

Isopressed Ceramics CDI-20, Rev E

General Provisions

- Brush Ceramic Products, 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. The properties tested 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.

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.

Test Conditions

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

As-Fired Dimensional Tolerances

Dimensional Tolerances	Class 1 Machined Before Firing	Class 2 As Pressed	Class 3 As Pressed
Tubes and Rods			
• Outside diameter	±1% NLT 0.005” (0.127 mm)	±2% NLT 1/16” (1.5875 mm)	±6% NLT 1/8” (3.175 mm)
• Inside diameter	±1% NLT 0.003” (0.0762 mm)	±1-1/2% NLT 0.005” (0.127 mm)	±2 NLT 0.010” (0.254 mm)
• Length	±1% NLT 0.005” (0.127 mm)	±4% NLT 1/16” (1.5875 mm)	±6% NLT 1/8” (3.175 mm)
• Concentricity	±1% NLT 0.005” (0.127 mm)	±5% NLT 0.010” (0.254 mm)	±10% NLT 0.025” (0.635mm)
• Camber, Max.	0.001 in/in	0.003 in/in	0.006 in/in
Ellipticity (roundness)	Within dimensional tolerances		
Bars, Plate, Blocks			
Width & Thickness	±1% NLT 0.005” (0.127 mm)	±4% NLT 1/16” (1.5875 mm)	±6% NLT 1/8” (3.175 mm)
Length	±1% NLT 0.005” (0.127 mm)	±4% NLT 1/16” (1.5875 mm)	±6% NLT 1/8” (3.175 mm)
	Within dimensional tolerances		
Bolt Pattern	±0.020” (0.508 mm)	±0.020” (0.508 mm)	±0.020” (0.508 mm)

Note 1: Bars, Plates & Blocks have 1/8” (3.175 mm) nominal radius.

Note 2: For extreme thin sections, some exceptions may be required.

Typical Properties

Property	Test Method	Value
Chemical <ul style="list-style-type: none"> BeO Content 	Spectrographic by difference	99.5% min
Thermal <ul style="list-style-type: none"> Coefficient of Thermal Expansion Conductivity Specific Heat 	ASTM E-228-95 Laser Flash Method Axial Rod Method (Ref ASTM C-408-88) ASTM C-351-92b	(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 0.25 cal/gm C)
Electrical <ul style="list-style-type: none"> Dielectric Constant Dissipation Factor Volume Resistivity Dielectric Strength 	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 0.004 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"> Density Hardness Average Grain Size** Impenetrability, Liquid 	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 ³ , Minimum Average Rockwell 45N 60 min. 9-25 microns (surface) Impervious
Mechanical <ul style="list-style-type: none"> Flexural Strength** Modulus of Elasticity Poisson's Ratio Tensile Strength Compressive Strength 	ASTM F-417-78 ASTM C-623-92 ASTM C-565-93 ASTM C-565-93 ASTM C-773-88	32,000 psi 50 x 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.

Large Parts

Parts which require especially long firing cycles due to their size have coarser grains and lower mechanical strength. Such parts typically include machining stock or parts whose dimensions exceed one inch (25.4 mm). There may be variation of properties within large parts. The outgoing quality of the large parts is required to conform to the bulk or samples properties set forth below. Variation within the large parts not detected in the above tests is considered normal to this product and is not cause for return or rejection.

On the basis of bulk testing or limited sampling of material near the surface, the large parts shall meet the following properties:

- Bulk density 2.85 g/cc min
- Grain Size 15 to 40 µm average
- Flexural strength 25,000 psi minimum average.

Visual Defect Criteria

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Visual Defects ASTM F109	Machined Level 1 Max	Machined Level 2 Max	As Fired Blank Level 3 Max
Blemish	None	0.030" (0.762 mm)	0.100" (2.54 mm)
Blister	None	0.015" (0.381 mm)	0.030" (0.762 mm)
Burr, Fin, Flash	None	None	Within dimensional tolerances
Chip (Open or closed) Chip length unlimited Parts up to 0.5" (12.7 mm) length or diameter	0.015" W x 0.015" D (0.381 mm W x 0.381 mm D)	0.020" W x 0.020" D (0.508 mm W x 0.508 mm D)	Within dimensional tolerances
Parts 0.5" to 1.0" (12.7 mm to 25.4 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)	Within dimensional tolerances
Parts 1.0" to 2.0" (25.4 mm to 50.8 mm) length or diameter	0.025" W x 0.025" D (0.635 mm W x 0.635 mm D)	0.040" W x 0.040" D (1.016 mm W x 1.016 mm D)	Within dimensional tolerances
Parts per 2.0" (50.8 mm) length or diameter	0.030" W x 0.030" D (0.762 mm W x 0.762 mm D)	0.050" W x 0.050" D (1.27 mm W x 1.27 mm D)	Within dimensional tolerances
Cracks & Lamination	None	Less than 0.015" (0.381 mm) into part	Within dimensional tolerances
Grinding Marks	Within surface finish tolerance	Within surface finish tolerances	N/A
Inclusion	None	0.010" (0.254 mm)	0.030" (0.762 mm)
Pit, Rock, Hole, Porous Area	0.015" (0.381 mm)	0.025" (0.635 mm)	0.050" (1.27 mm)

Machined Dimensional Tolerances

Dimensional Tolerances	Class 1	Class 2	Class 3	Class 4
Length (outside)	$\pm 0.0005"$ (0.0127 mm)	$\pm 0.001"$ (0.0254 mm)	$\pm 0.005"$ (0.127 mm)	$\pm 0.010"$ (0.254 mm)
Diameter (outside)	$\pm 0.0005"$ (0.0127 mm)	$\pm 0.001"$ (0.0254 mm)	$\pm 0.005"$ (0.127 mm)	$\pm 0.010"$ (0.254 mm)
I.D. Tubes	$\pm 0.0005"$ (0.0127 mm)	$\pm 0.001"$ (0.0254 mm)	$\pm 0.005"$ (0.127 mm)	$\pm 0.010"$ (0.254 mm)
Hole Diameter	$\pm 0.0005"$ (0.0127 mm)	$\pm 0.001"$ (0.0254 mm)	$\pm 0.005"$ (0.1274 mm)	$\pm 0.010"$ (0.254 mm)
Hole Location	$\pm 0.0005"$ (0.0127 mm)	$\pm 0.001"$ (0.0254 mm)	$\pm 0.010"$ (0.254 mm)	N/A
Concentricity, TIR	0.001" (0.0254 mm)	0.005" (0.127 mm)	0.010" (0.254 mm)	N/A
Roundness	Within dimensional tolerance			N/A
Radius	$\pm 0.001"$ (0.0254 mm)	$\pm 0.005"$ (0.127 mm)	$\pm 0.010"$ (0.254 mm)	N/A
Angle, Degree	$\pm 1/2$ degree	± 1 degree	± 2 degree	± 5 degree
Flatness (plates)	$\pm 0.0005"$ (0.0127 mm)	$\pm 0.001"$ (0.0254 mm)	$\pm 0.002"$ (0.0508 mm)	$\pm 0.005"$ (0.127 mm)
Camber in/in max	$\pm 0.0005"$ (0.0127 mm)	$\pm 0.001"$ (0.0254 mm)	$\pm 0.015"$ (0.381 mm)	$\pm 0.002"$ (0.0508 mm)
Parallelism, TIR	$\pm 0.0005"$ (0.0127 mm)	$\pm 0.001"$ (0.0254 mm)	$\pm 0.002"$ (0.0508 mm)	$\pm 0.005"$ (0.127 mm)
Surface Finish Ra Max	32	64	64	N/A

Tighter tolerances may be held for additional costs.

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

Three decimal places	$\pm 0.005"$ (0.127 mm)
Two decimal places	$\pm 0.010"$ (0.254 mm)
Fractions	$\pm 1/64"$ (0.3962 mm)
Angles	± 1 degree

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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