

# EPOXY TECHNOLOGY

E4110

Number of Components:	Two	Minimum Bond Line Cure Schedule*:	
Mix Ratio By Weight:	10:1	150°C	15 Minutes
Specific Gravity:		100°C	1 Hour
Part A	3.10	80°C	3 Hours
Part B	0.95	60°C	6 Hours
Pot Life:	4 Hours	23°C	3 Days

Shelf Life: One year at room temperature

Note: Container(s) should be kept closed when not in use. For filled systems, mix contents of each container (A & B) thoroughly before mixing the two together. \*Please see Applications Note available on our website.

**A heat cure is recommended to achieve optimum properties.**

## Product Description:

EPO-TEK® E4110 is an electrically conductive, silver-filled epoxy paste. This two component system is designed for low temperature curing from ambient to 80°C, although other heat cures can be used.

## EPO-TEK® E4110 Advantages & Application Notes:

- Ease of use: smooth flowing paste allows for automated dispensing, stamping, brushing, or hand applications. In some cases, the low viscosity nature of the paste allows it to be sprayed onto targets.
- Suggested applications include: EMI and Rf shielding, ITO interconnects in LCDs, low temperature cryogenic cooling.
- Exhibits superior adhesion to a wide variety of substrates including most metals, ceramics, glass and plastics.
- Hybrid / Micro-electronic adhesive including die-attach and substrate attach for Rf and Microwave devices.
- Bright and shiny silver epoxy; provides a metallic-like layer after cure.

**Typical Properties:** (To be used as a guide only, not as a specification. Data below is not guaranteed. Different batches, conditions and applications yield differing results; Cure condition: 150 °C/1 Hour; \* denotes test on lot acceptance basis)

Physical Properties:	
*Color: Part A: Silver Part B: Clear/Colorless	Weight Loss:
*Consistency: Smooth flowing paste	@ 200°C: 1.45%
*Viscosity (@ 100 RPM/23°C): 800 – 1,600 cPs	@ 250°C:
Thixotropic Index: 2.1	@ 300°C:
*Glass Transition Temp.(Tg): ≥ 40°C (Dynamic Cure	Operating Temp:
20–200°C /ISO 25 Min; Ramp -10–200°C @ 20°C/Min)	Continuous: - 55°C to 150°C
Coefficient of Thermal Expansion (CTE):	Intermittent: - 55°C to 250°C
Below Tg: 48 x 10 <sup>-6</sup> in/in/°C	Storage Modulus @ 23°C: 518,756 psi
Above Tg: 150 x 10 <sup>-6</sup> in/in/°C	Ions: Cl <sup>-</sup> 151 ppm
Shore D Hardness: 60	Na <sup>+</sup> 23 ppm
Lap Shear Strength @ 23°C: 1,266 psi	NH <sub>4</sub> <sup>+</sup> 23 ppm
Die Shear Strength @ 23°C: ≥ 5 Kg / 1,700 psi	K <sup>+</sup> 31 ppm
Degradation Temp. (TGA): 380°C	*Particle Size: ≤ 45 Microns
Electrical Properties:	
*Volume Resistivity @ 23°C: ≤ 0.0005 Ohm-cm	*Volume Resistivity @ 23°C (23°C/3 Day cure): ≤ 0.007 Ohm-cm
Thermal Properties:	
Thermal Conductivity: 1.37 W/mK	

## EPOXY TECHNOLOGY, INC.

14 Fortune Drive, Billerica, MA 01821-3972 Phone: 978.667.3805 Fax: 978.663.9782  
www.EPOTEK.com

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# EPOXY TECHNOLOGY

E4110-LV

Number of Components:	Two		Minimum Bond Line Cure Schedule*:
Mix Ratio By Weight:	10:1		150°C 15 Minutes
Specific Gravity:		E4110-LV	80°C 3 Hours
Part A	3.10	↑	23°C 3 Days
Part B	0.96		
Pot Life:	6 Hours	LOW VISCOSITY	→
Shelf Life:	One year at room temperature		

Note: Container(s) should be kept closed when not in use. For filled systems, mix contents of each container (A & B) thoroughly before mixing the two together. \*Please see Applications Note available on our website.

### Product Description:

EPO-TEK® E4110-LV is a two component, silver-filled epoxy used in electronic and circuit assembly applications in semiconductor and optical industries. A low viscosity version of EPO-TEK® E4110.

### EPO-TEK® E4110-LV Advantages & Application Notes:

- Very low viscosity, silver-filled epoxy which can be applied by hand, brushing, roll coating, tooth-picking or stamping, or spraying.
- After cure, it has a shiny, almost metallic looking finish. This can be used to repair surface imperfections in metal coating applications such as electroplating or sputtering processes.
- Suggested applications:
  - Electronics - filling vias at the PCB level for top-to-bottom connections; EMI & Rf shielding applications.
  - Hybrids - electrically conductive potting for radar systems. The potting can be self-leveling, trapping no voids and non-cracking with performance.
  - Optics - die-attaching LED's by the stamping process, or pin-transferring applications.

**Typical Properties:** (To be used as a guide only, not as a specification. Data below is not guaranteed. Different batches, conditions and applications yield differing results; Cure condition: 150 °C/1 Hour; \* denotes test on lot acceptance basis)

Physical Properties:	
*Color: Part A: Silver Part B: Clear/Colorless	Weight Loss:
*Consistency: Smooth flowing paste	@ 200°C: 0.33%
*Viscosity (@ 100 RPM/23°C): 350 – 850 cPs	@ 250°C: 0.65%
Thixotropic Index: 1.9	@ 300°C: 1.19%
*Glass Transition Temp.(Tg): ≥ 40°C (Dynamic Cure 20–200°C /ISO 25 Min; Ramp -10–200°C @ 20°C/Min)	Operating Temp:
Coefficient of Thermal Expansion (CTE):	Continuous: - 55°C to 150°C
Below Tg: 70 x 10 <sup>-6</sup> in/in/°C	Intermittent: - 55°C to 250°C
Above Tg: 287 x 10 <sup>-6</sup> in/in/°C	Storage Modulus @ 23°C: 469,744 psi
Shore D Hardness: 70	Ions: Cl <sup>-</sup> 148 ppm
Lap Shear Strength @ 23°C: 1,080psi	Na <sup>+</sup> 18 ppm
Die Shear Strength @ 23°C: ≥ 5 Kg / 1,700 psi	NH <sub>4</sub> <sup>+</sup> 19 ppm
Degradation Temp. (TGA): 390°C	K <sup>+</sup> 4 ppm
	*Particle Size: ≤ 45 Microns
Electrical Properties:	
*Volume Resistivity @ 23°C: ≤ 0.0005 Ohm-cm	*Volume Resistivity @ 23°C (23°C/3 Day cure): ≤ 0.007 Ohm-c
Thermal Properties:	
Thermal Conductivity: 1.24 W/mK	

low die shear strength.  
(is not valid)

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**Product Information Sheet**

**MATERIAL ID:**

**EPO-TEK® E4110-PFC**

**Date:** 08/2005

**Per:**

**Rev:** III

**Material Description:**

A two component, silver-filled thixotropic epoxy for fine pitch applications in semiconductor flip chip or SMD microelectronic assemblies. Screen-printed "bumps" of EPO-TEK® E4110-PFC can be the size of 80 µm diameter on 125 µm pitch. It is a more thixotropic version of EPO-TEK® E4110.

**Number of Components:**

Two

**Mix Ratio by weight:**

3:1

**Cure Schedule (minimum)**

150°C/15 Minutes - 80°C/3 Hours - 23°C/3 Days

**Specific Gravity:**

— Part A: 3.26 Part B: 4.04

**Pot Life:**

2-3 Hours

**Shelf Life:**

One year at room temperature

**NOTE:** Container(s) should be kept closed when not in use. Filled systems should be stirred thoroughly before mixing and prior to use

**MATERIAL CHARACTERISTICS:** To be used as a guide only, not as a specification. Data below is not guaranteed. Different batches, conditions and applications yield differing results; Cure condition: 150°C/1 Hour  
\* denotes test on lot acceptance basis

PHYSICAL PROPERTIES:	
<b>*Color (before cure):</b>	Part A: Silver Part B: Silver
<b>*Consistency:</b>	Smooth thixotropic paste
<b>*Viscosity (23°C):</b>	
@ 10 rpm	25,000 - 35,000 cPs
<b>Thixotropic Index:</b>	3.0
<b>*Glass Transition Temp:</b>	≥ 40 °C (Dynamic Cure 20—200°C /ISO 25 Min; Ramp -10—200°C @ 20°C/Min)
<b>Coefficient of Thermal Expansion (CTE):</b>	
Below Tg:	53 x 10 <sup>-6</sup> in/in°C
Above Tg:	144 x 10 <sup>-6</sup> in/in°C
<b>Shore D Hardness:</b>	70
<b>Lap Shear @ 23°C:</b>	1,200 psi
<b>Die Shear @ 23°C:</b>	≥ 10 Kg / 3,400 psi
<b>Degradation Temp:</b>	415 °C
<b>Weight Loss:</b>	
@ 200°C:	0.14 %
@ 250°C:	0.53 %
@ 300°C:	1.00 %
<b>Operating Temp:</b>	
Continuous:	- 55°C to + 150°C
Intermittent:	- 55°C to + 250°C
<b>Storage Modulus @ 23°C:</b>	624,637 psi
<b>Ion Content:</b>	
Cl <sup>-</sup> :	26 ppm
NH <sub>4</sub> <sup>+</sup> :	Not detectable
Na <sup>+</sup> :	6 ppm
K <sup>+</sup> :	3 ppm
<b>*Particle Size:</b>	≤ 20 microns

ELECTRICAL AND THERMAL PROPERTIES:	
<b>Thermal Conductivity:</b>	1.47 W/mK
<b>*Volume Resistivity @ 23°C:</b>	≤ 0.0005 Ohm-cm
<b>Volume Resistivity @ 23°C (23°C/10 Day cure)</b>	≤ 0.2 Ohm-cm
<b>Dielectric Constant (1kHz):</b>	N/A
<b>Dissipation Factor (1kHz):</b>	N/A

OPTICAL PROPERTIES @ 23°C:	
<b>Spectral Transmission:</b>	N/A
<b>Index of Refraction:</b>	N/A

## CUSTOM FORMULATION DATA SHEET

**MATERIAL ID:** EE129-4  
Date: 1/98 Per: RHE  
Rev.: 5/02; 10/02; 07/03; 04/05; 05/05  
Material Description: Room temperature cure, silver filled epoxy. Faster curing version of the EPO-TEK® E4110.  
Number of components: Two  
Mix Ratio: 1 to 1 by weight  
Cure Schedule (minimum): Room temperature/overnight; 65°C/2 hours; 80°C/1 hour; 100°C/½ hour  
Pot Life: 3 hours  
Shelf Life: One year at room temperature.  
NOTE: Container(s) should be kept closed when not in use. Filled systems should be stirred thoroughly before mixing and prior to use.

### **MATERIAL CHARACTERISTICS (typical)\*:**

#### **PHYSICAL PROPERTIES:**

Color:  
Before Cure: Silver  
After Cure: Silver  
Consistency: Smooth, thixotropic paste  
Viscosity (23°C/20 rpm): 5,427 cPs  
(23°C/100 rpm): 2,800 cPs  
Thixotropic Index: 3.62  
Specific Gravity:  
Part "A": 2.95  
Part "B": 3.62  
Shore D Hardness: 80  
Lap Shear Strength: 1,000 psi @ 23°C  
Die Shear Strength: > 10 Kg/3,400 psi  
Degradation Temp: 349°C  
Glass Transition Temp (T<sub>g</sub>):  
150°C/1 Hour cure: 99°C  
80°C/4 Hours cure: 43°C  
Coeff. of Thermal Expansion (CTE):  
Below T<sub>g</sub>:  $51 \times 10^{-6}$  in/in/°C  
Above T<sub>g</sub>:  $142 \times 10^{-6}$  in/in/°C  
Storage Modulus (65°C/2Hrs): 168,301 psi  
Outgassing to 200°C: 0.2%  
@ 300°C: 1.3%

#### **ELECTRICAL PROPERTIES:**

Volume Resistivity:  
Room temp/16 hr cure: 0.0096 ohm-cm  
Room temp/20 hr cure: 0.0090 ohm-cm  
Room temp/72 hr cure: 0.003 ohm-cm  
150°C/15 minute cure: 0.0003 ohm-cm  
80°C/2 hr cure: 0.002 ohm-cm  
55°C/16 hr cure: 0.00008 ohm-cm

#### **THERMAL PROPERTIES:**

Thermal Conductivity: 2.0 W/m²K

The data above is INITIAL only - it may be changed at anytime, for any reason without notice to anyone. It is provided only as a guide for evaluation/consideration.

\*These material characteristics are typical properties that are based on a limited number of samples tested in the laboratory. All properties are based on the cure indicated above. Some properties may vary as manufactured quantities are scaled up to production levels.

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# EPOXY TECHNOLOGY

# H20S

Number of Components:	Two	Minimum Bond Line Cure Schedule*:	
Mix Ratio By Weight:	1:1	175°C	45 Seconds
Specific Gravity:		150°C	5 Minutes
Part A	1.74	120°C	15 Minutes
Part B	3.07	100°C	45 Minutes
Pot Life:	4 Days	80°C	90 Minutes
Shelf Life:	One year at room temperature		

Note: Container(s) should be kept closed when not in use. For filled systems, mix contents of each container (A & B) thoroughly before mixing the two together. \*Please see Applications Note available on our website.

### Product Description:

EPO-TEK® H20S is a modified version of EPO-TEK® H20E, designed primarily for die stamping and dispensing techniques for chip bonding. EPO-TEK® H20S is a highly reliable, two component, silver-filled epoxy with a smooth, thixotropic consistency. In addition to the high electrical conductivity, the short curing cycles, the proven reliability, and the convenient mix ratio, EPO-TEK® H20S is extremely simple to use.

### EPO-TEK® H20S Advantages & Application Notes:

- Especially recommended for use in high speed epoxy chip bonding systems where fast cures are highly desirable.
- Suggested for JEDEC Level III and II plastic IC packaging.
- The low temperature cure makes it ideal for flex circuitry and other low stress applications.
- It is used extensively for bonding quartz crystal oscillators and other stress sensitive chips.
- Used for die and SMD bonding inside hybrid/hermetic packages such as DIP and TO-Cans; also EMI/Rf shielding of micro-electronics.
- Ideal for making ITO electrical contacts in LCD packaging; and suggested for LED die-attach.

**Typical Properties:** (To be used as a guide only, not as a specification. Data below is not guaranteed. Different batches, conditions and applications yield differing results; Cure condition: 150°C/1 hour; \* denotes test on lot acceptance basis)

### Physical Properties:

\*Color: Part A: Silver Part B: Silver  
 \*Consistency: Smooth, thixotropic paste  
 \*Viscosity (@100 RPM/23°C): 1,800 – 2,800 cPs  
 Thixotropic Index: 5  
 \*Glass Transition Temp.(Tg): ≥ 80°C (Dynamic Cure  
 20–200°C /ISO 25 Min; Ramp -10-200°C @ 20°C/Min)  
 Coefficient of Thermal Expansion (CTE):  
 Below Tg:  $31 \times 10^{-6}$  in/in/°C  
 Above Tg:  $120 \times 10^{-6}$  in/in/°C  
 Shore D Hardness: 57  
 Lap Shear Strength @ 23°C: 1,240 psi  
 Die Shear Strength @ 23°C: ≥ 5 Kg / 1,700 psi  
 Degradation Temp. (TGA): 441°C

### Weight Loss:

@ 200°C: 0.40%  
 @ 250°C: 0.60%  
 @ 300°C: 1.37%

### Operating Temp:

Continuous: - 55°C to 200°C  
 Intermittent: - 55°C to 300°C

### Storage Modulus @ 23°C: 339,720 psi

Ions: Cl<sup>-</sup> 162 ppm  
 Na<sup>+</sup> 0 ppm  
 NH<sub>4</sub><sup>+</sup> 4 ppm  
 K<sup>+</sup> 282 ppm

\*Particle Size: ≤ 20 Microns

### Electrical Properties:

\*Volume Resistivity @ 23°C: ≤ 0.0005 Ohm-cm

### Thermal Properties:

Thermal Conductivity: 3.25 W/mK

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**Appendix A : Use of Adhesives**

**4.1 Araldite 2011**

www.araldite.com

[http://ww1.huntsmanservice.com/tds/Structural-Adhesives/English/Long/Aral-2011%20\\_GB\\_.pdf](http://ww1.huntsmanservice.com/tds/Structural-Adhesives/English/Long/Aral-2011%20_GB_.pdf)

**4.2 Masterbond EP79**

www.masterbond.com

**Technical Data Sheet**

**MASTER BOND POLYMER SYSTEM EP79**

**Two Component, Silver Coated Nickel Filled Conductive Epoxy for High Performance Bonding and Sealing Featuring High Peel Strength, Superior Toughness and Very Low Volume Resistivity.**

**Product Description**

Master Bond Polymer System EP79 is a two component, silver coated nickel filled, electrically conductive adhesive for high performance bonding and sealing formulated to cure at room temperature or more rapidly at elevated temperatures. EP79 offers a convenient one-to-one mix ratio by weight or volume. It readily develops a high bonding strength of more than 1800 psi tensile shear and a T<sub>50</sub> of greater than 20 pli when measured and cured at 75°F. It is 100% reactive and does not contain any diluents or solvents. The volume resistivity of the cured system is very low — less than 0.04 ohm-cm.

Master Bond Polymer System EP79 can be applied with minimal sagging or dripping even on vertical surfaces although it can be made thinner (flowable) by adding 5 to 10% of an appropriate solvent (xylene, acetone, MEK, etc.) by weight. The high strength bonds are remarkably adaptable to thermal cycling and resistant to chemicals including water, oil and most organic solvents, over the exceptionally wide temperature range of 4°K to +275°F, enabling it to be serviceable even in cryogenic applications. Adhesion to metals, glass, ceramics, vulcanized rubbers and many plastics is excellent. Parts A and B are both colored gray. Master Bond EP79 adhesive is widely used in the electronic, electrical, computer, semiconductor, microwave, appliance, and automotive industries, among others. For convenient handling, EP79 is now available in premixed and frozen syringes.

**Product Advantages**

- Convenient mixing: 1 to 1 by weight or volume
- Contains no volatiles; excellent low outgassing properties
- Easy application: contact pressure only required for cure; adhesive spreads evenly and smoothly
- Versatile cure schedules: ambient temperature cures or fast elevated temperature cures as required
- Very low volume resistivity (<0.04 ohm-cm)
- High bond strength to similar and dissimilar substrates
- Superior durability, thermal shock and chemical resistance
- Outstanding toughness
- Cost effective alternative to silver filled epoxy

**Product Properties**

- Mixing ratio, weight or volume, Parts A to B .....1/1

## TRA-DUCT 2902 ROOM TEMPERATURE CONDUCTIVE SILVER EPOXY ADHESIVE

TRA-DUCT 2902 is an electrically conducting silver-filled epoxy compound recommended for electronic bonding and sealing applications that require a combination of good mechanical and electrical properties. This two-part, smooth paste formulation of refined pure silver and epoxy is free of solvents and copper or carbon additives. It develops strong, durable, electrically and thermally conducting bonds and coatings between many different and dissimilar materials such as metals, ceramics, glass and plastic laminates. TRA-DUCT 2902 cures at room temperature and can be used as a cold solder for heat-sensitive components where hot-soldering is impractical. It also can be used for the assembly and repair of electrical modules, printed circuits, wave guides, flat cables and high frequency shields. This adhesive complies with the requirements of NASA's Outgassing Specification.

PROPERTY	TYPICAL VALUES
Color	Silver
Specific gravity, mixed	2.450
Operating temperature range, °C	-60 to 110
Hardness, Shore D	80
Mix ratio, parts by weight, Resin/Hardener	100/6
Thermal conductivity, W/M <sup>2</sup> K	2.99E+00
Lap shear, alum to alum, psi	1 hour @ 110°C 1,600 15 minutes @ 150°C 1,600 2 hours @ 65°C 1,000 24 hours @ 25°C 700
Glass transition (Tg), °C, ultimate	24 hours @ 25°C 52.00
Coefficient of expansion, cm/cm/°C	4.90E-05
Volume resistivity, ohm-cm @ 25°C	1 hour @ 110°C 6.00E-04 15 min @ 150°C 5.00E-04 2 hours @ 65°C 9.00E-04 24 hours @ 25°C 1.00E-03 5 min @ 160°C 3.00E-04
Outgassing, NASA	Passes
Outgassing, NASA, %CVCM	0.050
Cytotoxicity study	ISO (10993-5) elution method Passes

**POT LIFE** 60 minutes

**CURE SCHEDULE**

24 hours @ 25°C or  
1 to 4 hours @ 65°C

*Signature*  
*Hyphen resistor for lay case*

PC 3001  
Conductive Adhesive

Thermosetting Polymer Silver Conductive Adhesive

**Description**

PC 3001 is a thermosetting, one-component, solvent-free, silver-filled epoxy conductive adhesive, designed for the **connection of electronic (SMDs) and bare dies with LTCC- and ceramic substrates**, for dispensing application.

**Advantages**

- High electrical and thermal conductivity.
- Very low degassing.
- Solvent-free, one-component.
- High reliability.
- Low ionic contamination.

**Typical Properties of the Uncured Adhesive**

<b>Ag Content</b>	81,5 ± 1.5 %
<b>Density</b>	4.4 g/cm <sup>3</sup>
<b>Viscosity</b> <sup>1)</sup>	9 ± 3 Pa•s
<b>Processing Life</b> <sup>2)</sup>	c. 20 hours
<b>Placing Time</b> <sup>3)</sup>	c. 16 hours
<b>Storage</b> <sup>4)</sup>	6 months

- 1) At shear rate  $D = 50 \text{ s}^{-1}$ : plate-cone system with cone 2°, temperature: 23 °C.  
 2) Time at room temperature during which the glue can be processed.  
 3) Max. time between paste application and component placement, at up to 60% R.H., at room temperature.  
 4) Storage in the freezer at - 40 °C.

**Processing**

- ⇒ Dispensing.
- ⇒ Recommended Substrate Materials: LTCC and Al<sub>2</sub>O<sub>3</sub> ceramic.
- ⇒ Ensure that the adhesive has reached room temperature.

**Dispensing**

- ⇒ Available syringes:  
 No. 1 (20g),  
 No. 2 (50g),  
 No. 3 (100g).
- ⇒ Depending on the application, the dot size and number of dots vary widely.

	Nozzle diameter
Archimedes screw system e.g. CAM/ALOT	0.33 – 0.20 mm
Jetting system e.g. Asymtec Jet	0.20 – 0.12 mm
Air pressure / time system e.g. GLT	0.41 – 0.25 mm
Peristaltic system e.g. Höfer+Bechtel	0.25 – 0.15 mm



## PC 3001 Conductive Adhesive

### Thermosetting Polymer Silver Conductive Adhesive

#### Typical Properties of the Cured Adhesive PC 3001

<b>Curing, Peak Temperature</b>	107/150 °C 207/120 °C
<b>Volume Resistivity</b>	<0.3 mΩ•cm
<b>Adhesion (DIN 1465)</b>	>8.5 N/mm <sup>2</sup>
<b>Elongation at Tear (ISO 527-2)</b>	>1%
<b>E Module (ISO 527-2)</b>	c. 3600 N/mm <sup>2</sup>
<b>Temperature Stability <sup>1)</sup></b>	180 °C
<b>Glass Transition Temperature</b>	41 °C
<b>Weight Loss during Curing Process at 140 °C</b>	< 1,2 %
<b>Water absorption</b>	< 0.19 %
<b>Impurities:</b>	
Cl <sup>-</sup>	<20 ppm
Na <sup>+</sup>	<10 ppm
K <sup>+</sup>	<10 ppm
<b>Thermal Conductivity</b>	> 5 W/m•K
<b>Shrinkage</b>	4.4%
<b>CTE below Tg</b>	<65 ppm/K
<b>above Tg</b>	<140 ppm/K

1) After storage 1000 h at 180 °C, the adhesion remains nearly unchanged.  
The data stated above were measured at laboratories of W.C. Heraeus GmbH&Co.KG.

#### Cleaning

##### Before Curing:

The uncured adhesive can be removed with Zestron HC and other Zestron and Vigon cleaning materials - see separate application recommendations for cleaning of SMT-adhesives. The cleaned parts must be completely dry before installing them in the machine.

##### After Curing:

Defective components can easily be replaced by heating (with hot air) the cured adhesive joint above 250 °C. The hot remaining adhesive can be removed with a sharp tool.

Issue from 24.07.02 HG-DK

The descriptions and engineering data shown here have been compiled by Heraeus using commonly-accepted procedures, in conjunction with modern testing equipment, and have been compiled as according to the latest factual knowledge in our possession. The information was up-to date on the date this document was printed (latest versions can always be supplied upon request). Although the data is considered accurate, we cannot guarantee accuracy, the results obtained from its use, or any patent infringement from its use (unless this is contractually and explicitly agreed in writing, in advance). The data is supplied on the condition that the user shall conduct tests to determine materials suitability for a particular application.

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