



AEROSPACE MATERIAL SPECIFICATION

AMS7013™

Issued

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Nickel Alloy, Corrosion and Heat-Resistant, Powder for Additive Manufacturing,
60Ni - 22Cr - 2.0Mo - 14W - 0.35Al - 0.03La
(Compositions similar to UNS N06230)

RATIONALE

To provide a specification that will allow Alloy 230 to be procured in the aerospace supply chain for use in additive manufacturing.

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

This powder is intended to be used for the additive manufacturing of aerospace parts requiring oxidation resistance up to 2100 °F (1149 °C) and relatively high strength up to 1800 °F (982 °C), but usage is not limited to such applications.

1.3 Classification

Maximum oxygen concentration is specified as follows:

Class A: Maximum oxygen concentration of 0.015% (150 ppm)

Class B: Maximum oxygen concentration of 0.030% (300 ppm)

Class C: Maximum oxygen concentration of 0.040% (400 ppm)

1.4 Safety - Hazardous Materials

While the materials, methods, applications, and processes described or referenced in this specification may involve the use of hazardous materials, this specification does not address the hazards that may be involved in such use. It is the sole responsibility of the user to ensure familiarity with the safe and proper use of any hazardous materials and to take necessary precautionary measures to ensure the health and safety of all personnel involved.

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2. APPLICABLE DOCUMENTS

The issue of the following documents in effect on the date of the purchase order forms a part of this specification to the extent specified herein. The supplier may work to a subsequent revision of a document unless a specific document issue is specified. When the referenced document has been cancelled and no superseding document has been specified, the last published issue of that document shall apply.

2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

AMS7002 Process Requirements for Production of Metal Powder Feedstock for Use in Additive Manufacturing of Aerospace Parts

ARP1917 Clarification of Terms Used in Aerospace Metals Specifications

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM B212 Apparent Density of Free-Flowing Metal Powders Using the Hall Flowmeter

ASTM B213 Flow Rate of Metal Powders Using the Hall Flowmeter

ASTM B214 Sieve Analysis of Granular Metal Powders

ASTM B243 Standard Terminology of Powder Metallurgy

ASTM B417 Standard Test Method for Apparent Density of Non-Free-Flowing Metal Powders Using the Carney Funnel

ASTM B703 Standard Test Method for Apparent Density of Metal Powders and Related Compounds Using the Arnold Meter

ASTM B822 Particle Size Determination of Metal Powders by Light Scattering

ASTM B923 Standard Test Method for Metal Powder Skeletal Density by He or Nitrogen Pycnometry

ASTM B964 Flow Rate of Metal Powder Using the Carney Funnel

ASTM E1019 Determination of Carbon, Sulfur, Nitrogen and Oxygen in Steel, Iron, Nickel, and Cobalt Alloys by Various Combustion and Fusion Techniques

ASTM E1834 Standard Test Method for Analysis of Nickel Alloys by Graphite Furnace Atomic Absorption Spectroscopy

ASTM E2465 Analysis of Ni-Base Alloys by Wavelength Dispersive X-ray Fluorescence Spectrometry

ASTM E2594 Analysis of Nickel Alloys by Inductively Coupled Plasma Atomic Emission Spectrometry

ASTM E2823 Analysis of Nickel Alloys by Inductively Coupled Plasma Mass Spectrometry

ASTM E3047 Standard Test Method for Analysis of Nickel Alloys by Spark Atomic Emission Spectroscopy

ISO/ASTM 52900 Additive Manufacturing - General Principles - Terminology

3. TECHNICAL REQUIREMENTS

3.1 Composition

Shall conform to the percentages by weight shown in Tables 1 and 2, determined by chemical analysis in accordance with ASTM E1834, ASTM E2465, ASTM E2594, ASTM E2823, ASTM E3047, or by other analytical methods acceptable to the purchaser. Carbon, sulfur, oxygen, and nitrogen content shall be determined by ASTM E1019.

Table 1 - Composition

	Min	Max
Carbon	0.05	0.15
Manganese	0.30	1.00
Silicon	0.25	0.75
Phosphorus	-	0.03
Sulfur	-	0.015
Chromium	20.00	24.00
Molybdenum	1.00	3.00
Tungsten	13.00	15.00
Cobalt	-	5.00
Titanium	-	0.10
Aluminum	0.20	0.50
Iron	-	3.00
Lanthanum	0.005	0.05
Boron	-	0.015
Copper	-	0.50
Oxygen	-	see Table 2
Nitrogen	-	0.025
Other Elements, each (3.1.1, 8.10)	-	0.10
Other Elements, total (3.1.1, 8.10)	-	0.50
Nickel		remainder

Table 2 - Oxygen limits based on powder classification

Class	Percent Maximum
A	0.015 (150 ppm)
B	0.030 (300 ppm)
C	0.040 (400 ppm)

3.1.1 Determination not required for routine acceptance.

3.2 Powder Production

Powder shall be manufactured in accordance with AMS7002, with the additional requirements defined in 3.2.1.

3.2.1 Melting

Metal shall be melted in an enclosed vessel under vacuum, argon, or helium gas atmosphere. An argon, or helium gas backfill after pulling vacuum is permissible. Air melting under a cover gas is not permitted. Molten material shall be converted to powder using argon and/or helium gas.

3.2.1.1 Powder Heats and Lots

Powder heat and lot definitions shall be in accordance with AMS7002.