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400 Commonwealth Dr., Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

Submitted for recognition as an American National Standard

MAM 4778

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BRAZING FILLER METAL, NICKEL ALLOY
92Ni - 4.5Si - 3.1B
980° - 1040°C Solidus-Liquidus Range

UNS N99630

1. SCOPE:

1.1 Form: This specification covers a nickel alloy in the form of wire, rod, strip, foil, and powder and a viscous mixture (paste) of the powder in a suitable binder and procured in metric units.

1.1.1 AMS 4778, specified in inch/pound units, is the equivalent of this MAM.

1.2 Application: Primarily for joining corrosion and heat resistant steels and alloys requiring corrosion and oxidation resistant joints with good strength at elevated temperatures. Also may be used as a corrosion and oxidation resistant hard coating. Flows well in most reducing and neutral atmospheres.

1.3 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 which 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.

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 2350 - Standards and Test Methods

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

ASTM B214 - Sieve Analysis of Granular Metal Powders
ASTM D638 - Tensile Properties of Plastics
ASTM E18 - Rockwell Hardness and Rockwell Superficial Hardness of Metallic Materials
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:

	min	max
Carbon	--	0.06
Silicon	4.00	5.00
Phosphorus	--	0.02
Sulfur	--	0.02
Boron	2.75	3.50
Cobalt (3.1.2)	--	0.10
Titanium	--	0.05
Aluminum	--	0.05
Iron	--	0.50
Zirconium	--	0.05
Selenium (3.1.2)	--	0.005 (50 ppm)
Nickel	remainder	

3.1.1 The requirements of 3.1 apply to wire, strip, and paste after removal of the bonding material.

3.1.2 Determination not required for routine acceptance.

3.2 Condition: The product shall be supplied in the following condition:

3.2.1 Wire and Strip: Powder bonded in a suitable plastic.

3.2.2 Rod: As cast, with fins and projections removed.

3.2.3 Foil and Powder: As fabricated.

3.2.4 Paste: Shall consist of 84 - 90% powder in a suitable binder and shall not contain flux.

3.3 Properties: Filler metal shall conform to the following requirements:

3.3.1 Wire and Strip:

3.3.1.1 Burn-Off of Plastic: The plastic used for bonding powder to form wire and strip shall burn off, leaving no undesirable residue, when the product is heated to a temperature not higher than 980°C.

3.3.1.2 Tensile Strength: Shall be not lower than 2.5 MPa, determined in accordance with ASTM D638, Speed B.

3.3.1.3 Metallic Content: The ratio of volume of powder to volume of plastic binder shall be the largest possible consistent with the requirements of 3.3.1.1 and 3.3.1.2.

3.3.2 Rod, Foil, and Powder: Shall have properties as agreed upon by purchaser and vendor.

3.3.3 Paste: Shall leave no undesirable residue when heated in a protective atmosphere to a temperature higher than 540°C. Paste shall have a shelf life of not less than six months; not more than thorough mixing shall be required to restore paste for use during that time.

3.3.4 When used as a hard coating, alloy shall melt quickly and shall flow freely under neutral oxy-acetylene flame, without bubbling or boiling, so as to produce an adherent deposit free from porosity due to blow-holes, gas cavities, or slag inclusions.

3.3.4.1 Alloy, deposited as in 3.3.4, shall have hardness not lower than 25 HRC, or equivalent, determined in accordance with ASTM E18.

3.4 Quality: The product, as received by purchaser, shall be uniform in color, quality, and condition and free from foreign materials and from imperfections detrimental to its working qualities. Rod and powder shall have a metallic luster. Wire, strip, and foil shall be sound, smooth, and free from ragged edges, splitting, damaged ends, and other injurious imperfections.

3.5 Sizes and Tolerances: The product shall be supplied in the following standard sizes and to the tolerances shown:

3.5.1 Wire:

3.5.1.1 Nominal Diameters: 0.8, 1.6, 3.2, and 4.8 millimetres.

3.5.1.2 Diameter Tolerance: ±0.10 mm.

3.5.2 Rod:

3.5.2.1 Nominal Diameters: As ordered.

3.5.2.2 Diameter Tolerance: ±0.8 mm.

3.5.2.3 Concentricity: When long lengths are supplied as welded composites of cast lengths, diameters of adjacent sections shall be concentric within ±0.8 mm.

3.5.3 Strip and Foil: As agreed upon by purchaser and vendor.

3.5.4 Powder:

3.5.4.1 Nominal Size: 140 U.S. Standard.

3.5.4.2 Shall be of such fineness that not more than a trace of powder shall be retained on a 125 µm U.S. Standard sieve, not less than 90% will pass through a 106 µm U.S. Standard sieve, and not more than 50% will pass through a 44 µm U.S. Standard sieve, determined in accordance with ASTM B214.

4. QUALITY ASSURANCE PROVISIONS:

4.1 Responsibility for Inspection: The vendor of the product 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 4.4. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product 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 shall be performed on each lot.

4.3 Sampling: Shall be in accordance with the following; a lot, for other than Ø powder or paste, shall be all product which has been tested and found to conform to 3.1, in the same temper and size, and presented for vendor's inspection at one time; a lot of powder shall be a uniform blend of powder produced from one or more furnace charges, each meeting the requirements of 3.1, and presented for vendor's inspection at one time; and a lot of paste shall be that paste produced from a single lot of powder combined with binder from the same manufacturing batch and presented for vendor's inspection at one time:

4.3.1 Composition: One sample from each lot.

4.3.2 Properties: One sample from each lot.

4.3.3 Other Technical Requirements: As agreed upon by purchaser and vendor.