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INTERNATIONAL
400 Commonwealth Drive, Warrendale, PA 15096-0001

AEROSPACE MATERIAL SPECIFICATION

SAE AMS 7910A

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Superseding AMS 7910

Beryllium Near-Net Preforms
Standard Grade
Cold Isostatic Pressed, Sintered

1. SCOPE:

1.1 Form:

This specification covers beryllium in the form of bar, rod, tubing, and shapes fabricated from beryllium powder consolidated by cold isostatic pressing (CIP) and sintering.

1.2 Application:

These products have been used typically for parts requiring high strength-to-weight ratio and high modulus of elasticity, but usage is not limited to such applications.

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.

1.3.1 WARNING: Beryllium Product. Inhalation of dust or fumes may cause serious chronic lung disease. Potential cancer hazard is based principally on animal tests.

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.

QUESTIONS REGARDING THIS DOCUMENT: (724) 772-7161 FAX: (724) 776-0243
TO PLACE A DOCUMENT ORDER: (724) 776-4970 FAX: (724) 776-0790
SAE WEB ADDRESS: http://www.sae.org

2.1 SAE Publications:

Available from SAE, 400 Commonwealth Drive, Warrendale, PA 15096-0001 or www.sae.org.

AMS 2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels, Corrosion and Heat Resistant Steels and Alloys

2.2 ASTM Publications:

Available from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959 or www.astm.org.

ASTM E 8 Tension Testing of Metallic Materials
ASTM E 8M Tension Testing of Metallic Materials (Metric)
ASTM E 112 Determining Average Grain Size
ASTM E 1417 Liquid Penetrant Examination
ASTM E 1742 Radiographic Examination

2.3 ANSI Publications:

Available from ANSI, 25 West 43rd Street, New York, NY 10036-8002.

ANSI B46.1 Surface Texture
ANSI Y14.5M Dimensioning and Tolerancing

3. TECHNICAL REQUIREMENTS:

3.1 Composition:

Shall conform to the percentages by weight shown in Table 1; beryllium oxide shall be determined by gas fusion; aluminum, iron, magnesium, silicon, and other metallic impurities by spectrochemical methods; carbon by combustion; and beryllium determined by difference. In case of disputes between analysis by different spectrochemical methods, DC plasma shall govern.

TABLE 1 - Composition

Element	min	max
Beryllium Oxide	--	1.5
Aluminum	--	0.10
Carbon	--	0.15
Iron	--	0.13
Magnesium	--	0.08
Silicon	--	0.06
Other Metallic Impurities, each	--	0.04
Beryllium	98.5	--

3.2 Condition:

Cold isostatically pressed (CIP) and sintered with secondary options of flattening, forming or hot isostatically pressing (HIP) and heat treated and/or stress relieved.

3.2.1 Surface Finish: The product shall be furnished with a machined surface. The standard finish of the machined surface shall be no greater than 100 Ra (125 microinches rms), determined in accordance with ANSI B46.1. Some surfaces may be left in coarser as-processed finish as agreed upon by purchaser and vendor.

3.3 Properties:

The product shall conform to the following requirements.

3.3.1 Tensile Properties: Shall be as shown in Table 2, determined at room temperature in accordance with ASTM E 8 or ASTM E 8M.

TABLE 2 - Minimum Tensile Properties

Property	Value
Tensile Strength	38.0 ksi (262 MPa)
Yield Strength at 0.2% Offset	25.0 ksi (172 MPa)
Elongation in 4D	2%

3.3.2 Grain Size: Shall average no larger than 25 microns (25 µm), determined in accordance with ASTM E 112 using the intercept method at 500X magnification.

3.4 Quality:

The product, 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 product.

3.4.1 Soundness:

3.4.1.1 The product shall be free from cracks, determined visually, and, when applicable, by fluorescent penetrant inspection as in 3.4.1.1.1.

3.4.1.1.1 Fluorescent penetrant inspection shall be performed, when agreed upon between purchaser and vendor, in accordance with ASTM E 1417, Level 2.

3.4.1.2 Density shall be at least 99.0% of theoretical density, determined using the water displacement method. The accuracy of density determination shall be to the second decimal or better.

3.4.1.2.1 The theoretical density shall be calculated using Equation 1.

$$\text{Theoretical Density } (\text{gm/cm}^3) = \frac{100}{\frac{100 - \%\text{BeO}}{1.8477\ \text{gm/cm}^3} + \frac{\%\text{BeO}}{3.009\ \text{gm/cm}^3}} \qquad \text{(Eq. 1)}$$

3.4.1.3 Radiographic Inspection: When specified by purchaser, radiographic inspection to a penetrameter sensitivity of 2% shall be performed in accordance with ASTM E 1742; however, exceptions are taken to the penetrameter contrast requirement and applicable area of penetrameter density ranges of +30% or -15% from the density at penetrameter location(s).

3.4.1.3.1 Radiographic indications (voids or inclusions) shall conform to the following requirements:

3.4.1.3.1.1 Maximum dimension of any indication, measured in the plane of the radiograph, shall not exceed 0.060 inch (1.52 mm).

3.4.1.3.1.2 Maximum average dimension of any indication shall be the arithmetic average of the maximum and minimum dimensions measured in the plane of the radiograph and shall not exceed 0.040 inch (1.02 mm).

3.4.1.3.1.3 The total combined volume per cubic inch (16.4 cm^3) of all detectable radiographic indications shall not exceed the volume of a 0.060 inch (1.52 mm) diameter sphere (e.g., total spherical volume shall not exceed 1.1×10^{-4} in^3 [1.84 mm^3]). For calculation purposes, assume all indications are spherical.

3.4.1.3.1.4 Part Density Uniformity: The terms variable density areas, banding, or striations denote relatively large areas of a radiograph, which vary in density as compared to the surrounding area. These areas shall not vary in radiographic density by more than 5% compared to the surrounding area of comparable section thickness. Suspect areas shall be re-radiographed and interpreted with the appropriate penetrameter or beryllium of 5% in thickness placed as follows:

3.4.1.3.1.4.1 Less dense (darker radiograph) areas shall be covered by the penetrameter. The radiograph of the covered area shall appear lighter than that of the adjacent area.

3.4.1.3.1.4.2 More dense (lighter radiograph) areas shall have the penetrameter placed immediately adjacent to them. The radiograph of the covered area shall appear lighter than that of the suspect more-dense area.

3.4.1.3.1.5 Discrete high density (light radiograph) indications, or areas in product 1.00 inch (25.4 mm) thick or less, which are 5% or less in radiographic density variation compared to the surrounding material, are acceptable.

3.5 Tolerances:

Shall conform to the dimensions and dimensional tolerances specified in the purchase order or applicable drawings in accordance with ANSI Y14.5M.

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 the performance of all required tests. Purchaser reserves the right to sample and to perform any confirmatory testing deemed necessary to ensure that the product conforms to specified requirements.

4.2 Classification of Tests:

All technical requirements are acceptance tests and shall be performed on each lot as applicable.

4.3 Sampling and Testing:

Shall be in accordance with the following; a lot shall be all product, processed at the same time manufactured from a specific powder lot, using the same standard CIP cycle and the same thermal processing.

4.3.1 Composition: Not less than one sample from each lot.

4.3.2 Tensile Properties: Not less than one round specimen from each lot at any location.

4.3.3 Grain Size: Not less than one specimen from each lot.

4.3.4 Density: At least five samples per lot unless a different sampling plan is agreed upon by purchaser and vendor.

4.3.5 Radiography: When specified, in accordance with a sampling plan agreed upon by purchaser and vendor.

4.3.6 Penetrant: When specified as agreed upon by purchaser and vendor.

4.3.7 Tolerances: Each part, unless a sampling plan has been agreed upon by purchaser and vendor. Conformance may be ascertained with go no-go gauges instead of actual measurements.