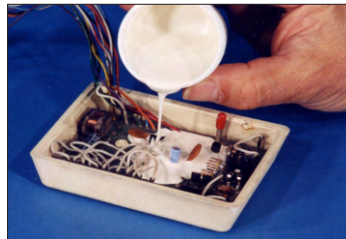
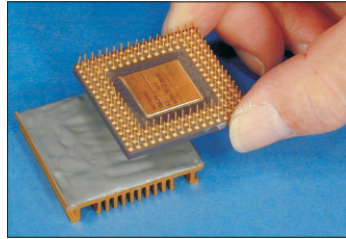


# HIGH TEMP. MATERIALS INSTRUCTIONAL HANDBOOK



# COTRONICS CORP

High Temperature Specialty Materials Since 1971

# Cotronics High Temp. Epoxy Adhesive Properties

FEATURES	CONDUCTIVE			500°F ROOM TEMP. CURES			600°F ROOM TEMP. CURES			MACHINEABLE			ONE PART
	120	132	4461	4525	4538	7050	4460	4700	4703	4540	4420		
Cat No.	Superior Electrically Conductive	High Thermal Conductive	Low Viscosity Adhesive and Coating	General Purpose Superconductive and Potting	Super Flexible Superconductive and Potting	Super Bonder Bonds to Most Surfaces	Ultra-Temp. Low Viscosity and Coating	Ultra Temp. Purpose Epoxy and Coating	Ultra Temp. Tooling and Repair Epoxy	Machinable Aluminum and Repair	Component Adhesive		
<b>Maximum Temp °F</b>	500	500	500	500	450	450	600	600	700	500	450		
<b>Components - Color</b>	2-Silver	2- Grey	2- Amber	2- Black	2-Tan	2- Black	2-Amber	2- Black	2- Black	2- Grey	1- Beige		
<b>Mixed Viscosity (cps)</b>	300,000	60,000	3,600	12,400	17,200	5,000	1,600	15,500	37,000	14,800	Paste		
<b>Density R/H (gm/cc)</b>	3.8/0.9	1.8/0.9	1.2/0.9	2.0/0.9	1.2/0.9	1.8/0.9	1.1/1.2	2.0/1.2	2.0/1.2	1.5/0.9	1.7		
<b>Hardness (Shore D)</b>	70	75	85-95	80	60-80A	70	90	94	95	80	75		
<b>Tensile Strength (psi)</b>	6,500	7,200	9,500	10,000	6,000	5,000	10,300	11,100	11,800	10,000	7,000		
<b>Thermal Cond.</b> (BTU in./hr. °F ft)	50	40	4	13	7	4.5	4	13	18	35	8		
<b>Thermal Expansion</b> (x 10 <sup>-5</sup> /°C)	4.1	4.1	5.4	3.3	N/A	4.8	5.4	3.4	3.9	4.1	3.3		
<b>Dielectric Strength</b> (volts/mil)	N/A	100	450	450	450	400	500	550	450	100	400		
<b>Volume Resistivity</b> (ohm-cm)	0.00008	10 <sup>8</sup>	10 <sup>13</sup>	10 <sup>16</sup>	10 <sup>14</sup>	10 <sup>14</sup>	10 <sup>14</sup>	10 <sup>14</sup>	10 <sup>10</sup>	10 <sup>8</sup>	10 <sup>10</sup>		
<b>Heat Distortion (°C)</b>	210	210	210	210	75	75	260	300	320	225	175		
<b>Thermal Stability</b> (% 1000 hr. @ 200°C)	0.2	0.2	0.2	0.05	0.5	0.5	0.1	0.1	0.02	0.5	0.6		
<b>Elongation (%)</b>	0.2	0.2	5	2	12-100	3	5	2	2	1.2	1.5		
<b>Shrinkage (%) max)</b>	0.2	0.8	0.8	0.2	0.8	0.8	0.5	0.2	0.1	0.1	0.3		
<b>Moisture Absorption</b> (% age 30 days @ 50°C)	0.2	0.2	0.15	0.1	0.5	0.2	0.1	0.02	0.15	0.2	0.5		
<b>Mix Ratio</b> (by weight)	100/3.4	100/8	100/17	100/8	100/120	100/10	100/80	100/28	100/22	100/9	N/A		
<b>Working Time</b> (25 gms @ 75 F)	30	30	30	30	90	5	N/A	N/A	N/A	30	N/A		
<b>Cure</b> (hrs. 75°F)	16	16	16	16	4-24	4-16	N/A	N/A	N/A	16	N/A		
<b>Cure</b> (min. 250°F)	7	5	5	5	60	1-2	4 hrs.	4 hrs.	4-6 hrs.	8	30		

Manufactured in accordance with ISO9000

# Adhesives, Potting and Conductive Epoxies



**Bonding**



**Conductive**



**Potting**

## Material Selection

Choose the material that most closely matches the specific details of your application. The details would include the temperature range, electrical and thermal properties, thermal expansion, viscosity, hardness and any process limitation that you may have (ie. cure procedures)

## Preparation

1. Clean surfaces of all grease, oil, dirt, old coatings, rust, etc. (For best results use Resbond 105RS Solvent). Roughen surface to improve adhesion.
2. Re-stir all Resins and Hardeners before measuring to insure a uniform, homogeneous product. Warming resins to 100°F (38°C) - 120°F (49°C) will reduce the viscosity to ease mixing.

## Mix Ratio

**Note:** All measurements are by weight.

1. One and two component systems: re-mix thoroughly, apply and heat cure as directed.
2. Two component systems: check the product label for the exact mix ratio, all mix ratios are by weight. Weigh out the resin and the hardener into separate clean containers.

**Note:**  $Weight\ required = (total\ weight) - (weight\ of\ container)$

3. Combine the resin and hardener. Mix slowly and thoroughly. Do not whip air into the mix. Make sure to scrape the sides and walls of the container to insure a complete mix.

**Caution:** Mixing batches over 50-100 grams can create excessive heat in some formulations.

## Air Removal and Vacuum Degassing

Warming resin and letting the mixture stand several minutes before use will normally remove most of the entrapped air. **Note:** the use of warmed resin may reduce working time.

Vacuum degassing should be employed for most critical applications.

## Applying The Adhesives

Apply with a trowel or with a dispensing syringe. Bond lines should be between 0.005" - 0.010" for best results. Disposable syringes are available from Cotronics.

## Potting and Casting Applications

Slowly, pour in a thin stream, to allow air to escape. The material should be able to flow around and under the components being potted. **Note:** Pouring too fast may trap air pockets.

## Curing

Follow the cure directions listed on the product label.

## Post Cure

Post curing will result in optimum properties (strength; chemical, solvent and moisture resistance, conductivity and resistivity, etc.).

1. Consult the label for specific instructions.
2. Recommended cure cycle 1-2 hours at 250°F (120°C) and 1-2 hours at 350°F (175°C).

## Clean Up

Clean up resin/hardener prior to curing with solvents (Denatured Alcohol).

## Safety

Read MSDS carefully before use. Prolonged skin contact may cause irritation.

Uncured materials can be washed from the skin with a mild soap and water.

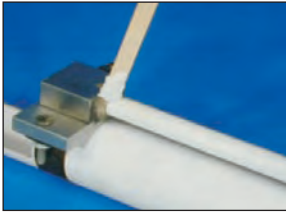
If any material contacts eyes, flush continuously with water and consult a physician immediately.

# Cotronics High Temp. Ceramic Adhesive Properties

BASE	ALUMINA			ZIRCON		MICA	MAGNESIA	SILICA		GRAPHITE	METALLIC			
	901	903HP	989	920	904			940	907		919	940LE	7030	931
Cat. No.	901	903HP	989	920	904	940	907	919	940LE	7030	931	950	952	954
Type	Fiber Base	Hi-Bond Strength	General Purpose	Thermally Cond.	Ultra Temp	Fast Set	Industrial Strength	High Resist.	Low Exp.	High Strength	Graphite	Alum. Metal	Nickel Metal	Stainless Steel
Service Temp. (°F)	2600	3250	3000	3000	4000	2000	2300	2800	2500	1800	5400	1200	2000	2000
Base	Al <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>	ZrO <sub>2</sub>	Zircon	Mica	MgO	SiO <sub>2</sub>	SiO <sub>2</sub>	Carbon	Al	Nickel	316SS
Compressive Strength (psi)	1200	7000	3000	4500	6000	4000	3500	4500	3200	5000	3000	4000	5000	4500
Flexural Strength (psi)	600	3500	1100	450	3000	1800	1250	450	2100	1450	1500	3000	3000	2500
Thermal Exp. (10 <sup>-6</sup> /°F)	4	4	4.5	4.5	4.1	4.5	4.5	2.6	0.3	7.5	4.1	10	4	10
Thermal Cond. (BTU in/ hr °F Ft <sup>2</sup> )	2	40	15	15	10	8	6	4	10	8.3	60	44	14	10
Dielectric Strength (volts/mil)	200	250	200	270	250	125	300	270	200	100	COND.	COND.	COND.	COND.
Volume Resistivity (ohm-cm)	10 <sup>12</sup>	10 <sup>10</sup>	10 <sup>8</sup>	10 <sup>11</sup>	10 <sup>8</sup>	10 <sup>8</sup>	10 <sup>9</sup>	10 <sup>11</sup>	10 <sup>11</sup>	10 <sup>9</sup>	COND.	COND.	COND.	COND.
Consistency	Paint	Paint	Paint	Paste	Paste	Paste	Paste	Paste	Paste	Paste	Paste	Paint	Paste	Paste

**970N Kit Ceramic Adhesive Sampler Kit includes 4 ounces each of 901, 919, 940, 907GF, 989, 950 & 7030**  
*It is the ideal choice for simplifying product selection*  
*Manufactured in accordance with ISO 9000*

# CERAMIC ADHESIVES



**Bonding**



**Sealing**



**Protecting**

*Use the 970N Selector Kit for product evaluation and selection. Development work and custom formulations are available upon request.*

## Selection Criteria

1. Select an adhesive with a thermal expansion as close as possible to the materials being bonded.
2. Check for the maximum temperature, electrical properties and the bond strength required.

## Surface Preparation

**For Non-porous Materials** Clean dirt, oils and greases from the substrates surface. Mechanically roughen surfaces prior to bonding.

**Porous Materials** Clean surface of loose dirt and dust. Moisten the surface to be bonded with a solution of 50% ceramic adhesive thinner and 50% water.

## Adhesive Preparation

1. One and two component systems: re-mix all materials thoroughly prior to use.
2. Two component systems: weight out powder and activator according to the mix ratio on the mix ratio on the label. **Note: weight required = (total weight - weight of container)** Mix thoroughly. Do not whip air into the mix.

## Apply Adhesive

1. Apply by spatula, brush or by dipping. Completely wet the surfaces being bonded.
2. Immediately press surfaces together. If necessary, clamp or fix materials to maintain uniform distance while curing. Best results are obtained with gap widths of 0.005" to 0.010".
3. Excess adhesive can be removed with a damp rag. Discard excess materials.

## Curing

**Note: Always follow the product's specific instructions as shown on the product label.**

1. Let joint air set for 1- 4 hours.
2. Cure for a minimum of 2 hours at 200°F (90°C).
3. Avoid excessively fast heating. It will cause adhesive to bubble and form a weak bond.

**Note: These products will not out-gas after a complete cure.**

## Post Cure

**A second cure will provide maximum strength, solvent and moisture resistance**

1. Consult the product label for specific instructions.
2. Recommended post cure: 1 hour at 250°F and 1 hour at 400°F - 600°F.

## Potting

For potting directions refer to the instructions for ceramic potting materials (page 6).

## Coating

One Component Systems may also be used to form Ceramic Coatings.

1. Thin the adhesive use the thinner developed for use with each specific adhesive.
2. Make a solution by mixing 50% ceramic thinner and 50% water.
3. Brush or Spray on a thin coat. Air dry coating. Re-apply. Repeat until desired thickness is obtained.
4. Follow cure instructions as required on the product label.

**Note: These products will not out-gas after a complete cure.**

# DURAPOT™ POTTING COMPOUNDS

These Epoxy and Ceramic, High Temp. Potting Compounds offer high temp. stability and excellent chemical, solvent and electrical resistance. They are the ideal choice for the most demanding Electronic, Industrial, Instrumentation Military, etc. Applications.



## Ceramic Potting Directions

1. Thoroughly re-mix the powder supplied. All measurements are by weight. Weigh out the base (powder) and activator (liquid) into clean mixing containers. Check product label for specific mix ratios and whether activator or water is used in your system. For fine details add 1% - 2% extra activator, or water, to increase fluidity. Working time will be approximately 10 - 20 minutes at 70°F (20°C).

**Note:** *Adding too much activator will weaken the cured result.*

2. Mix to a heavy paste-like consistency. This will produce parts with optimum strength and minimum shrinkage. The paste like mixture will flow when vibration is applied to the mold.

3. Pour the ceramic mixture into the casting shell working it in and around the components. Overfill the mold slightly. Vibrate the mold to remove air bubbles. (1- 5 minutes should be sufficient). After 20 minutes remove any excess material with a trowel.

**Hint:** *familiarize yourself with these materials by making a trial potting in a plastic drinking cup before making an actual part. A part 2" dia. x 1" high is ideal for testing.*

4. Cure for 16 - 24 hrs. at room temp. Post cure for 2 hrs. at 225°F. This will remove moisture and add strength to the cured casting. Additional post curing between 600°F - 900°F will increase the strength and improve the moisture resistance of the potting compound.

**Notes:** *Full Electrical Properties are obtained only after the Moisture is Removed.*

*Durapot Ceramics are vacuum stable and will not out gas after curing.*

5. The potted material will be porous and can be sealed (against moisture) with Duraseal 1529 or Resbond 797 (call Cotronics for details).

## Epoxy Potting Directions

1. Clean the surfaces exposed to the potting compound insuring that all surfaces to be bonded are free of grease, oil, dirt, etc.

2. Re-stir resins and hardeners before mixing to insure a uniform homogeneous product. Warming resins to 100°F - 120°F will reduce the material's viscosity and facilitate handling.

**Note:** *Warming the resins will reduce working time of the potting compound.*

3. Weigh out the resin and hardener into clean, separate containers. All mix ratios are weight ratios. Specific mix ratios are given on product labels.

4. Mix slowly and thoroughly to insure a homogeneous mix. Make sure to scrape sides and walls of container to insure a complete mix. **Do not whip air into the mix.**

5. Air Removal: Cotronics' potting compounds contain additives that minimize air entrapment. Additional air can be removed by warming the resin to 100°F-120°F and letting it stand for several minutes will normally remove most of the remaining entrapped air.

6. Potting: if a mold release is required use Replicast 101MR for best results. Pour mixture slowly, in a thin stream to allow entrapped air to escape. Allow the potting compound to flow around and under the components being potted. A fast pour will entrap air. Clean any excess uncured epoxy with Resbond 105RS surface cleaner.

7. Recommended curing instructions for each formulation can be found on the product's label. General curing instructions: heat for 1-2 hours at 250°F (120°C) and 1 hour at 350°F (175°C).

**Note:** *Optimum high temperature properties (strength; chemical, solvent and moisture resistance; electrical and thermal conductivity and/or resistance) will only be obtained after a post cure.*

# DURABOND™ EPOXY AND CERAMIC PUTTIES

These smooth, creamy putties combine the high temperature performance of Cotronics' specialty formulations with easy to use, dispensing systems. Perfect for on site repairs.

Choose from systems based on: Machinable Aluminum (500°F - RK454 or 1200°F - 7025), 316 Stainless Steel (500°F - RK456 or 2000°F - 7032), Ceramic (2300°F - 907GF) or Alumina (3000°F - 7020).

Just dispense and apply. These smooth, creamy putties will not run, drip or sag while applying and can be easily cured at room temperature.



## Surface Preparation

Surfaces should be free of oil, grease, dirt, corrosives or other contaminants.

Porous materials should be soaked in solvents to remove any soluble contaminants.

**For best results**, roughen all smooth, metal surfaces with abrasives or grit blast them with a coarse media.

## Mixing

For one component systems: re-mix thoroughly before applying.

For two component systems: thoroughly re-mix the components before dispensing. Check label for mix ratios where applicable. Weigh out each component and thoroughly mix to a uniform consistency. The viscosity may be reduced by adding a small amount of thinner (5% by weight maximum) if required.

## Application

Putties may be applied using a spatula, putty knife or caulking gun. Multiple layers may be required for cross-sections larger than 1/8" to 1/4" to avoid blistering. Epoxy based systems can be applied in thicker sections without blistering.

## Curing

Individual cure cycles are specified on each product label. Below instructions are guidelines for curing. Alternative cure times may be appropriate for high volume production applications and should be tested in the specific application prior to use.

**Note: excessive fast drying (or applying high heat when moist) may cause blisters.**

**For ceramic based systems a typical cure schedule is shown below.**

1. Air dry for a minimum of 2 hours at room temperature. Thick cross-sections will require 4-16 hours to cure. Putties should be applied in layers carefully drying material in between coatings.
2. Heat cure at 150-200°F for 2 - 4 hours.
3. Post curing at 400°F is required for water insolubility.

**For epoxy based systems a typical cure schedule is shown below.**

1. Cure at room temperature for a minimum of 16 - 24 hours prior to use.
2. Post curing is recommended for optimum properties. For room temperature curing systems post cure for a minimum of 2 - 4 hours at 250°F. For heat curing systems post cure for 2-4 hours at 350°F.

## Storage







Tightly close opened containers after each use to prevent evaporation.

Periodically invert containers to help reduce settling.

Store containers between 40°F and 80°F.

**Safety** read MSDS carefully before use. Prolonged skin contact may cause irritation. Uncured materials can be washed from the skin with a mild soap and water. If any material contacts eyes, flush continuously with water and consult a physician immediately.

# Rescor Castable Ceramics

Cat. No.	740	750	760	770	780	RTC-60
<b>Description</b>	Insulating Foam	Shock Resistant	Ultra Temp.	Corrosion Resistance	General Purpose	High Purity
<b>Maximum Temp. °F</b>	2300	2700	4000	2700	3000	3250
<b>Base</b>	Al <sub>2</sub> O <sub>3</sub> -SiO <sub>2</sub>	SiO <sub>2</sub>	ZrO	SiC	Al <sub>2</sub> O <sub>3</sub>	Al <sub>2</sub> O <sub>3</sub>
<b>Standard Grades Sample Castings</b>						
<b>Properties</b>						
<b>Density (# / ft<sup>3</sup>) (in/10 # kit)</b>	54 223	110 157	250 69	145 119	180 96	175 98
<b>Shrinkage (% as cast) (% @ 1000°F)</b>	0.50 1.00	NIL 1-30	NIL 1.00	NIL 1.50	NIL 1.00	NIL 1.25
<b>Compressive Strength (psi)</b>	1,500	6,000	4,000	6,000	6,000	2,500
<b>Modules of Rupture (psi)</b>	900	1,500	1,200	1,500	1,800	1,000
<b>Thermal Exp. (x 10<sup>-7</sup> / °F)</b>	4.5	0.3	5.6	4.5	4	4
<b>Thermal Cond. (BTU in/hr.°F ft<sup>3</sup>)</b>	1	4	6.5	30	10	10
<b>Dielectric Strength (volts/mil)</b>	100	100	N.A.	N.A.	200	175
<b>Volume Resistance (ohm-cm)</b>	10 <sup>9</sup>	10 <sup>9</sup>	N.A.	N.A.	10 <sup>9</sup>	10 <sup>9</sup>
<b>Moisture Resistance</b>	Excellent	Excellent	Excellent	Excellent	Excellent	Excellent
<b>Color</b>	Tan	White	Tan	Black	White	White
<b>Mix Ratio (base/activator)</b>	100/64	100/28	100/18	100/24	100/24	100/10
<b>Working Time (minutes)</b>	20	20	20	20	20	25

Manufactured in accordance with ISO9000



# RESCOR™ CER-CAST CERAMIC

## Easy to use, Economical, Fast Setting and High Strength



Rescor™ Cer-Cast Castable Ceramics make Alumina, Silicon Carbide, Zirconium Oxide, Fused Silica and Insulating Ceramic Foam parts, tubes, crucibles, etc. in minutes. Rescor™ advanced ceramics are ideal for all your research, prototype and production applications.

### Trial Parts

*To check product shrinkage and strength prior to casting the desired part.*

Use a drinking cup with a 2" diameter. Pour the mixed material approximately 1" high. Follow the heat treating directions below. Check product shrinkage and strength and use values as a guide for creating the actual part.

*Note: A thick paste like consistency will provide optimum strength and minimum shrinkage.*

*A thick paste will flow when vibration is applied to the mold and container.*

### Estimating Shrinkage

Minor shrinkage normally occurs and must be taken into account for all critical applications. See below for typical shrinkage values. (Actual values will vary.)

Cure Temp.	Typical Shrinkage (%)	Typical Strength (MOR)
Room Temp.....	0.1 to 0.5.....	800 - 1200 psi
1000°F (535°C) .....	0.3 to 1.3 .....	1000 - 2000 psi
1700°F (910°C) .....	1.0 to 2.0.....	3000 - 7000 psi

### Molds

For best results use Replicast 101 Liquid Rubber or a urethane mold.

Before casting a part, apply a light coat of Spray on 101MR or brush on 102MR mold release.

It is not recommended to use metal molds. If metal molds are used, apply a thin coat of 102MR Paste Mold Release and design the mold with sufficient draft so that the cast ceramics can be removed.

### Ceramic Casting

*Check the product label for the mix ratio. All mix ratios are by weight.*

1. Weigh out the powder and the activator. Mix thoroughly, the material should become a thick, paste-like consistency. If casting parts with fine details add 1% or 2% extra activator, by weight. This will increase the fluidity of the mixture. Working time is approximately 10 to 15 minutes.
2. Pour the ceramic mixture into the mold and overflow it slightly. Work the slurry into the corners.
3. Vibrate the mold to remove air bubbles. (2-5 minutes should be sufficient.
4. After 20 minutes, remove any excess material with a trowel.

### Curing

1. Cover the mold with a thin sheet of plastic and cure for 16 - 24 hours at room temperature.
2. Heat the ceramic casting for 2 hours at 225°F (110°C). This will remove remaining water/ moisture and will create additional strength.
3. **For parts under 4" thick:** Heat the ceramic casting at a rate of 200°F per hour. Post cure at 1750°F (950°C) to increase the strength by 2 - 3 times.

**For castings over 4" thick:** request a special, slow curing instruction sheet (downloadable).

*Note: Ceramic Castings will not out gas after they are fully cured.*

# Rescor Machinable Ceramics

Cat. No.	902	914	915	916	960	961	310M	311	56L
Material	Alumina Silicate	Glass Based	MACOR™	Boron Nitride	Alumina 96%	Alumina 98%	Silica	Alumina Silica	Graphite
Temperature Limit °F	2100	1000	1800	1500	3000	3100	3000	2600	5400
Compressive Strength (psi)	38,000	40,000	50,000	30,000	60,000	380,000	1,200	500	16,000
Flexural Strength (psi)	14,000	26,000	15,000	10,000	38,000	40,500	520	250	6,500
Thermal Expansion (x 10 <sup>-6</sup> /°F)	1.8	5.2	5.2	5.24	4.3	3.7	0.3	2.9	3.1
Thermal Conductivity (BTU in/hr.°F.ft. <sup>2</sup> )	9	2.8	12	12	32	42	1.3	2.4	50+
Volume Resistivity (ohm-cm)	10 <sup>14</sup>	10 <sup>14</sup>	10 <sup>14</sup>	10 <sup>13</sup>	10 <sup>14</sup>	10 <sup>16</sup>	10 <sup>6</sup>	10 <sup>6</sup>	N/A
Dielectric Strength (volts/mil)	100	480	1000	1000	200	500	100	100	N/A
Loss Factor (@ 1 Mhz)	0.04	0.01	0.003	0.0008	0.0016	0.001	0.0002	0.02	N/A
Dielectric Constant (@ 1 Mhz)	5.3	7.5	6.0	4.4	9	9	3.17	2.17	N/A
Porosity (%)	2.9	0	0	2.0	10	0	63	52	10
Density (gm/cc)	2.30	2.60	2.52	2.00	3.0	3.82	0.80	0.80	1.63
Hardness (Mohs scale)	6	5	5	2	5	8	4	4	3
Adhesive for Bonding	919	940	940	908	989	989	940LE	940LE	931
Machining Instructions (pg. no.)	10	12	12	12	12	12	12	12	12

Manufactured in accordance with ISO9000

# 902 PRECISION MACHINABLE CERAMIC

## Machining Tools

Use standard tools for turning, drilling, tapping, threading, milling, grinding, etc.

Use carbide tipped tools when available.

Keep tools sharp. Dull tools can cause chipping.

Use the cutting speeds and feed rates that are specified for metal machining.

### **Do not use any lubricants or coolants.**

Clean machine thoroughly after machining. Rescor 902 particles are abrasive.

## Part Design

*Machined parts 1.8% to 2% undersized to allow for expansion during firing. A machined dimension of 0.980" will be 1.000" after firing. Diameters will expand from 1.8% to 2%.*

The cross sectional thickness of the ceramic should be kept below ½" to prevent cracking during firing.

Use a smooth, gentle transition from thick to thin sections and if necessary drill holes to keep the cross sectional thickness below ½".

## Firing

Place the machined 902 ceramic part into a cold, air atmosphere furnace.

Protect from any direct flame impingement or direct contact with heating elements.

## Heating Schedules

### For Parts ≤ 1/2" in Thickness

Heat at 200°F (90°C) /hour until .....1900°F- 2000°F (1035°C - 1093°C)

Hold ¼" parts at temperature for .....½ hour

Hold ½" parts at temperature for .....1 hour

Furnace must be cooled to below 200°F (90°C) prior to removing the parts.

### For Parts ≥ 1/2" in Thickness

Heat at 200°F (90°C) /hour until

Set Point	Hold for a Minimum of
-----------	-----------------------

925°F . . . . .	4 Hours
-----------------	---------

1050°F . . . . .	4 Hours
------------------	---------

1550°F . . . . .	4 Hours
------------------	---------

1700°F . . . . .	4 Hours
------------------	---------

1950°F . . . . .	2 Hours
------------------	---------

Cool parts for a minimum of 4 Hours before removing.

### For Difficult Parts

Heat at 50°F/hour until. . . . . 600°F

Followed by 35°F/hour between . . . . . 600°F to 1200°F

Followed by 15°F/hour until . . . . . 1950°F

Cool parts at a maximum rate of 200°F/hour.

**Note:** Fired 902 Ceramic can be ground wet with Silicon carbide wheels.

## Trouble Shooting Guide

Before calling Cotronics' Technical Service

1. Check the furnace temperature and the curing schedule.
2. Check for full expansion.
3. Re-Design part with smooth, well rounded corners.



Special Sizes, Quantity Prices, Custom Machined Parts Upon Request

# MACHINABLE CERAMICS INSTRUCTIONS

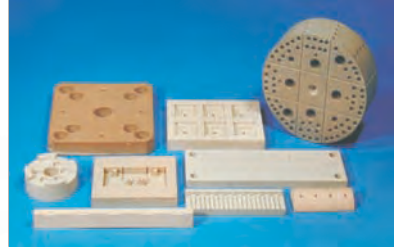
310M - 914 - 960 - 915 - 56L

## Machining Tools

Use only sharp cutting tools, carbide cutting tools are preferred. Check tools for sharpness frequently. Ceramics can cause rapid wear of cutting edges. Clamp work firmly to avoid vibration and chatter.

## Lubrication

Keep a continuous stream of water on the work and tool. Insufficient lubrication will cause dulling of cutting tools and chipping of the ceramic. Lubrication is a must for precision work. Lubricants recommended include Cimstar 40 Pink, Supercut S67 and Quaker 103.



## Cutting

Use bonded silicon carbide or diamond cut off wheels with speeds of 6000 - 8000 S. F. M. (2000-2500 rpm). Cut down into work.

## Bandsaw

Use continuous coat, carbide grit blades. Use a band speed of 100 feet per minute.

## Drilling

Use Carbide drills, Carboloy 883 or equivalent. For high speed drills, drill slower. Never drill all the way through. Use a drill jig and drill from both sides.

**Re-sharpen bits every 3 - 4 holes.**

Drill Size	RPM	Feed-RPI	Drill Size	RPM	Feed - RPI
1/4 inch . . .	300 . . . . .	0.005	3/4 inch . . . . .	200 . . . . .	0.010
1/2 inch . . .	250 . . . . .	0.007	1 inch . . . . .	100 . . . . .	0.012

## Milling

Cutting Speed (surface ft. per min.) . . .	20 - 35
Chip Load (inches per tooth) . . . . .	0.002
Depth of Cut (inches) . . . . .	0.150 - 0.200

## Threading

Use a diamond wheel with a tool post grinder or tungsten carbide tool.

## Tapping

Use high speed steel or carbide. Drill size should allow for 70% thread form. Use lubricant.

## Turning

Use carbide tool bits or silicon carbide wheels on post grinder.	
Tool Type . . . . .	Carboloy 883
Cutting Speed (surface ft. per min.) . . .	30 - 50
Feed Rate (inches per revolution) . . . . .	0.002 - 0.005
Depth of Cut (inches) . . . . .	0.150 - 0.250

## Grinding

Use a silicon carbide, resinoid bonded wheel at the recommended speeds.

**For Heavy grinding** use a soft, coarse grained wheel.

**For Finishing** use a hard, fine grained wheel.

## Note

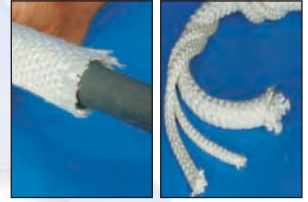
Heat treating **is not** required for use under 2400°F.

**960 shrinkage may occur in use > 2400°F.**

Check for shrinkage before making actual parts by exposing a test piece to the service temperature for the intended usage time.

**Note: Cotronics' ceramics are abrasive. Clean machines thoroughly after machining.**

# Cotronics' Ceramic Paper, Blankets and Boards Sleeving, Rope & Moldable Putties



CAT. NO. DESCRIPTION	300 Papers	360 Boards	360M Moldable Putty	370 Flexible Blankets	372 Wrap-It Sheets	Ultra Temp. Products	Tapes Cloths Sleeving
Melting Point °F	3200	3200	3200	3200	3200	3600	3000
Continuous Use Temp. °F	2300	2300	2300	2300	3000	3000	up to 2600
Density (#/ ft <sup>3</sup> )	12	16	40	6-12	18	6-15	10-40
Modules of Rupture (psi)	N.A.	55	150	N.A.	N.A.	N.A.	High Tear.
Dielectric Constant (@ 10 <sup>8</sup> cps)	1.61	1.61	1.61	1.61	1.61	1.61	1.61
Dielectric Strength (volts/mil)	100	100	100	100	100	100	100-450
Construction	Matted	Bonded	Putty	Matted	Wet Mat	Varies	Woven
Compressibility	Soft	Firm	Hard	Soft	Firm	Soft	Strong
Thermal Conductivity (*BTU/hr.ft. <sup>2</sup> °F/ in.)							
500°F	0.38	0.45	0.85	0.38	0.65	0.35	0.50
1000°F	0.60	0.70	0.90	0.60	0.70	0.55	1.00
1500°F	0.90	0.95	1.05	0.90	0.95	0.86	1.60

## Hints and Tips:

### Ceramic Paper and Boards

Contain a trace amount of organic binders which will discolor and give off a burnt odor when heating past 400°F (204°C) for the first time. Burn off will be complete after material is exposed to 600°F - 800°F (315°C - 425°C).

Ceramic boards can be hardened by applying, or soaking, in 901A ceramic hardener and then drying. Heating will increase the material's strength and hardness.

### Ceramic Putty and Wrap-it

These materials are water based. They cure by moisture evaporation. Material will be hard after the moisture completely evaporates. This is a slow process at room temperature that can be accelerated with mild heat (below 200°F, 100°C) and air flow.

Smooth Ceramic Putty with wet gloves and a putty knife. Keep wet to insure smooth surface.

Typically a 1/8" to 1/4" layer of Ceramic Putty or Wrap-It will dry in 48 hours at room temp.

A 1" thick layer may take up to 48-72 hours at room temperature.

Heating at 200°F (100°C) with mild air flow will reduce time to 4- 8 hours.

### Ceramic Cloths, Tapes and Sleeving

These materials may fray on cutting. Treat with a sealant before cutting to minimize fraying.

Call our technical sales representatives for recommendations.

### Replicast 101MR

Spray mold release can be used as a mold release for Ceramic Putty and Wrap-It.

*Materials also available in REACH compliant versions, call for details*

# PROTECTIVE COATINGS AND SEALANTS

Duralco™ Protective Coatings offer the ultimate in high temperature and corrosion resistance. Easy to use. Just select the proper grade for the application conditions and surfaces to be coated. Consult Cotronics' data sheets or our technical staff for assistance and recommendations.

## Surface Preparation

1. Remove old coatings, paints, greases, etc. Make sure the surfaces are free of grease, oil, dirt, old coatings, rust
2. Sand or grit blase blast surface using 100 - 200 mesh sand, alumina or iron grit.
3. Wash with Resbond 105RP Surface Prep Solvent.

## Mixing

Settling may occur due to high solids content.

For both one and two component systems: re-mix thoroughly prior to use.

*All ratios are by weight. See the product label for the exact mix ratio.*

For two component systems: Weigh out the base and activator into clean, separate mixing containers. Mix together thoroughly to insure a homogeneous mix.

## Application

Duralco coatings can be applied by brushing, spraying or dipping. Spraying is preferred for most for most applications as it will result in light moist coverage of the coating.

*To avoid runs and obtain smooth, uniform coverage* (when spraying) add up to 5% of solvent.

**Note:** *a protective face mask must be employed to prevent inhalation of mist.*

## Coating Thickness

It is always preferable to apply the coatings in two thin layers rather than one heavy coat.

Allow parts to cool to room temperature then repeat above procedures to apply the second coat.

Make sure there is sufficient drying time between layers.

**Note:** *Excessive fast drying, or applying high heat when moist, can cause blisters.*

## Drying

Follow instructions provided on the containers for each individual system.

Coatings should be fully dried before continuing with the final cure.

## Curing

Follow instructions on the individual product containers.

blisters. The coatings should be smooth and uniform. They should be free of all blisters when

**Note:** *Excessively fast drying may cause blisters.*

## Post Cure

A post cure is required if the material is being used at temperatures below 250°F (120°C)

Follow the cure cycle as shown on the product label.

## Clean Up

Clean equipment with water or the required solvent.

## Toxicity

Precautions should be taken against inhalation, digestion, contact with eyes, open sores and cuts. Consult the MSDS for specific recommendations.

**Note:** *a protective face mask must be employed to prevent inhalation of mist when spraying.*



## **Mixing and Measuring Adhesives**

**Re-stir** all products before weighing or dispensing. Carefully weigh out the resins and hardeners separately, before mixing. The total weight of the mixture should be a minimum of 25 grams to insure a homogenous mixture. Mix thoroughly before using.

*Improper measuring or mixing can cause materials not to cure, create soft spots or air voids, create sticky surfaces, cause softening at elevated temperatures, reduce the levels of chemical or electrical resistance achieved in final product.*

## **Bonding Dissimilar Materials**

Select an adhesive with a thermal expansion coefficient that closely matches the materials to be bonded. When possible select a flexible epoxy. Free surfaces of dirt, oils, greases and mechanically roughen the surfaces prior to bonding. Cure as directed on the product label.

## **Recommended Bond Line Thickness For Adhesive Bonding**

For standard epoxy and ceramic adhesives a bond line thickness of 5-8 mils (0.005"-0.008") will produce excellent results. For Cotronics' epoxy or ceramic, non-sag putties bond lines measuring 0.020" or more can be used. To form a thick layer, or section, apply putty in several layers curing between each application.

## **Joint Design and Bond Strength**

Get the most out of your Cotronics' adhesives with optimal joint designs. Butt joints will form the weakest, type of joint. Tongue and groove, rod into a tube designs mechanically reinforces the joint. For repair and difficult applications use a metal or ceramic cloth buried in the glue line for additional reinforcement.

## **Bonding to Teflon, Nylon, Polyolefin and Similar Plastics**

Specific surface treatments and/or etching are required for bonding these specialty plastics. Cotronics offers flexible and activated epoxies that form strong adhesive bonds to many of these difficult-to-bond materials.

## **Preventing Flow of an Adhesive From a Joint**

Select an adhesive with high viscosity or thixotropic properties. Use just enough material to completely fill the gap being bonded. High viscosity (extra heavy/thick) versions can be made upon request.

## **Thinning Adhesives for Application**

Epoxies can be thinned with mild heat or an epoxy thinner (Resbond 105RT). Ceramic adhesives should be thinned with the thinner associated with the specific formulation being used. Add a minimum amount of thinner to avoid excess shrinkage, cracking and weak bonds.

## **Removing Bubbles in Potting Materials**

You can reduce the amount of entrapped air by warming epoxies prior to application or by vacuum degassing. Apply 29mmHg pressure for 2 minutes, release and repeat one time.

## **Working With Electrically or Thermally Conductive Adhesives**

Electrically and Thermally conductive adhesives will provide optimum results after they are post cured for 2 hours at 250°F. Electrically conductive adhesives are also available in flexible versions to accommodate bonding substrates with different thermal expansions.

## **Cracking in Ceramic Adhesives and Castable Ceramics**

Adding excess activator or additional water to uncured ceramic material mixtures may result in weak and cracked castings, encapsulations or adhesive bonds. Check the mix ratio that was used when mixing the materials.

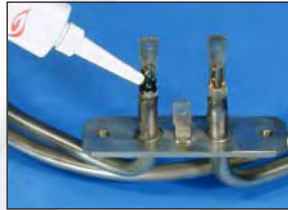
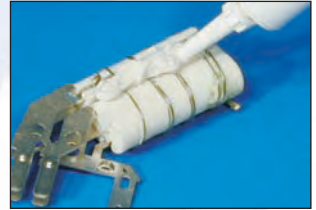
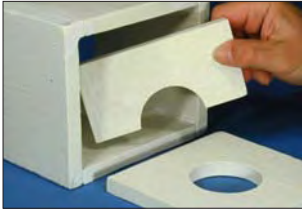
## **Accelerating Cure Time**

The best way to shorten the cure cycle is to raise the temperature. Most systems can be quickly cured at 250°F. *Materials should not be heated above 250°F° before they are dry or initially cured.* Check the product label for each products specific curing instructions.

## **Custom Formulations and Packaging**

Custom formulations, variations of standard stock formulations, development programs and special packaging for production and field applications are available upon request.

# HIGH TEMP. MATERIALS INSTRUCTIONAL HANDBOOK



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**For Specific Application Assistance**  
**Contact Cotronics' Application Engineers 718-788-5533**

**For Additional Technical Visit Our Website**  
**[www.cotronics.com](http://www.cotronics.com)**