powder are supplied, the vendor of finished or semi-finished parts shall furnish with each shipment three copies of a report showing the purchase order number, this specification number, lot number, contractor or other direct supplier of powder, part number, and quantity. When powder for making parts is produced or purchased by the parts vendor, that vendor shall inspect each lot of powder to determine conformance to the requirements of this specification, and shall include in the report a statement that the powder conforms, or shall include copies of laboratory reports showing the results of tests to determine conformance.

- 4.6 Resampling and Retesting: If any sample used in the above tests fails to meet the specified requirements, disposition of the powder may be based on the results of testing three additional samples for each original nonconforming sample. Failure of any retest sample to meet the specified requirements shall be cause for rejection of the powder represented and no additional testing shall be permitted. Results of all tests shall be reported.

5. PREPARATION FOR DELIVERY:

5.1 Packaging and Identification:

- 5.1.1 Powder shall be packaged, under inert atmosphere or under vacuum, in containers of the size ordered. A lot may be packaged in smaller quantities and delivered separately under the basic lot approval as long as lot identity is maintained. Each container shall be sealed to protect the contents from contamination during shipment and under normal dry storage conditions. Seals used on containers shall be so designed that they must be destroyed in order for the container to be opened.

- 5.1.2 Each container shall be permanently and legibly marked to show the following information:

ALLOY POWDER, CORROSION AND HEAT RESISTANT

AMS 5855

MANUFACTURER'S IDENTIFICATION _____

QUANTITY _____

LOT NO. _____

- 5.1.3 Individual packages or containers may be packed in an exterior shipping container which will protect the powder, during shipment and storage, against damage from exposure to weather or any normal hazard.

- 5.1.4 Each exterior shipping container shall be legibly marked with the following information in such a manner that the markings will not smear or be obliterated during normal handling or use:

ALLOY POWDER, CORROSION AND HEAT RESISTANT

AMS 5855

MANUFACTURER'S IDENTIFICATION _____

PURCHASE ORDER NUMBER _____

QUANTITY _____

LOT NUMBER _____

- 5.1.5 Containers shall be prepared for shipment in accordance with commercial practice to ensure carrier acceptance and safe transportation to the point of delivery. Packaging shall conform to carrier rules and regulations applicable to the mode of transportation.

- 5.1.6 For direct U.S. Military procurement, packaging shall be in accordance with MIL-STD-794, Level A or Level C, as specified in the request for procurement. Commercial packaging as in 5.1.5 will be acceptable if it meets the requirements of Level C.

6. ACKNOWLEDGMENT: A vendor shall mention this specification number in all quotations and when acknowledging purchase orders.

7. REJECTIONS: Powder not conforming to this specification or to authorized modifications will be subject to rejection.

8. NOTES:

- 8.1 Definitions: For definitions of terms used herein, refer to ASTM B243.