Application Note

Revision 2.0
May 28, 2021

Environmental Reliability
BERGQUIST GAP FILLER TGF 4500CVO

Henkel Reliability Laboratory Testing

This report outlines Henkel's BERGQUIST brand laboratory results of the environmental reliability testing conducted on GAP FILLER TGF 4500CVO. GAP FILLER TGF 4500CVO is a high performance, thermally conductive gap filling material that is ideal for fragile assemblies or filling intricate air gaps between electronic components. The thermal conductivity of this two-part materials that required mixing and is 4.5 W/m-K. It is highly consistent and even to surfaces with high roughness and/or topography, allowing for excellent interfacing and wet-out characteristics. Expect consistent and reliable thermal performance with GAP FILLER TGF 4500CVO, even when exposed to extreme environments.

The Henkel Laboratory tests Thermal Interface Materials (TIMs) in the following environments: 85ºC/85% Relative Humidity (RH), Continuous Bake and Thermal Cycling (-50ºC to 150ºC at 30-minute intervals).

The 85ºC/85% RH test is the harshest test condition as this environment can quickly degrade test materials that react with water and/or tend to oxidize. The High Temperature Continuous Bake environment accelerates changes in material characteristics for TIMs with temperature sensitivity. The TO-220 Thermal Test Vehicle utilizes copper and aluminum components, simulating real-world applications. In the Thermal Cycling (or Thermal Shock) environment, the CTE mismatch of metals creates a great deal of stress, in turn inducing significant internal and external stress upon the test material, potentially resulting in a reduction in performance.

The goal of the environmental reliability testing is to accelerate aging of the TIM and determine the effect on the key thermal performance while in a controlled laboratory setting. GAP FILLER TGF 4500CVO is subjected to constant pressure throughout the test via spring clip on the TO-220 testing. The thermal test vehicle is removed at each time interval for testing from the oven chamber. Thermocouples are utilized to measure the transistor junction, transistor base, heat sink and ambient temperatures. Thermal Performance is reported as the temperature delta between the transistor junction and the heat sink divided by the power dissipated by the TO-220.

GAP FILLER TGF 4500CVO was exposed to 85ºC/85% Relative Humidity, Continuous Bake and Thermal Cycling tests for 1000 hours. Reliability testing over time are reported below. Due to the numerous of thicknesses possibility, customers are always advised to test in their applications for their specific testing.

Figure 1: Typical environmental chamber

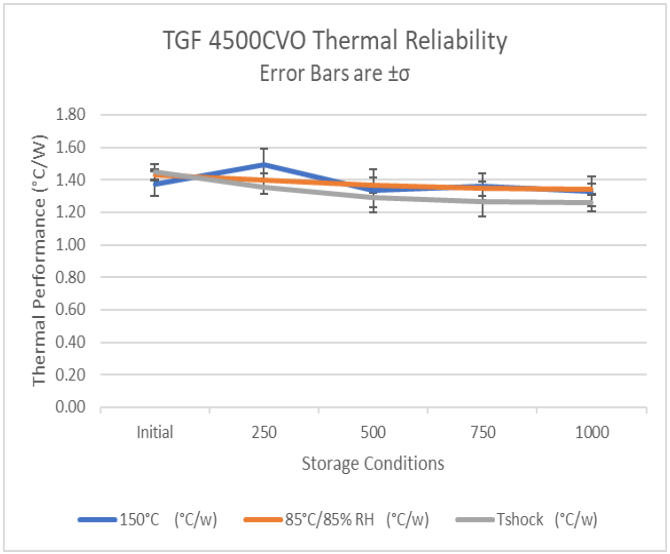

Figure 2: TO-220 Thermal Performance Testing

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TGF 4500CVO Thermal Performance			
	150°C (°C/w)	**85°C/85% RH (°C/w)**	**Tshock (°C/w)**
Initial	1.38	1.43	1.45
250	1.49	1.40	1.35
500	1.33	1.36	1.29
750	1.36	1.34	1.26
1000	1.33	1.34	1.26

Table 1: TO-220 Thermal Performance Testing

For the calculation on the Thermal Performance is as follow:

The final transistor temperature (Tr), specimen heat sink temperature (Ts), and transistor power dissipation (W) are recorded and the Thermal Performance is calculated (°C/W). The formula for Thermal Performance is shown below:

$$\text{Thermal Performance}(^{\circ}\text{C/W}) = \frac{\text{Tr} - \text{Ts}}{\text{W}}$$

TGF 4500CVO was also tested using 40 mil thickness separately at 85ºC/85% Relative Humidity (RH), Continuous Bake and Thermal Cycling (-50ºC to 150ºC at 30-minute intervals). See graph below for results.

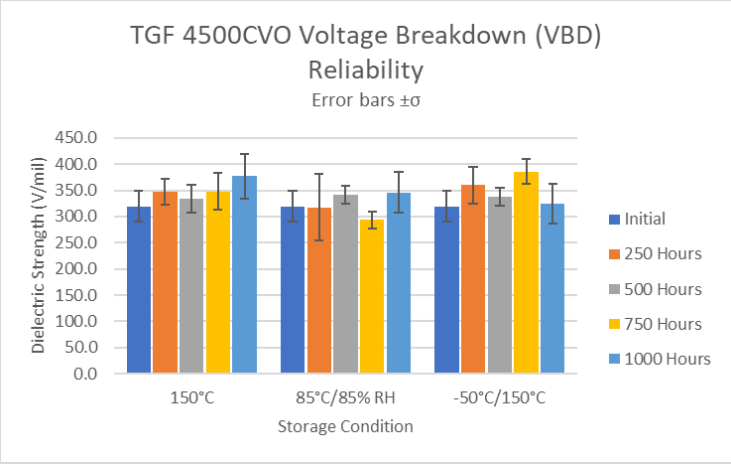

Figure 3: Voltage Breakdown Testing

Conclusion

Overall, GAP FILLER TGF 4500CVO exhibits minimal changes over the extended 1000 hours of testing across the 20 mil and 40 mil thickness. GAP FILLER TGF 4500CVO consistently provided superior thermal performance and voltage breakdown throughout the duration of the Henkel laboratory environmental reliability testing.

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