

S-200-F C Beryllium Shapes

Effective: March 29, 2012

Rev. C

1. SCOPE

This specification defines the requirements for standard beryllium shapes designated as S-200-F C. This standard grade is produced from beryllium powder consolidated by cold isostatic pressing (CIP) and sintering.

2. CHEMICAL COMPOSITION

2.1. The chemical composition shall conform to the following:

Beryllium Assay, % minimum (1)	98.5
Beryllium Oxide, % maximum (2)	1.5
Aluminum, % maximum (3)	0.10
Carbon, % maximum (4)	0.15
Iron, % maximum (3)	0.13
Magnesium, % maximum (3)	0.08
Silicon, % maximum (3)	0.06
Other Metallic Impurities, % maximum inch each (3)	0.04

Note: (1) Difference (i.e. 100% - other elements)
 (2) Leco Inert Gas Fusion
 (3) Spectrochemical Methods
 (4) Leco Combustion

3. DENSITY

- 3.1. The minimum bulk density shall be 99.0% Theoretical Density.
 3.2. The theoretical density is to be calculated using the following formula:
- $$\text{Theoretical Density (gm/cc)} = \frac{100 - \% \text{ BeO}}{1.8477 \text{ gm/cc}} + \frac{100\%}{3.009 \text{ gm/cc}} \times \% \text{ BeO}$$
- 3.3. Density shall be determined using the water displacement method.
 3.4. At least five (5) samples per lot shall be tested, unless a different sampling plan is agreed upon by purchaser and vendor.

4. TENSILE PROPERTIES

- 4.1. Minimum tensile properties for the material at room temperature, as determined per ASTM E 8, preparation per MAB-205 M shall be:
- | | |
|--|----|
| Ultimate Tensile Strength, Ksi, minimum | 38 |
| Yield Strength (0.2% offset), Ksi, minimum | 25 |
| Elongation (% in 4 diameters), minimum | 2 |
- 4.2. Mechanical properties shall be determined for each lot of shapes. Reference Section 12 for lot definition.

5. SURFACE FINISH

- 5.1. The shapes are available with an “as processed” surface or with a machined surface. The “as-processed” surface may be pitted with a slight surface porosity. The standard surface finish on a machined shape shall be 125 micro-inches rms (approximately 110 micro-inches Ra) maximum, employing ANSI/ASME B46.1.

6. PENETRANT INSPECTION

Penetrant inspection, only when required by the purchase order, shall be as follows:

- 6.1. Penetrant and visual acceptance criteria for “as processed” surfaces.
- 6.1.1. Penetrant inspection will be to detect cracks only.
- 6.1.2. Cracks that violate the customer finished part are not permissible.
- 6.2. Penetrant and visual acceptance criteria for machined surfaces.
- 6.2.1. Cracks are not permissible
- 6.2.2. Penetrant inspection indications
1. The size of an individual indication on the surface may not exceed 0.050” (1.27 mm).
 2. A maximum of 3 indications of the size 0.003” to 0.050” (0.08mm to 1.27mm) per inch² (650mm²) of the surface is acceptable.
 3. No restrictions to size or number, if they do not hold Zygo.
- 6.3. Penetrant inspection shall be performed per ASTM E1417 using penetrants and a dry developer conforming to MIL-I-25135, Type 1, Level 2, Method B, Form A. Personnel performing this inspection shall be certified in accordance with AMS-410 and MIL-STD-410.

7. RADIOGRAPHIC INSPECTION

- 7.1. Radiographic inspection (for fully machined parts only) acceptance requirements, only when specified on the purchase order, shall be as follows: (Reference definitions in Section 7.3).
- 7.1.1. Radiographic inspections acceptance criteria shall be as defined below:

Maximum Dimension	Max. Avg. Dimension	Total Combined Volume Per Cubic Inch
0.060 inch	0.040 inch	Sphere 0.060 inch dia.

- 7.1.2. Radiographic inspection shall reveal no cracks that violate the finished customer part.
- 7.2. Radiographic inspection to penetrometer sensitivity of 2% shall be performed in accordance with ASTM E1742, however exceptions are taken to the penetrometer contrast requirement and the applicable area of penetrometer density ranges of +30% or -15% from the density at penetrometer locations. The decision to accept or reject may be made directly beneath the penetrameters.
- Note:** Due to the nature of radiographic inspection, it is noted that the sensitivity of the inspection method decreases with increasing material thickness.
- 7.3. Definitions of Radiographic Indications
- 7.3.1. Maximum Average Dimension of any Indications
Any dimension of an indication measured in the plane of the radiograph shall not exceed the indicated size.
- 7.3.2. Maximum Average Dimension of any Indication
The average dimensions of an indication shall be the arithmetic average of the maximum and minimum dimensions measured in the plane of the radiograph. The average dimension of an indication shall not exceed the indicated average.
- 7.3.3. Total Combined Volume Per cubic Inch of all Indications
The total combined volume per cubic inch (16.4 cc) of all indications with an average dimension larger than 0.001 inch (0.025 mm) shall not exceed the volume of a sphere of the indicated volume.
- 7.3.4. Uniformity of Part Radiographic Density
The terms variable radiographic density areas, banding or striations shall denote relatively large areas of a radiograph, which vary in radiographic density as compared to the surrounding area. These areas shall not

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vary in radiographic density by more than 5% as compared to the surrounding area of comparable section thickness.

7.3.5. Light high density radiographic indications or areas in material 1.000" (25.4mm) thick or less, which are 5% or less in radiographic density compared to the surrounding material are radiographically acceptable.

8. GRAIN SIZE

8.1. The average grain size shall be determined in accordance with ASTM E-112, using the intercept method at 500X magnification.

8.2. The average grain size shall not exceed 25 microns.

9. TOLERANCES

9.1. Material furnished under this specification shall conform to the dimensions and dimensional tolerances established by the purchase order and applicable drawings.

10. REPORTS

10.1. Certification of compliance with this specification will be furnished on request and when specified, actual test results will be certified. Additional testing in accordance with customer instructions will be performed, if mutually acceptable, and actual test results will be certified.

11. MARKING

11.1. Each part, surface area permitting, will be legibly marked to give the following information.

Specification Number
Lot and Serial Numbers
X-Ray Number (if required)
Manufacturer's Identification
WARNING: Beryllium

or as specified by the customer or its agent and agreed to by Materion Brush, Inc.

12. SAMPLING REQUIREMENTS

A production lot will consist of a finite number of shapes originated from a common input powder batch (blend), manufactured during the same process run and having the same thermal history. Sampling requirements for verification of the following properties of a production lot will be as specified by Materion Brush, Inc unless negotiated otherwise with the customer or their agent.

Chemical Analysis
Density Uniformity
Mechanical Properties
X-Ray Requirements (if applicable)
Grain Size

13. SAFETY / ENVIRONMENTAL

Handling Beryllium Containing Material in solid form poses no special health risk. Like many industrial materials, beryllium-containing materials may pose a health risk if recommended safe handling practices are not followed. Inhalation of airborne beryllium may cause a serious lung disorder in susceptible individuals. The Occupational Safety and Health Administration (OSHA) has set mandatory limits on occupational respiratory exposures. Read and follow the guidance in the Material Safety Data Sheet (MSDS) before working with this material. For additional information on safe handling practices or technical data on Beryllium Containing Material, contact Materion Brush Beryllium & Composites, EH&S Product Steward @ 216-383-4040

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