



## S-200-F C Beryllium Shapes

Effective: November 6<sup>th</sup> 2014

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, % max 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:

$$\text{Theoretical Density} = \frac{100\%}{\frac{100-\%BeO}{1.8477\text{gm/cc}} + \frac{\%BeO}{3.009 \text{ gm/cc}}}$$

- 3.3. Density shall be determined using the water displacement method.
- 3.4. A minimum of 5 samples per lot shall be tested, unless a different sampling plan is agreed upon by the purchaser and vendor

### 4. TENSILE PROPERTIES

- 4.1. Minimum tensile properties for the material at room temperature, as determined per ASTM E 8 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.

### 5. PENETRANT INSPECTION

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

- 5.1. Penetrant and visual acceptance criteria for machined surfaces
  - A. Cracks are not permissible
  - B. Pores (as determined by penetrant):
    - 1. The size of an individual pore on the surface may not exceed 0.050".
    - 2. A maximum of 3 pores (of the size 0.003" to 0.050") per square inch of the surface is acceptable.
    - 3. No restrictions to the size or number if they do not hold penetrant.

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- 5.2 Penetrant and visual acceptance for “as processed” surfaces.
  - 5.2.1 Penetrant inspection will be to detect cracks only.
  - 5.2.2 Cracks that violate the customer finished part are not permissible.
- 5.3 Penetrant inspection shall be performed per ASTM E 1417, using penetrants and a dry developer conforming to MIL-I-25135, Type I, Level 2, Method B, Form A. Personnel performing this inspection shall be certified in accordance with NAS-410.

6. RADIOGRAPHIC INSPECTION

Radiographic inspection (for fully machined parts only) acceptance requirements, only when specified on purchase order, shall be as follows:

- 6.1. Radiographic inspection to penetrameter sensitivity of 2% shall be performed in accordance with ASTM E1742. However, exceptions are taken to the penetrameter contrast requirement and the applicable area of penetrameter density ranges of +30% or -15% from the density at penetrameter 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.**

- 6.2. Radiographic indications (voids and/or inclusions) shall conform to the requirements as established and defined below. Radiographic inspection shall reveal no cracks that violate the finished customer part.

6.2.1. Requirements:

Material shall conform to the following requirements, as defined in 6.2.2

Maximum Dimension	Maximum Average Dimension	Total Combined Volume per Cubic Inch
0.060 inch	0.040 inch	Sphere 0.060 inch diameter

6.2.2. Definitions:

6.2.2.1. Maximum Dimension of any indication.

Any dimension of any indication measured in the plane of the radiograph.

6.2.2.2. Maximum Average Dimension of any indication.

The average dimension of an indication shall be the arithmetic average of the maximum and minimum dimensions measured in the plane of the radiograph.

6.2.2.3. Total Combined Volume Per Cubic Inch of all indications.

The total combined volume per cubic inch of all indications with an average dimension larger than 0.001 inch.

6.2.2.4. The minimum detectable size of voids and inclusions will increase as the section thickness increases, due to the decreased sensitivity referred to in paragraph 6.1.

6.2.2.5. Part Density Uniformity

The terms variable density areas, banding or striations shall 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% as compared to the surrounding area of comparable section thickness.

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

## 7.GRAIN SIZE

- 7.1. The average grain size shall be determined in accordance with ASTM E-112, using the intercept method at 500X magnification.
- 7.2. The average grain size shall not exceed 25 microns.

## 8.TOLERANCES

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

## 9.SURFACE FINISH

- 9.1. 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.

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## 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. Surface area permitting, each part will be legibly marked employing an electro etching technique or tagging if insufficient area is available.
- 11.2. Marking is to include the following:

Materion Brush Inc. (MBI)

Lot and/or Part Number

Serial Number

Specification Number

X-Ray Number

Purchase Order Number

WARNING: Beryllium

## 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

- 13.1 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 Beryllium & Composites, EH&S Product Steward @ 216-383-4040

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