



AEROSPACE MATERIAL SPECIFICATION

AMS7910™**REV. E**

Issued 1992-07
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Revised 2024-12

Superseding AMS7910D

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

RATIONALE

AMS7910E results from a Five-Year Review and update of this specification with changes to prohibit unauthorized exceptions (see 3.6, 4.4.1, 5.1.1, and 8.4); update Form (see 1.1), Applicable Documents (see Section 2 and 2.4), Condition (see 3.2), Surface Finish (see 3.2.1), Average Grain Size (see 3.3.2), and Surface Condition (see 3.4.3); and allow the use of the immediate prior specification revision (see 8.3).

1. SCOPE

1.1 Form

This specification covers beryllium in the form of bar, rod, tubing, and shapes fabricated from impact-ground 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

Inhaling dust or fumes containing beryllium may cause chronic beryllium disease, a serious chronic lung disease, in some individuals. Over time, lung disease can be fatal. Read the product-specific Safety Data Sheet (SDS) for additional environmental, health, and safety information before working with beryllium or beryllium-containing materials.

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SAE reviews each technical report at least every five years at which time it may be revised, reaffirmed, stabilized, or cancelled. SAE invites your written comments and suggestions.

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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.

AMS2806 Identification, Bars, Wire, Mechanical Tubing, and Extrusions, Carbon and Alloy Steels and Corrosion and Heat-Resistant Steels and Alloys

AS7766 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 E8/E8M Tension Testing of Metallic Materials

ASTM E112 Determining Average Grain Size

ASTM E1417/E1417M Liquid Penetrant Testing

ASTM E1742/E1742M Radiographic Examination

2.3 ASME Publications

Available from ASME, P.O. Box 2900, 22 Law Drive, Fairfield, NJ 07007-2900, Tel: 800-843-2763 (U.S./Canada), 001-800-843-2763 (Mexico), 973-882-1170 (outside North America), www.asme.org.

ASME B46.1 Surface Texture

ASME Y14.5M Dimensioning and Tolerancing

2.4 Definitions

Terms used in AMS are defined in AS7766.

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 by difference. In case of disputes between analyses by different spectrochemical methods, emission spectroscopy 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 (see 3.1.1)	--	0.04
Beryllium	98.5	--

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

3.2 Condition

Impact-ground powder 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 125 microinches Ra (3.2 μm), 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 E8/E8M with the rate of strain set at 0.005 in/in/min (0.005 mm/mm/min) and maintained within a tolerance of ± 0.002 in/in/min (± 0.002 mm/mm/min) through the 0.2% offset yield strain and may be increased thereafter to 0.05 in/in/min (0.05 mm/mm/min).

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 Average Grain Size

The average grain size shall be determined in accordance with ASTM E112. The mean intercept length shall be no larger than 25 μm .

3.4 Quality

The product, as received by the 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 Density

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.

3.4.1.1 The theoretical density shall be calculated using Equation 1.

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

3.4.2 Radiographic Inspection

When specified by the purchaser, radiographic inspection to a penetrameter sensitivity of 2% shall be performed in accordance with ASTM E1742/E1742M; 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.

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

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

3.4.2.1.2 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).

3.4.2.1.3 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 $1.1 \times 10^{-4} \text{ in}^3$ [1.84 mm³]). For calculation purposes, assume all indications are spherical.

3.4.2.1.4 Part Density Uniformity

The terms variable density areas, banding, or striations denote relatively large areas of a radiograph that 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:

- a. 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.
- b. 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.

3.4.2.1.4.1 Discrete high-density (light radiograph) indications, or areas in product 1.000 inch (25.40 mm) and under in nominal thickness, 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.

3.4.3 Surface Condition

3.4.3.1 The product shall be free from cracks determined visually. When agreed upon between the purchaser and producer, penetrant inspection shall be performed in accordance with ASTM E1417/E1417M, Type 1, Level 2.

3.5 Tolerances

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

3.6 Exceptions

Any exceptions shall be authorized by the purchaser and reported as in 4.4.1.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection

The producer of the product shall supply all samples for the producer's tests and shall be responsible for the performance of all required tests. The 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 the purchaser and producer.

4.3.5 Radiography

When specified, in accordance with a sampling plan agreed upon by the purchaser and producer.

4.3.6 Penetrant

When specified as agreed upon by the purchaser and producer (see 3.4.3.1).

4.3.7 Tolerances

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

4.4 Reports

The producer of the product shall furnish with each shipment a report showing the results of tests for composition, tensile properties, and grain size of each lot and stating that the product conforms to the other technical requirements. This report shall include the purchase order number, lot number, AMS7910E, condition of material per 3.2, serial numbers, and quantity. When radiographic inspection is specified by the purchaser, radiographic films shall be submitted with the shipment.