CeramTec

CeramTec North America Corporation

Welcome to the World of High-Performance Ceramics

Advanced Ceramic-to-Metal & Glass-Ceramic Sealing Technology

The Company — The Technology

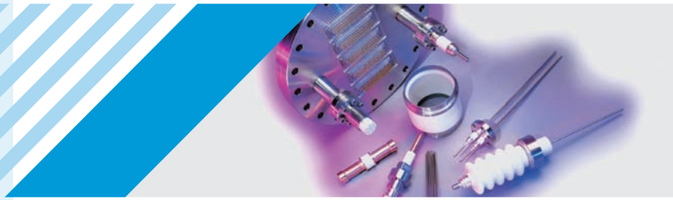
CeramTec began pioneering ceramic-to-metal technology in 1951 and has been the leader in providing innovative solutions for demanding applications ever since. When faced with a design challenge, our engineers optimize materials and seal configurations to minimize stresses and produce high-reliability hermetic assemblies. Manufacturing personnel at CeramTec use state-of-the-art coating and metallizing equipment, and then utilize one of our many vacuum or atmosphere furnaces to process anything from the tiniest feedthrough to eight foot long isolators. Our systems are continuously upgraded with solid-state devices to ensure accurate temperature and process control.

Because we are committed to excellence in ceramic-to-metal and glass-ceramic technology, we continue to satisfy customers worldwide with responsive service, unsurpassed design expertise and total product quality.

North American Operations

www2.ceramtec.com

One Technology Place
Laurens, SC 29360
Phone: (864) 682-3215
Toll Free: (800) 752-SEAL (7325)
Fax: (864) 682-1140
Email: sales@ceramtec.com



Products That Set Industry Standards

Ceramaseal® products include feedthroughs, multipin connectors, coaxial connectors, thermocouples, isolators, viewports, and vacuum hardware. These components are ideally suited to support optical, gas, liquid, power, instrumentation, and sensing applications. All of these products are built to endure extreme conditions, whether it be an ultra-high vacuum (UHV) environment, temperatures ranging from cryogenic (4 K) to 450° C, pressures in excess of 25,000 psig, corrosive or caustic environments, while maintaining an unsurpassed level of reliability and performance.

The company maintains an extensive inventory of precision-engineered hermetic electrical & optical components and other specialty components. The items depicted in this catalog represent the culmination of more than 50 years of developing and applying ceramic-to-metal and connectivity solutions to customer problems worldwide. Ceramaseal® assemblies have set the industry standards and are readily available for shipment. In addition, we can design and manufacture any custom ceramic-to-metal or glass-ceramic component to suit your needs, including catalog product modifications and new design challenges.

Applications Demanding The Best

OEM's, laboratories and other organizations use Ceramaseal® products in a variety of rigorous applications, including:

- Ultra-high-vacuum
- Semiconductor Processing Equipment
- Oil Exploration
- Aerospace
- Aggressive Chemicals
- Cryogenics
- High-pressure
- High-temperature
- High-voltage
- Nuclear Submarines
- Microwave
- Fusion
- High-Energy Physics
- Laser Technology
- Medical Technology
- Accelerators
- Superconductivity

Manufacturing Capabilities
Process Under Control

Capabilities: Far Beyond Vacuum Brazing
When it comes to highly engineered hermetically sealed electrical or optical assemblies the joining or bonding technology is really about selecting materials with similar coefficients of thermal expansion. The importance of material purity, quality and consistency is paramount. For this reason, CeramTec is completely vertically integrated and thus controls the process from beginning to end. This begins with ceramic powder production right through the machining and welding of precision metal components.

< Powder processing using our 24-ft-diam. Anhydro spray dryer

Dry pressing of high volume ceramic insulators.

Powder Processing
The technical ceramic process starts with the formulating and mixing of the ceramic powders and binding agents into an aqueous slurry form. This process is referred to as body preparation. The ceramic slurry goes through various milling and drying operations like spray drying, which can be seen here. This creates a consistent grain size, which optimizes the powders for the forming process. All of our ceramic products, which include more than 10 standard bodies, start with our own in-house powder processing.

Forming
Typical ceramic forming technologies used for the production of the ceramic insulators used within our Hermetic products include extrusion, dry pressing and isostatic pressing. High volume insulators are usually dry pressed, while tube or rod-like insulators are extruded and large or complex insulators are isostatically pressed. Many of these insulators will go through our "green" (compressed powder, before firing) machining process before being fired. Green machining can typically achieve tolerances of +/- 1% or +/- .005", whichever is greater.

Firing
The firing or sintering process is the prolonged baking of the ceramic parts in a gas or electric kiln at temperatures between 1,300 – 1,800° C (based on the specific material being sintered). Through reactions that occur during sintering, a strengthening and densification of the ceramic takes place, resulting in a reduction in porosity. There is approximately 20% controlled shrinkage when firing ceramics. Typical firing cycles can range from 12 - 120 hours depending upon the kiln type and product.

Hard (diamond) grinding of ceramic products to achieve tight tolerances.

Ceramic Machining
Tight tolerances and/or surface finishes typically require a post firing machining process, which is also done in-house. This could include grinding, honing, lapping or polishing and is where the majority of the expense in manufacturing ceramic parts is generated. Due to the high hardness of ceramic materials that have been fired, diamond tools are almost exclusively used. Diamond grinding can easily produce tolerances of +/- .001" and much tighter tolerances within tenths can be produced.

Continuous tunnel kiln used to fire ceramic insulators.

Metallizing

CeramTec employs a number of proprietary metallizing processes but the vast majority of the metallized insulators used in our Ceramaseal® assemblies are manufactured using thick-film metallization of alumina ceramics. The most common method used is the refractory metal process, which utilizes molybdenum as a sintered metal base layer on the ceramic. The wide selection of molybdenum based coatings along with the stringent furnace operating parameters insures good bond strength and reliability with alumina body compositions of 85-99% alumina. Typical applications methods include hand painting, screen printing or using one of our automated metallizing banders. In-process inspection and verification of metallizing and plating thickness are performed by x-ray fluorescence (XRF).

Plating

Metallized ceramic insulators that will be used in our moly-manganese sealing process have to be nickel plated first. CeramTec has both electroless and electrolytic nickel plating lines, which are used for plating over the molybdenum metallizing on the insulators as well as other metal components. A separate gold plating line is primarily used to gold plate the pins and female contacts on finished connector assemblies to maximize the electrical contact.

Electrolytic nickel plating of metallized ceramic insulators and other metal components.

Thick film metallization of ceramic insulators.

Assembly of Ceramaseal® products in a controlled environment.

Vacuum brazing furnaces with computer programmed profiles.

Critical Assembly

Within the Assembly Department the metallized insulators will be assembled with the conductors/pins, weld adapters, sleeves or caps and braze alloys. The parts are assembled on a firing fixture and will be fired within one of our many brazing furnaces, which are specific to the braze alloy used and the configuration or size of the part. Critical components are assembled in an ultra-clean environment using protective wear to prevent contamination.

Vacuum Brazing

CeramTec has a variety of furnaces which allow high temperature brazing in vacuum, hydrogen, nitrogen, or partial pressure atmospheres. A broad selection of brazing filler metals are used and are selected based on the optimization to the base metals (or ceramic) to be brazed. These include precious metal, copper, and high nickel alloys with melting ranges from 705°C to 1300°C. This broad temperature capability allows for the flexibility of step brazing when a complex assembly has multiple braze joints.

The 'active metal' ceramic-to-metal brazing process is a one-step operation compared to the moly-manganese process, which typically has five steps. This process requires an 'active' element that will react with the ceramic, forming a reaction layer between the ceramic and the molten braze that will reduce the interfacial energy to such a level that wetting of the ceramic takes place. This active element typically refers to a small percentage of titanium or zirconium added to the braze filler metal or directly applied to the ceramic. The active braze process is ideally suited for sealing to sapphire, larger ceramic to metal assemblies, and non-oxide ceramics.

CeramTec's third sealing process is referred to as glass-ceramic sealing. This is glass-to-metal sealing whereby the amorphous glass material is "crystallized" through a subsequent heat treatment. The resulting material is primarily crystalline in nature and takes on similar properties to ceramic. The high temperature glass-ceramic materials that have characteristics suitable for high vacuum, high pressure, high thermal expansion, and temperature capability from cryogenic to 450°C bake out. This glass-ceramic sealing process is ideal for sealing to high expansion metals such as 304 or 316 stainless steel and is commonly used for our high density connectors and matched impedance coaxial connectors.

During the design process, CeramTec typically uses Finite Element Analysis (FEA) to initially test different joint configurations, braze alloys and brazing conditions prior to any actual brazing. A scanning electron microscope (SEM) is used to analyze the braze joints during product development.

Machining of Metal Components

Machining of complex metal components is all done within our in-house machine shop. We utilize multiple EDM and wire EDM machines, CNC and mechanical lathes, milling machines and other metal machining equipment to precision machine the components used within our assemblies. We also machine our own firing fixtures and the dies used within our pressing equipment.

Machining of metal components for Ceramaseal® assemblies using a CNC lathe.

ISO 9001:2000 Quality System Registered

Welding

Many of CeramTec's standard and custom Ceramaseal® products require the welding of the feedthroughs into flanges or plates. We are equipped with both automatic and manual pulsed T.I.G. welding stations. For precision welding applications that require a lower welding temperature to protect the seal joint, we utilize laser welding technology. Induction brazing equipment is also used.

Welding of Ceramaseal® products using an automatic T.I.G. welding lathe

Testing & Inspection

CeramTec's products and assemblies are applied to the most rigorous applications, which require a very high level of quality assurance. For this reason 100 % of CeramTec's Ceramaseal® Products are leak-tested on one of our many dry helium mass spectrometers before they are stocked or shipped. All parts are guaranteed to $1x10^{-10}$ Atm cc/sec He. Leak test certificates are available upon request. For dimensional accuracy, CeramTec tests all critical components on one of our coordinate measuring machines (CMM).

There are stringent cleaning processes that are adhered to throughout the manufacturing and packaging process. Class-1000 clean room facilities are also maintained for those customers that require special cleaning & packaging.

Throughout all of our processes there are rigorous quality standards that are met and thorough inspections of incoming parts, in-process parts and final assemblies. CeramTec North America is ISO 9001:2000 quality system registered. Exceeding the customers' expectations is about more than shipping a quality product on time. It is about a higher level of customer service and support than is required, which is what our sales and customer service staff aim to accomplish throughout the sales process.

Customer service representatives standing by to serve you.

100%

Helium Leak Test

Helium leak testing of our Ceramaseal® products.

Testing and Ratings

The ratings in this catalog are provided as a guide only. Product should be independently tested to determine suitability for your application. Custom testing is available upon request.

Temperature Ratings

Insulation resistance for ceramic materials decreases as temperature increases. Most products in this catalog have a minimum room temperature resistance of 5000 megohms at 500 volts. Maximum temperature ratings listed are for bake-out only. The insulation resistance at these temperatures may not be suitable for all applications.

Note that the thermal gradient for any of the ceramic-to-metal or glass-ceramic seals in this catalog should not exceed 25° C per minute. Severe thermal gradients can be detrimental to joint design due to variations in expansion coefficients and the thermal conductivity of components.

The upper temperature ratings in this catalog are determined by a sequence of vacuum bake outs at 50° C increments and 1 hour holds starting at 200° C and proceeding until failure or 550° C.

The lower temperature rating is determined by progressive thermal shocks starting with 5 cycles from room temperature (RT) to -25° C, followed by RT to -65° C. The thermal shock procedure follows MIL-STD-202F, Method 107G. This is followed by cycling from RT to liquid nitrogen (LN2) temperature (approx. -200° C). The part is then vacuum baked out and helium leak tested.

Pressure Ratings

Pressure ratings within this catalog were determined by first welding the component into a suitable flange or adapter, then pressurizing at 50 – 500 psi increments up to 50,000 psi or until failure. All pressure testing is done at room temperature (20°C). After each pressure increment, critical dimensions are measured to monitor plastic deformation of metal components and a

helium leak test is performed to verify hermeticity. An appropriate safety factor is applied depending on the failure mode of the test sample (Catastrophic failures - no observable yielding of a metal component prior to ceramic failure or Ductile failures - observable yielding of a metal component (<.003") has taken place.)

Current Ratings

The current ratings for the standard products within this catalog are based on the amount of current necessary to cause a maximum allowable temperature rise of 60° C. The conductors of the assembly are connected with jumpers so that the applied current passes through all conductors simultaneously. The temperature rise is measured with a thermocouple placed on the assembly in the location of the conductor seals. Temperature rise is measured as a function of time for a given applied current until the steady state temperature is achieved.

Voltage Ratings

The voltage ratings in this catalog are based upon operation with one side in dry atmospheric conditions while the opposite end (right side in drawings) is in a stable vacuum environment with a system pressure of $1x10^{-4}$ torr. Other comparable environments would be air pressure of 80 psi or high dielectric oil. Note that the voltage rating on many of our high voltage products are when used with the mating air side plug or cable assembly and are noted as such. During testing, voltage is applied between a conductor and the outer ground shell of the assembly. The voltage is slowly increased until flashover occurs. Based on the magnitude of the flashover voltage, an appropriate safety factor is applied.

VSWR (Voltage Standing Wave Ratio)

The VSWR vs. Frequency charts in the Coaxial section of this catalog were generated through the testing of parts on a network analyzer using NIST traceable calibration standards.

Dimensional Information

All drawing dimensions within this catalog are for reference only. Tolerances will vary by specific product line and will depend on various geometric parameters. Vacuum and pressure specifications apply to the right side of the drawings. All dimensions are in inches [millimeters].

RoHS Compliant

RoHS Compliant

99.5% of the products within this catalog are RoHS compliant. Those parts that aren't compliant will be noted as such.

Table of Contents

A Feedthrough

Instrumentation / Power	A.1	Page 14-15
Power	A.2	Page 16-17
Pin Header	A.3	Page 18-19
Multipin Header	A.4	Page 20-21
Micro & Mini HV	A.5	Page 22-25
Power Plug	A.6	Page 26-35
High Power – Liquid Cooled	A.7	Page 36-41
High Voltage	A.8	Page 42-47
RF Power – Liquid Cooled	A.9	Page 48-49
Baseplate	A.10	Page 50-51

B Multipin Connector

Micro D Type: MIL-DTL-83513	B.1	Page 56-57
Sub D Type: MIL-C-24308	B.2	Page 58-59
Circular Type: MIL-C-26482	B.3	Page 60-63
Circular Type: MIL-C-5015	B.4	Page 64-65
Circular Type Power: MIL-C-5015	B.5	Page 66-69
High Voltage	B.6	Page 70-71
Baseplate	B.7	Page 72-73

C Coaxial

Microdot	C.1	Page 80-83
SMB	C.2	Page 84-87
SMA	C.3	Page 88-95
BNC	C.4	Page 96-105
MHV	C.5	Page 106-113
Type N	C.6	Page 114-117
HN	C.7	Page 118-119
SHV 5 KV	C.8	Page 120-125
BSHV 7.5 KV	C.9	Page 126-127
SHV 10 KV	C.10	Page 128-131
SHV 20 KV	C.11	Page 132-133
Between Series	C.12	Page 134-137

D Thermocouple

Loop Type	D.1	Page 142-143
Spade Type	D.2	Page 144-147
Spade & Power	D.3	Page 148-149
MIL-C-5015 Type	D.4	Page 150-151

E Isolator

Cryogenic	E.1	Page 156-157
Water	E.2	Page 158-159
Vacuum	E.3	Page 160-167

F Viewport

Sapphire	F.1	Page 172-173
Fused Silica	F.2	Page 174-175
Extended Range	F.3	Page 176-177
Differentially Pumped	F.4	Page 178-179

G Pressure

NPT	G.1	Page 184-187
CeramTite™	G.2	Page 188-189
Tec-Seal™	G.3	Page 190-191

H Accessories

Contacts	H.1	Page 196-197
Plugs	H.2	Page 198-203
Air Side Cables	H.3	Page 204-207
In-Vacuum Cables	H.4	Page 208-215
Standoffs & Spacers	H.5	Page 216-217
Flanges	H.6	Page 218-219

I Technical Reference

Engineering Data	I.1	Page 222-228
Cable Plug Attachment	I.2	Page 229-241
Installation	I.3	Page 242-247
Part Number Index		Page 248-254
Quote Form/Terms & Conditions		Page 255-256