

**S-200-F  
Standard Grade Beryllium**

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

Rev. C

**1. SCOPE**

This specification defines the requirements for a standard grade of beryllium designated as S-200-F. This standard grade is to be produced through the consolidation of beryllium powder by vacuum hot pressing. Parts and shapes are machined from the vacuum hot pressed material.

**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.

### 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    | 47.0 |
| Yield Strength (0.2% offset), ksi, minimum | 35.0 |
| Elongation (% in 4 diameters), minimum     | 2.0  |

### 5.PENETRANT INSPECTION

5.1. Penetrant and Visual Acceptance Criteria

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.

5.2. 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.

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## 6. RADIOGRAPHIC INSPECTION

- 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.

### 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 |
|---------|-------------------|---------------------------|--------------------------------------|
| Type I  | 0.030 inch        | 0.020 inch                | Sphere 0.050 inch diameter           |
| Type II | 0.030 inch        | 0.020 inch                | Sphere 0.032 inch diameter           |

### 6.2.2. Dimensions:

#### 6.2.2.1. Maximum Dimension of any indication.

Any dimension of any indication measured in the plane of the radiograph shall not exceed 0.030 inch.

#### 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. The average dimension of an indication shall not exceed 0.020 inch.

#### 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 shall not exceed the volume of a sphere of the indicated volume.

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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 20 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. If tolerances are not specified by purchase order, the following tolerances shall apply, employing ANSI Y 14.5M:

| <u>Diameter, Width or Thickness, Inches</u> | <u>Tolerance</u> |
|---|------------------|
| Up to 3, inclusive                          | -0 + 1/64        |
| Over 3 to 20, inclusive                     | -0 + 1/16        |
| Over 20, inclusive                          | -0 + 1/4         |

| <u>Length, Inches</u> | <u>Tolerance</u> |
|-----------------------|------------------|
| Up to 20, inclusive   | -0 + 1/8         |
| Over 20               | -0 + 1/4         |

## 9.SURFACE FINISH

9.1. The materials shall be furnished with a machined surface. The standard surface finish 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. SAFETY / ENVIRONMENTAL

- 12.1. 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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