

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

RATIONALE

AMS 7910B is a Five Year Review and update of this specification.

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 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.

1.3.1 WARNING

Beryllium Product: Inhaling dust or fumes may cause chronic beryllium disease, a serious chronic lung disease, in some individuals. Cancer hazard. Over time, lung disease and cancer can be fatal. Target organ is primarily the lung.

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.

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2.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or 724-776-4970 (outside USA), 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 International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

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

2.3 ASME Publications

Available from American Society of Mechanical Engineers, 22 Law Drive, P.O. Box 2900, Fairfield, NJ 07007-2900, Tel: 973-882-1170, www.asme.org.

ASME B46.1 Surface Texture
 ASME 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 elements by spectrochemical methods; carbon by combustion; and beryllium determined by difference. In case of disputes between analysis by different spectrochemical methods, IC 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 Elements, each (3.1.1)	--	0.04
Beryllium	98.5	--

3.1.1 Determination is not required for routine acceptance of each lot.

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

If surface finish is not specified, the material shall be furnished with an as-sawed, as CIP, as HIP, sintered, heat treated, and/or machined surface. Machined surfaces shall have surface finish no greater than 100 Ra (125 microinches rms), determined in accordance with ASME B46.1.

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.

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.

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

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). The decision to accept or reject may be made directly beneath the IQI/Shim combination.

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 cm³) 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} in³ [1.84 mm³]). 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 penetrometer or beryllium of 5% in thickness placed as follows:

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

b. More dense (lighter radiograph) areas shall have the penetrometer 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. (Note: The minimum detectable size of voids and inclusions will increase as the section thickness increases.)

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.