Tgrease 300X Thermal Reliability

This report summarizes the thermal reliability testing of Tgrease 300X, utilizing reliability test fixtures ideal for high performance thermal grease and phase change materials. The reliability test conditions are designed to characterize the long term performance of the thermal material by subjecting the material in the test fixtures to isothermal conditions, repeated thermal shock conditions, long-term power cycling conditions, and moderate heat and high humidity conditions.

Test Equipment

- Tgrease 300X batch 472534.
- Thermal Shock and Environmental Chambers
- Thermal resistance tester
- Power cycling pcb test units

Test Procedure

Test Fixture and Sample Preparation
The test fixture for each condition is explained for each test in the respective portion or this document.

Conditions:
Control @ 22°C
Thermal bake @ 100°C
Thermal bake @ 125°C
Thermal shock cycling 125°C to -40°C
HAST @ 85°C and 85% relative humidity
HAST @ 45°C and 85% relative humidity

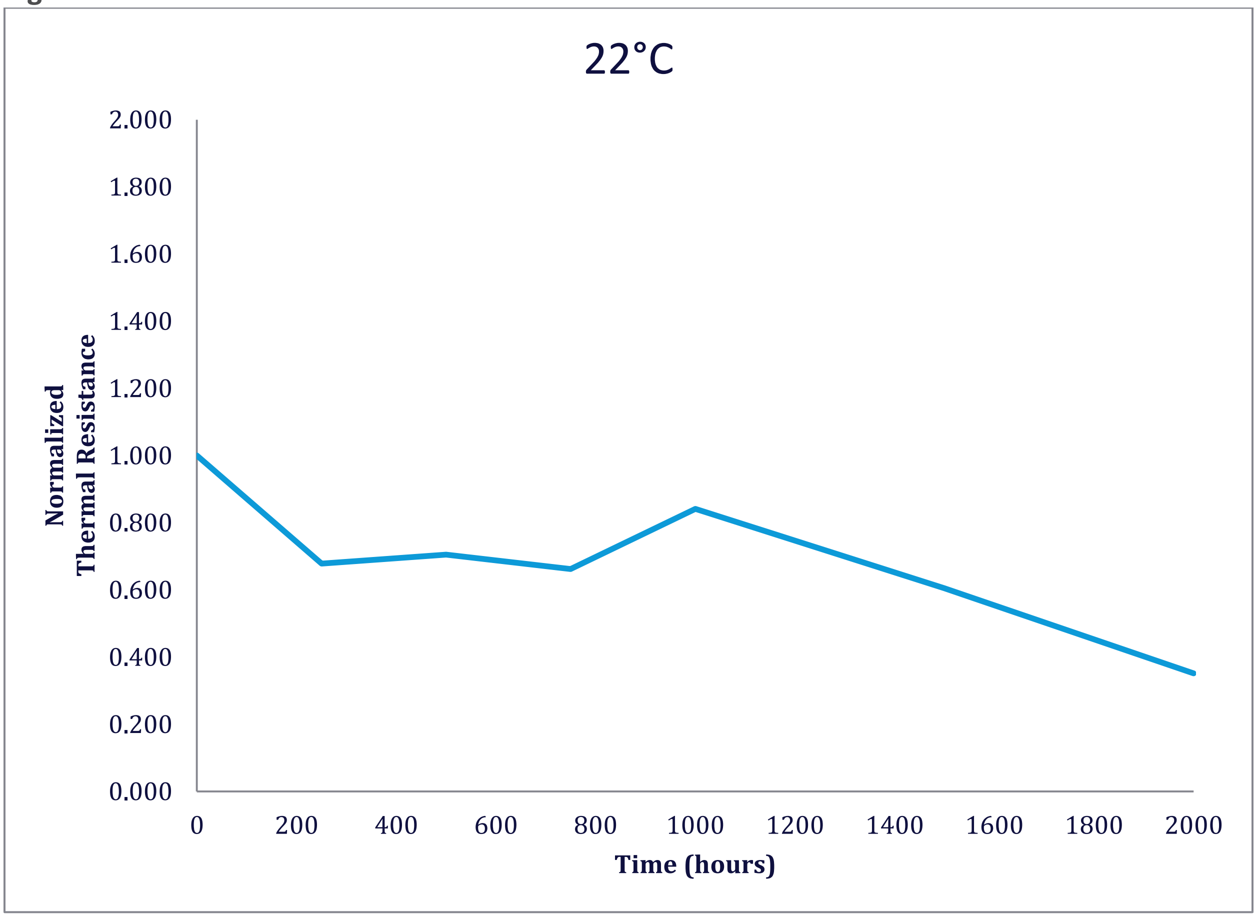
After each 250 hour/cycle interval, samples from each condition were evaluated for thermal resistance. The thermal resistance in this document has been normalized to calculate the thermal resistance change in terms of the thermal resistance at time zero.   The calculation is: thermal resistance from each interval divided by the original measured thermal resistance. For example: no change in thermal resistance would be indicated by a normalized thermal resistance of 1 while a doubling of thermal resistance is a normalized thermal resistance of 2.

Results

Control

Control samples were performed for 2000 hours at 22°C. The control samples were tested for thermal resistance on a modified ASTM D5470 thermal resistance tester. During testing, the samples were maintained between two round aluminum disks measuring one square inch in surface area. Clamps were used to hold a constant pressure on the samples. See Figure 1 for control results.

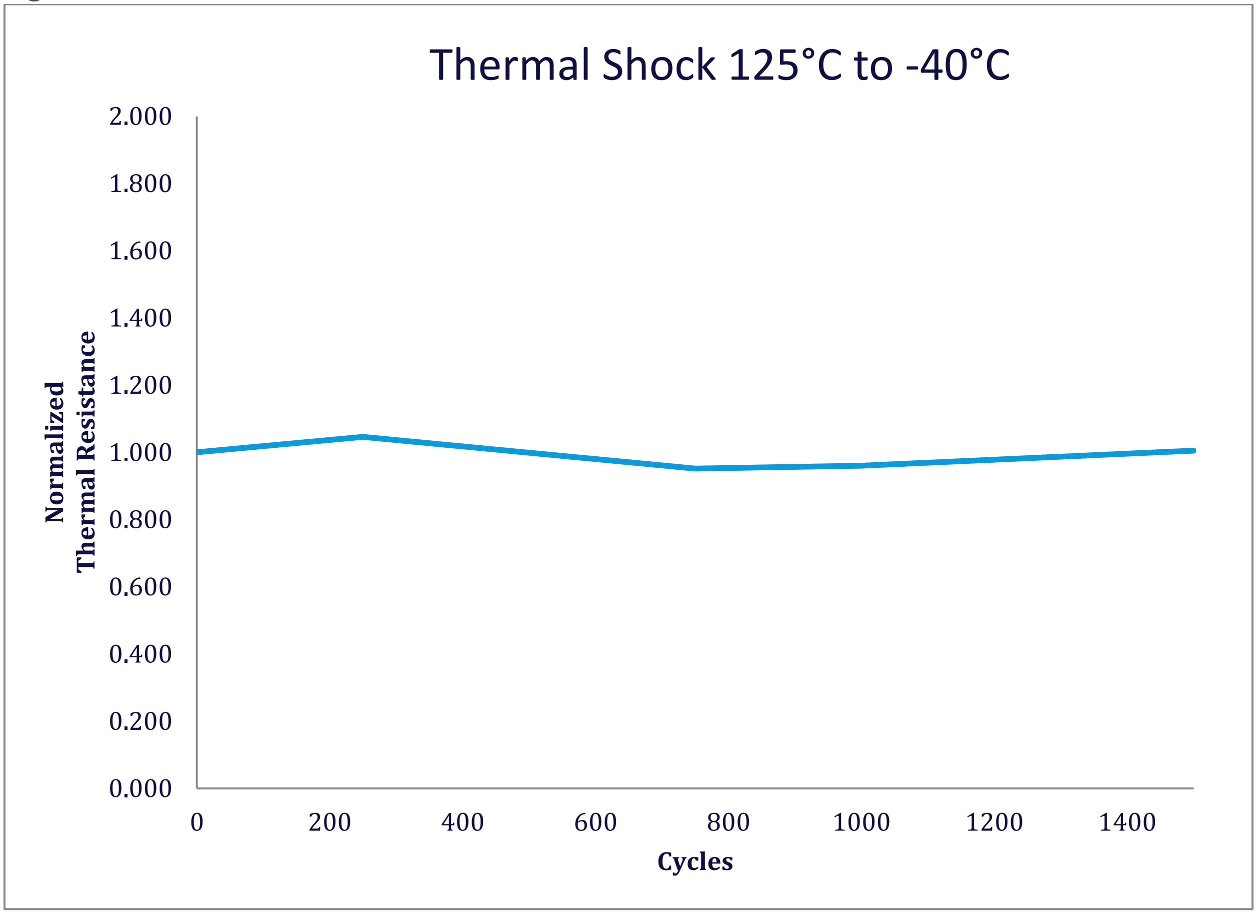
Figure 1: Control Results



Thermal Shock

Thermal shock was performed for 1,500 cycles from -40°C to 125°C. Each cycle is one hour, with the assembly spending thirty minutes at each condition. The sample transition time between the two temperature extremes is approximately 10 seconds. The samples were tested for thermal resistance on a modified ASTM D5470 thermal resistance tester. During testing, the samples were maintained between two round aluminum disks measuring one square inch in surface area. Clamps were used to hold a constant pressure on the samples. See Figure 2 for thermal shock results.

Figure 2: Thermal Shock Results



Isothermal Bake

Isothermal bake was performed at 100°C and 125°C for 2,000 hours and 1,500 hours, respectively. The bake samples were tested for thermal resistance on a modified ASTM D5470 thermal resistance tester. During testing, the samples were maintained between two round aluminum disks measuring one square inch in surface area. Clamps were used to hold a constant pressure on the samples. See Figures 3 and 4 for isothermal bake results.

Figure 3: Isothermal Bake 100 °C Results

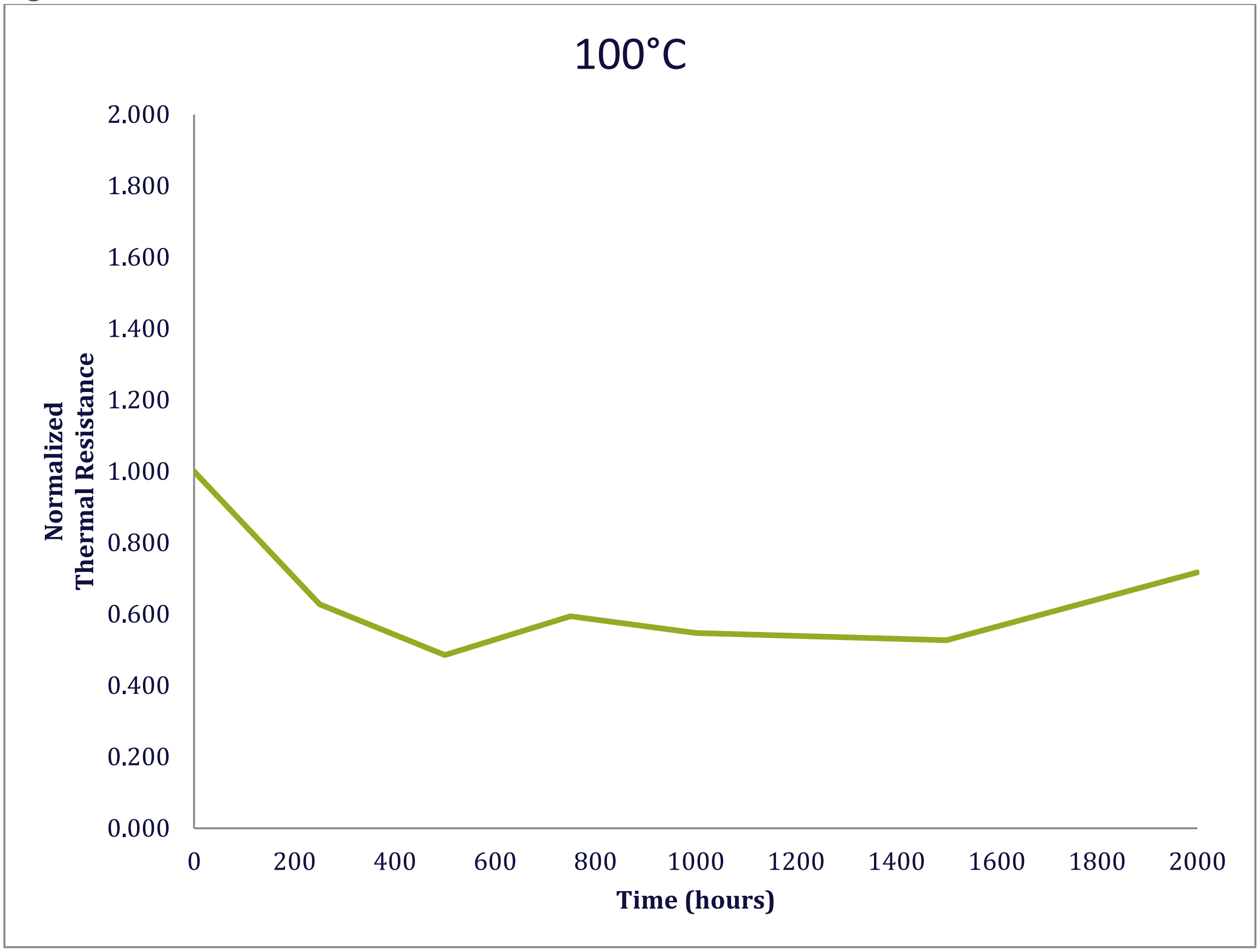
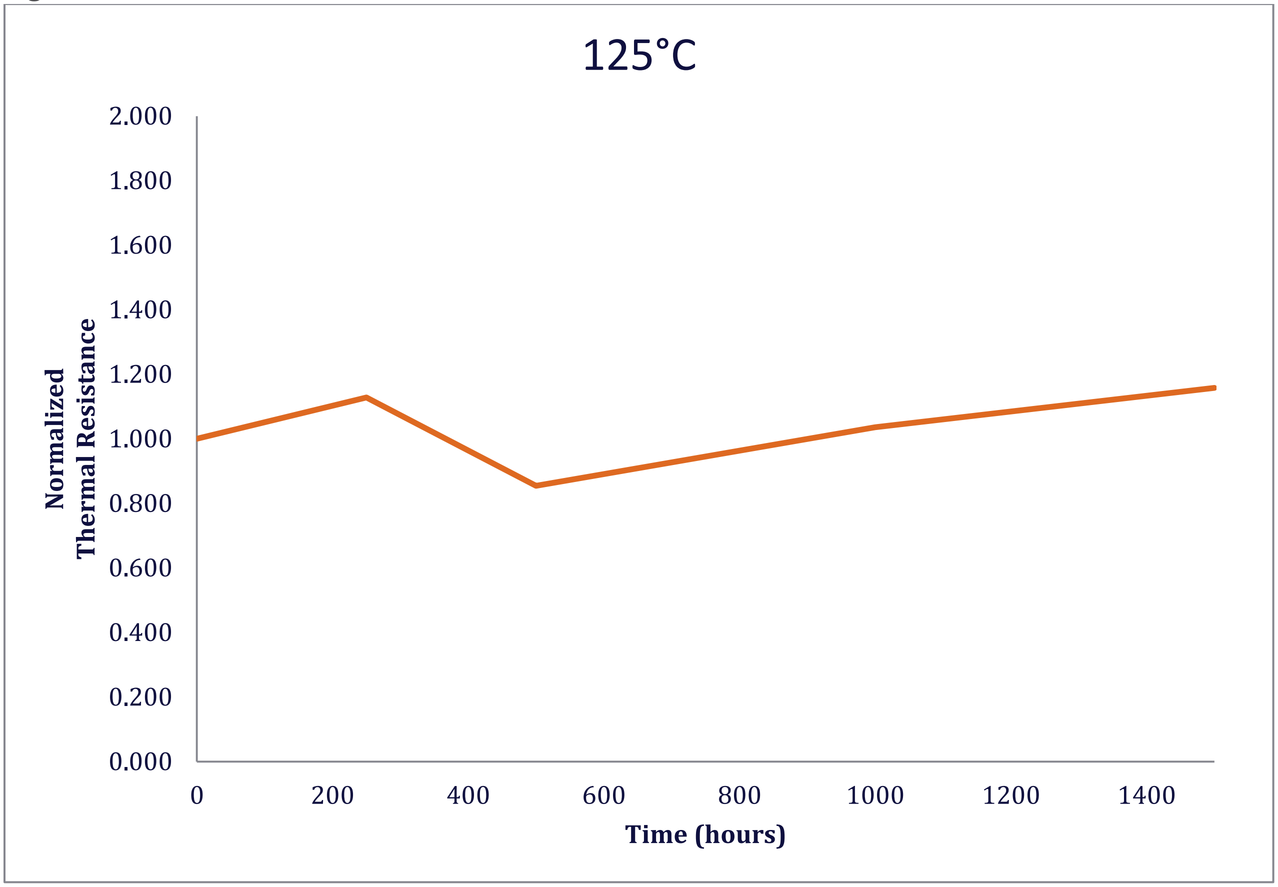


Figure 4: Isothermal Bake 125 °C Results



HAST

HAST was performed for 2,000 hours at 45°C and 85% relative humidity and 85°C and 85% relative humidity. The HAST samples were tested for thermal resistance on a modified ASTM D5470 thermal resistance tester. During testing, the samples were maintained between two round aluminum disks measuring one square inch in surface area. Clamps were used to hold a constant pressure on the samples. See Figures 5 and 6 for HAST results.

Figure 5: 45°C and 85% Relative Humidity HAST Results

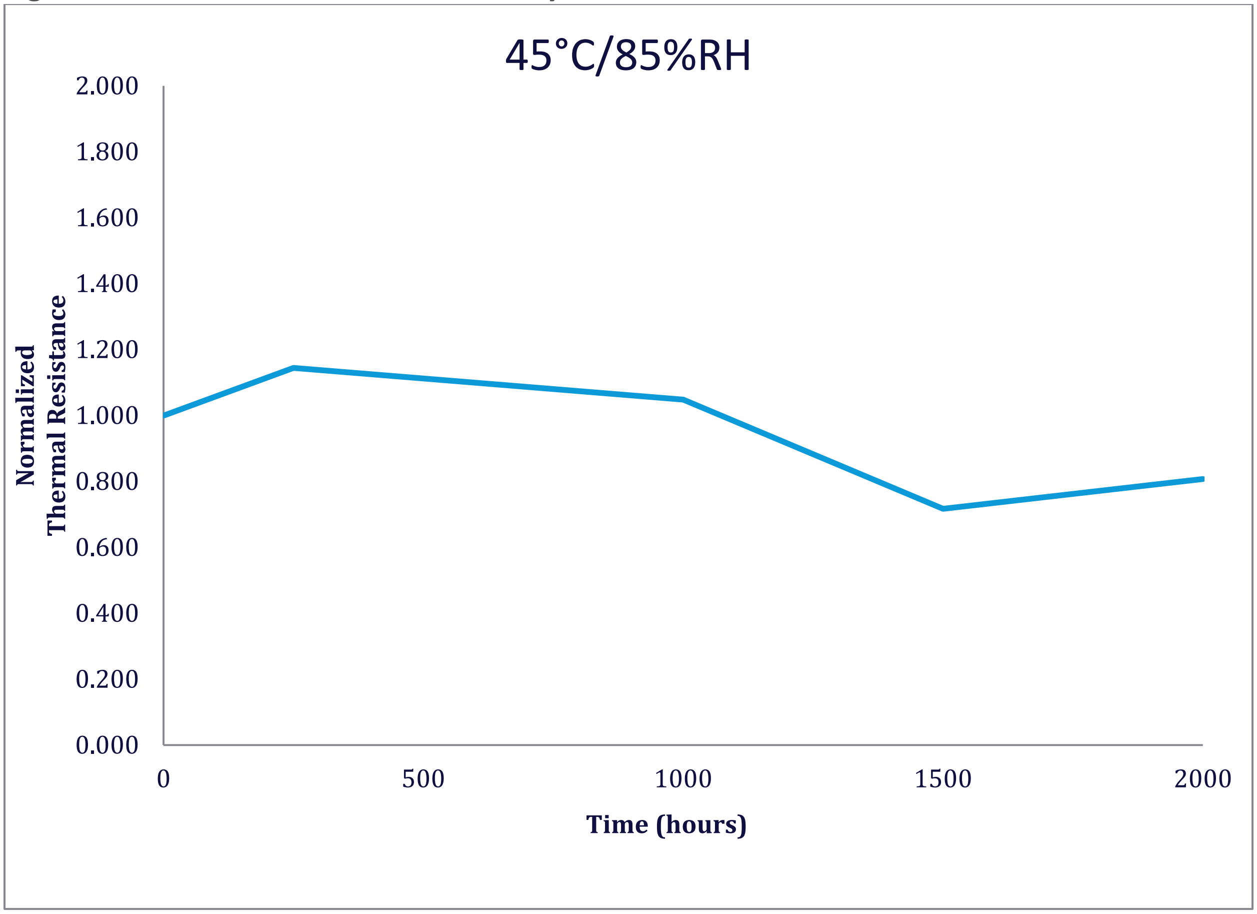
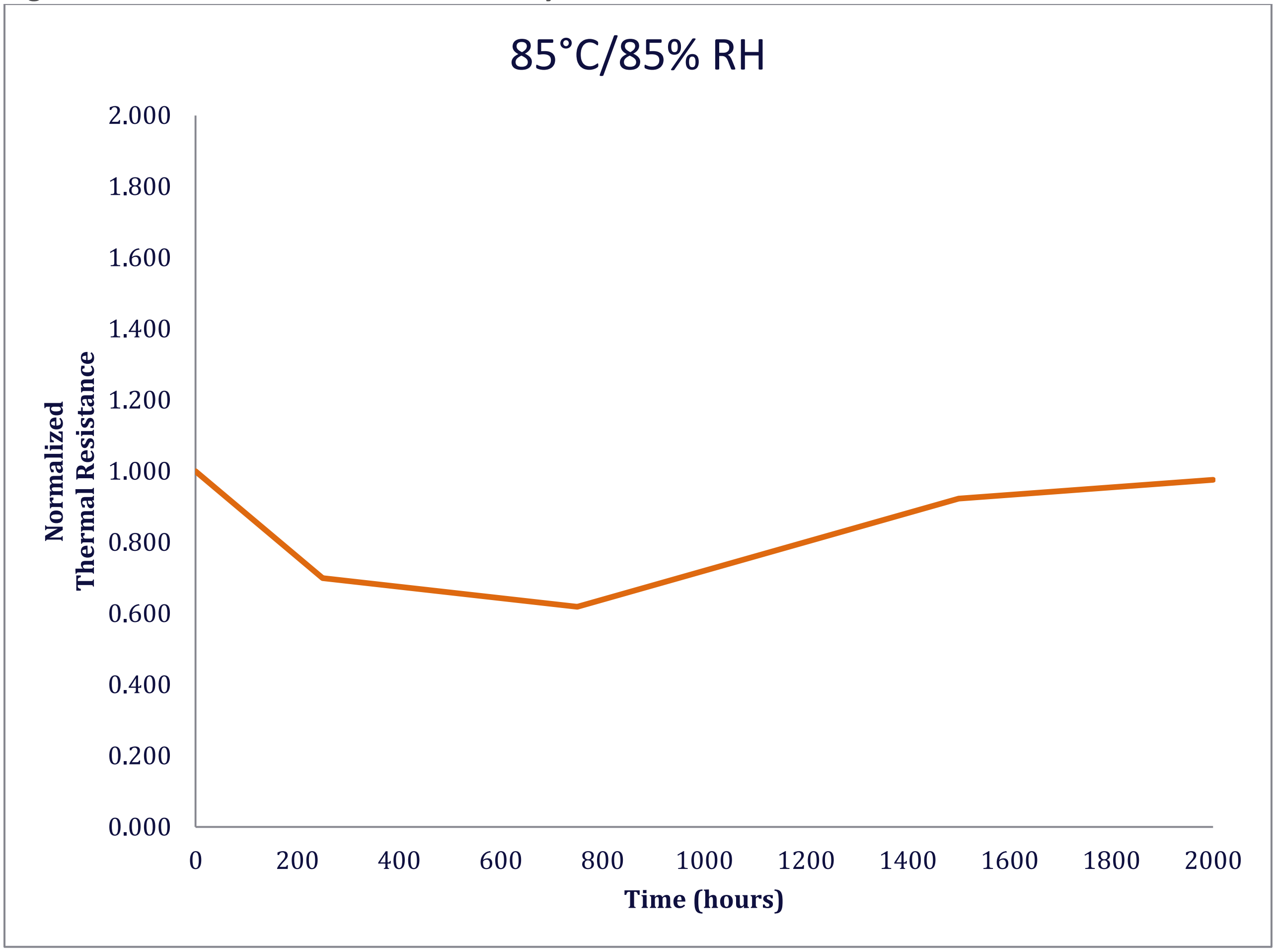


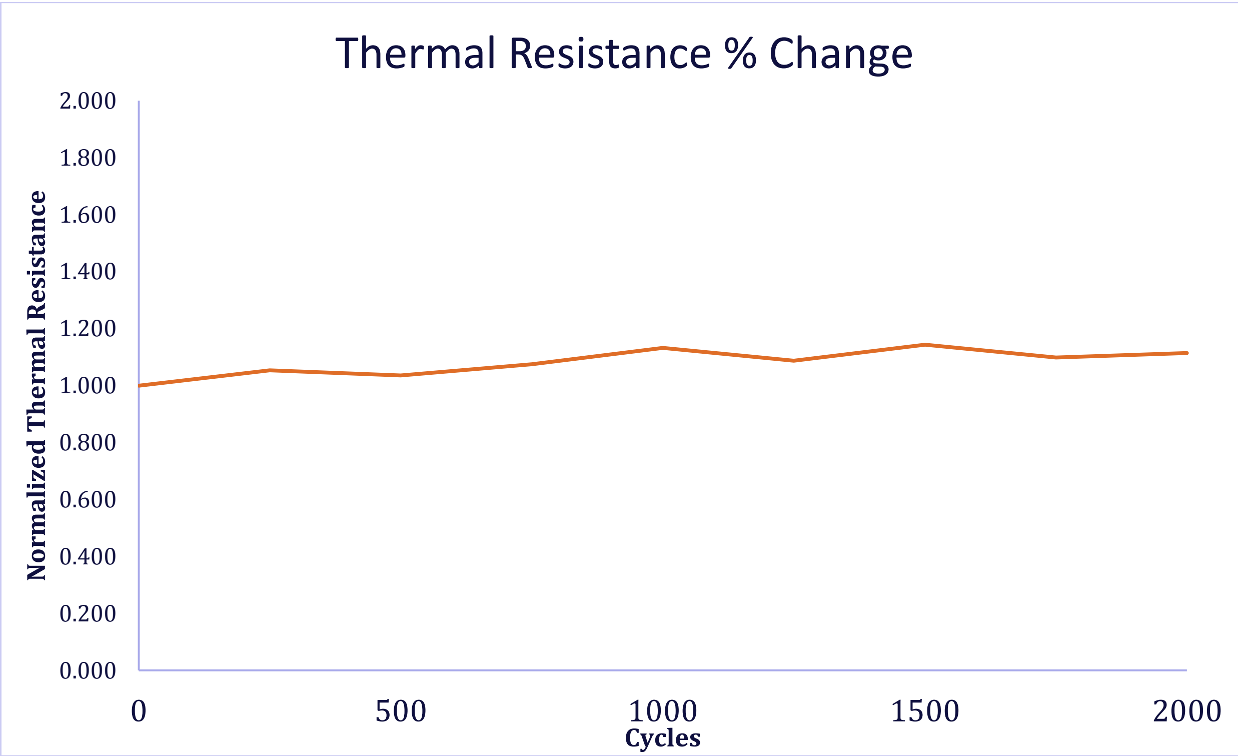
Figure 6: 85°C and 85% Relative Humidity HAST Results



Power Cycling

Power Cycling was performed for 2,000 cycles using a pc simulation fixture from room temperature to 100°C. Approximately 0.1mm to 0.2mm of sample is spread onto the die of the pcb test fixture. Power is supplied to the pcb in cycles such that the measured temperature of the sample cycles from room temperature to 100°C in approximately 20 minutes. The unit is cooled with a heatsink assembly and fan placed on top of the fixture. Enough weight is placed on the assembly to achieve approximately 20psi. See Figure 7 for power cycling results.

Figure 7: Power Cycling Thermal Resistance Results



Discussion

When analyzing the results to determine the thermal reliability of the material in the accelerated and stressed conditions, it is essential to observe the general long term trend over the duration of the study. Variations from interval test point to interval test point will occur. But a long term negative, or increase of thermal resistance, indicates a failing study and may indicate the poor thermal performance over stressed conditions. As the material may crack or degrade, less substrate contact may result which would lead to less heat transfer. Significant trends were not observed for any condition. Some conditions can be seen that approach a 15% to 20% increase in thermal resistance near the end of the study. However, this may partially be due to study and testing variability as well as the material showing some minor hardening over some long term baking conditions. Increases above 20% of the starting thermal resistance values would be a concern for failure.

The data from the testing completed demonstrates that Tgrease 300X performed on average the same or slightly better at the end point for control, high temperature bake, thermal shock, and HAST testing than before exposure. Any decrease in thermal resistance is most likely due to the materials natural ability to wet-out the surfaces further filling the microscopic voids on the surfaces of the mated components. Even though most voids are filled immediately there are smaller voids containing air that eventually become filled with the product. Optimal filler packing may also be occurring over time resulting in lower thermal resistance values.

In conclusion, all conditions showed a slight decrease in thermal resistance or showed a minor increase in thermal resistance. Tgrease 300X passes all of the stressed conditions and can be considered a reliable thermal interface material that will continue to perform well under the most rigorous conditions.

Additional Figures

Figure 8: Aluminum Disk Test Fixtures

Figure 9: Aluminum Disks Clamped With Sample Between Them

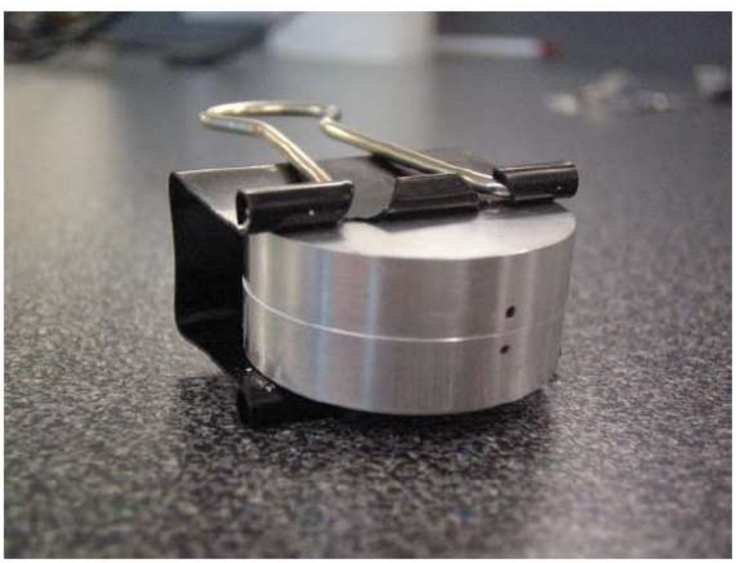


Figure 10: Close-Up of The Aluminum Disks In The Thermal Tester

Figure 11: ASTM D5470 Thermal Resistance Tester

Reported By:

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