

## Dry-Pressed Ceramics As-Fired or Machined CDDP-10 Rev F

### 1.0 General Provisions

- Materion Ceramics, Inc. will provide written Certification of Compliance to this specification upon request.
- Normal inspection is performed in accordance with ANSI/ASQ Z1.4-1993.
- The term “Lot” is defined to include parts formed from the same powder batch and fired in the same kiln firing.
- Visual defects are defined according to ASTM F-109.
- All dimensions are interpreted per ASME Y14.5 M 1994.
- The products produced to this specification are required to meet all the values listed in Section 2, 3, 4, 5 & 6. The properties tested in Section 7 are offered as typical properties of the ceramic and are not evaluated on a lot-to-lot basis, unless otherwise noted.
- For areas not covered by this specification ASTM F-356-91 applies. (Standard Specification for Beryllia Ceramics for Electronic and Electrical Applications).
- Unless otherwise stated on the purchase order, all Dry Pressed Ceramics will be manufactured and inspected to Visual Level 2 as per Section 7.0 and Dimensional Class 2 as per Section 5.

### 2.0 Chemical Composition (Powder Batch)

- Beryllium Oxide (BeO) is usually described as 99.5% minimum. The 99.5% minimum is defined to be 100 percent minus the total percentage of metallic impurities. The metallic impurity content is determined by emission spectroscopy.

### 3.0 Test Conditions

- All physical, mechanical and electrical testing are performed at room temperature, except where noted.

### 4.0 Dimensional As-Fired Material

- Length/Width =  $\pm 1\%$  but NLT 0.003” (0.0762 mm)\*
- Thickness =  $\pm 2\%$  but NLT 0.003” (0.0762)
- Hole Diameter and Location =  $\pm 1\%$  but NLT 0.005” (0.127 mm)\*
- Flat and Parallel = 0.004” in/in but NLT 0.002” (0.0508 mm) TIR
- Parallel through Thickness:
  - Parts up to 0.5” (12.7 mm) Length or Diameter = 0.001” (0.0254 mm) Max
  - Parts 0.5” (12.7 mm) to 1.0” (25.4 mm) Length or Diameter = 0.002” (0.0508 mm) max
  - Parts 1.0” (25.4 mm) and above Length or Diameter = 0.004” (0.1016 mm) Max
- Surface Finish – 15 Ra max
- For parts with extreme area-to-thickness ratios, exceptions to the above tolerances may be required.

\*Tighter tolerances may be held for additional costs.



## 5.0 Dimensional Machined Material (Lot Sample)

Dimensional Tolerances	Class 1	Class 2	Class 3
Length (outside)	±0.0005" (0.0127 mm)	±0.001" (0.0254 mm)	±0.005" (0.127 mm)
Diameter	±0.0005" (0.0127 mm)	±0.001" (0.0254 mm)	±0.005" (0.127 mm)
I.D. Tubes	±0.0005" (0.0127 mm)	±0.001" (0.0254 mm)	±0.005" (0.127 mm)
Hole Diameter	±0.0005" (0.0127 mm)	±0.001" (0.0254 mm)	±0.005" (0.127 mm)
Hole Location	±0.001" (0.0254 mm)	±0.005" (0.127 mm)	±0.010" (0.254 mm)
Concentricity, TIR	0.001" (0.0254 mm)	±0.005" (0.127 mm)	±0.010" (0.254 mm)
Roundness	Within dimensional tolerance		
Radius	±0.001" (0.0254 mm)	±0.005" (0.127 mm)	±0.010" (0.254 mm)
Angle, Degree	±1/2 degree	±1 degree	±2 degrees
Flatness (plates)	0.0005" (0.0127 mm)	0.001" (0.0254 mm)	0.002" (0.0508 mm)
Camber in/in max	0.0005" (0.0127 mm)	0.001" (0.0254 mm)	0.015" (0.0381 mm)
Parallelism, TIR	0.0005" (0.0127 mm)	0.001" (0.0254 mm)	0.002" (0.0508 mm)
Surface Finish Ra Max	16	32	64

Where tolerances are not specified, standard tolerances will be used as follows:

Three decimal places	±0.005" (0.127 mm)
Two decimal places	±0.010" (0.254 mm)
Fraction	± 1/64" (0.3962 mm)
Angles	± 1 degree

## 6.0 Visual Defect Criteria

Visual Defects ASTM F109	Machined Level 1 Max	Machined Level 2 Max	As Fired Blank Level 3 Max
Blemish	Acceptable	Acceptable	Acceptable
Blister	0.001" (0.0254 mm) height	0.001" (0.0254 mm) height	0.001" (0.0254 mm) height
Burr, Fin, Flash	0.001" (0.0254 mm) height	0.001" (0.0254 mm) height	0.003" (0.0762 mm) height
Chip (Open or closed) Chip length unlimited	(W is wide – onto face) (D is depth – down edge)	(W is wide – onto face) (D is depth – down edge)	(W is wide – onto face) (D is depth – down edge)
Parts up to 0.5" (12.7 mm) length or diameter	0.020" W x 0.020" D (0.508 mm W x 0.508 mm D)	0.030" W x 0.030" D (0.762 mm W x 0.762 mm D)	0.040" W x 0.040" D (1.016 mm W x 1.016 mm D)
Parts 0.5" to 1.0" (12.7 mm to 25.4 mm) length or diameter	0.030" W x 0.030" D (0.762 mm W x 0.762 mm D)	0.040" W x 0.040" D (1.016 mm W x 1.016 mm D)	0.060" W x 0.060" D (1.524 mm W x 1.524 mm D)
Parts 1.0" to 2.0" (25.4 mm to 50.8 mm) length or diameter	0.030" W x 0.030" D (0.762 mm W x 0.762 mm D)	0.040" W x 0.040" D (1.016 mm W x 1.016 mm D)	0.080" W x 0.080" D (2.032 mm W x 2.032 mm D)
Parts per 2.0" (50.8 mm) length or diameter	0.040" W x 0.040" D (1.016 mm W x 1.016 mm D)	0.050" W x 0.050" D (1.27 mm W x 1.27 mm D)	0.100" W x 0.100" D (2.54 mm W x 2.54 mm D)
Cracks & Lamination Part size is Length or Dia. Parts Below 0.5" (12.7 mm) Parts 0.5" to 1.0" (12.7mm to 25.4 mm) Parts above 1.0" (25.4 mm)	None allowed <0.010" (0.254 mm) into part	<0.010" (0.254 mm) into part < 0.020" (0.508 mm) into part	<0.020" (0.508 mm) into part <0.040" (1.016 mm) into part
Grinding Marks	0.001" (0.0254 mm) depth	0.001" (0.0254 mm) depth	0.001" (0.0254 mm) depth
Inclusion	0.015 (0.381 mm) dia	0.015 (0.381 mm) dia	0.030" (0.762 mm) dia
Pit, Pock, Pullout, Pore, Hole, Void, Porous, Dents	0.010 (0.254 mm) dia	0.020" (0.508 mm) dia	0.050" (1.27 mm) dia

## 7.0 Typical Properties

Property	Test Method	Value
Chemical <ul style="list-style-type: none"> <li>BeO Content</li> </ul>	Spectrographic by difference	99.5% min
Thermal <ul style="list-style-type: none"> <li>Coefficient of Thermal Expansion</li> <li>Conductivity</li> </ul>	ASTM E-228-95 Laser Flash Method  Axial Rod Method (Ref ASTM C-408-88)	(25-1000°C) $9.0 \times 10^{-6}/^{\circ}\text{C}$ @ 25°C 285 W/mK @ 100°C 220 W/mK @ 150°C 180 W/mK @ 25°C 251 W/mK @ 100°C 188 W/mK @ 150°C 150 W/mK
<ul style="list-style-type: none"> <li>Specific Heat</li> </ul>	ASTM C-351-92b	0.25 cal/gm C)
Electrical <ul style="list-style-type: none"> <li>Dielectric Constant</li> <li>Dissipation Factor</li> <li>Volume Resistivity</li> <li>Dielectric Strength</li> </ul>	ASTM D-150-95 ASTM D-2520-95 ASTM D-150-95 ASTM D-2520-95 ASTM D-257-93 ASTM D-116-86	@ 1MHz 6.73 @ 9.3 GHz 6.67 @ 1MHz 0.0004 Max @ 9.3 GHz 0.004 Max > $10^{15}$ ohm-cm ¼" (6.35 mm) thick 230V/mil
Physical <ul style="list-style-type: none"> <li>Density</li> <li>Hardness</li> <li>Average Grain Size**</li> <li>Impenetrability, Liquid</li> </ul>	ASTM C-373-88 ASTM E-18-96 Linear Intercept Method (Ref ASTM E-112-96) ASTM E-165-95 or other dye penetrants	2.85 g/cm <sup>3</sup> , Minimum Average Rockwell 45N 60 min. 9-25 microns (surface) Impervious
Mechanical <ul style="list-style-type: none"> <li>Flexural Strength**</li> <li>Modulus of Elasticity</li> <li>Poisson's Ratio</li> <li>Tensile Strength</li> <li>Compressive Strength</li> </ul>	ASTM F-417-78 ASTM C-623-92 ASTM C-565-93 ASTM C-565-93 ASTM C-773-88	32,000 psi $50 \times 10^6$ psi 0.26 22,000 psi 225,000 psi
Gas Impenetrability	He-Mass Spectrometer	$10^{-8}$ cc/sec. Helium

\*\*Due to geometry and size of specific parts, the grain size and flexural strength may vary from nominal values.

### Health and Safety

Handling beryllium oxide ceramics 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 oxide ceramics, contact Materion Ceramics at 520-746-0251.

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