TEST REPORT

Tgrease 2500 and 2500S Thermal Reliability

Purpose

This report summarizes the thermal reliability testing of Tgrease™ 2500 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 high temperature isothermal conditions, repeated thermal shock conditions, and moderate heat and high humidity conditions.

Test Equipment

- Tgrease 2500
- 6 aluminum disks measuring 1in^2 in area (with thermocouple holes)
- 3 Standard binder clips
- Thermal Shock and Environmental Chambers
- ASTM D5470 Thermal Resistance Tester
- Data acquisition system for temperature monitoring

Test Fixture and Sample

The samples were placed and maintained between two aluminum disks measuring one square inch in surface area. Clamps were used to hold a constant pressure on the samples while in the environmental chamber. After each 250 hour/cycle interval, samples from each condition were evaluated for thermal resistance. The samples maintained between the disks were placed in a modified ASTM D5470 thermal resistance tester. Thermal resistance is recorded. 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.

TEST REPORT

Tgrease 2500 and 2500S Thermal Reliability

Figure 5: Aluminum Disk measuring 1in^2 in area

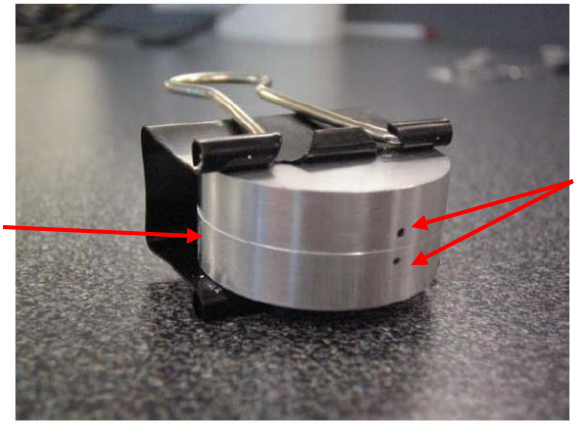


Figure 6: Aluminum Disks Clamped with Sample

Figure 7: Close-Up of The Aluminum Disks in the Thermal Tester

TEST REPORT

Tgrease 2500 and 2500S Thermal Reliability

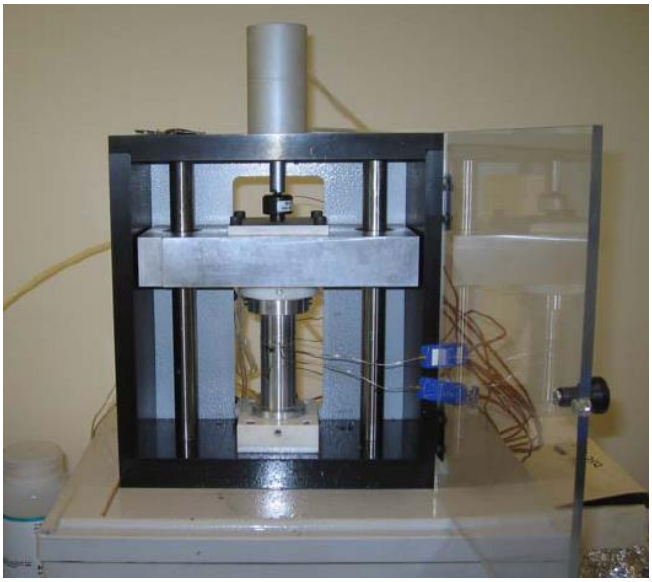


Figure 8: ASTM D5470 Thermal Resistance Tester

Test Conditions

- Isothermal @ 125°C
- HAST @ 85°C and 85% relative humidity
- Thermal shock from -55°C to 125°C (1 cycle is 30 minutes per condition, 10 second transfer)

TEST REPORT

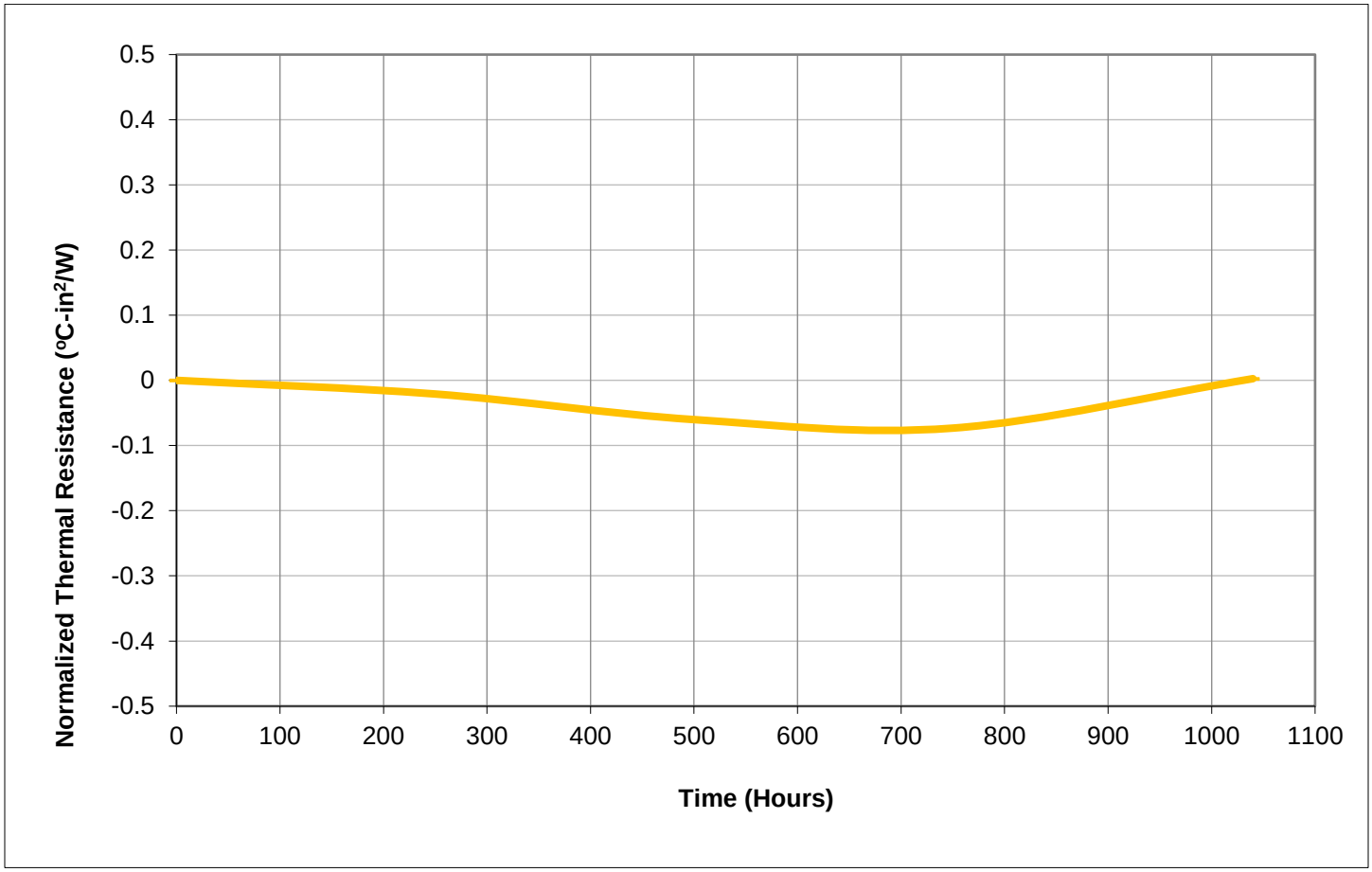
Tgrease 2500 and 2500S Thermal Reliability

Results

Isothermal Bake

Isothermal bake was performed for 1,000 hours at 125°C. 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 while in the environmental chamber.

Figure 1: Isothermal Bake Results: 125°C



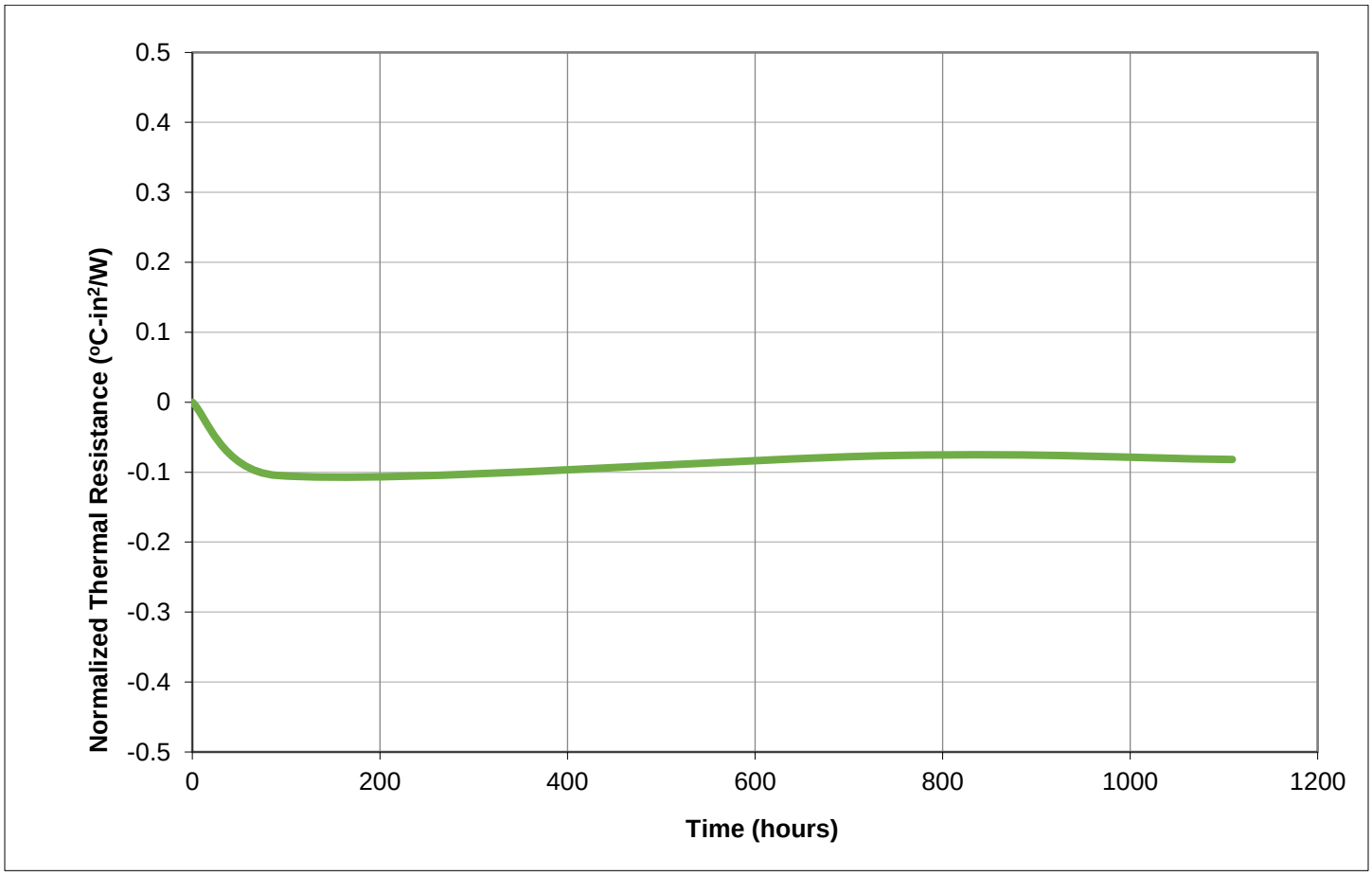
TEST REPORT

Tgrease 2500 and 2500S Thermal Reliability

HAST

HAST was performed for 1,000 hours at 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 while in the environmental chamber.

Figure 2: HAST Results: 85°C/85%RH



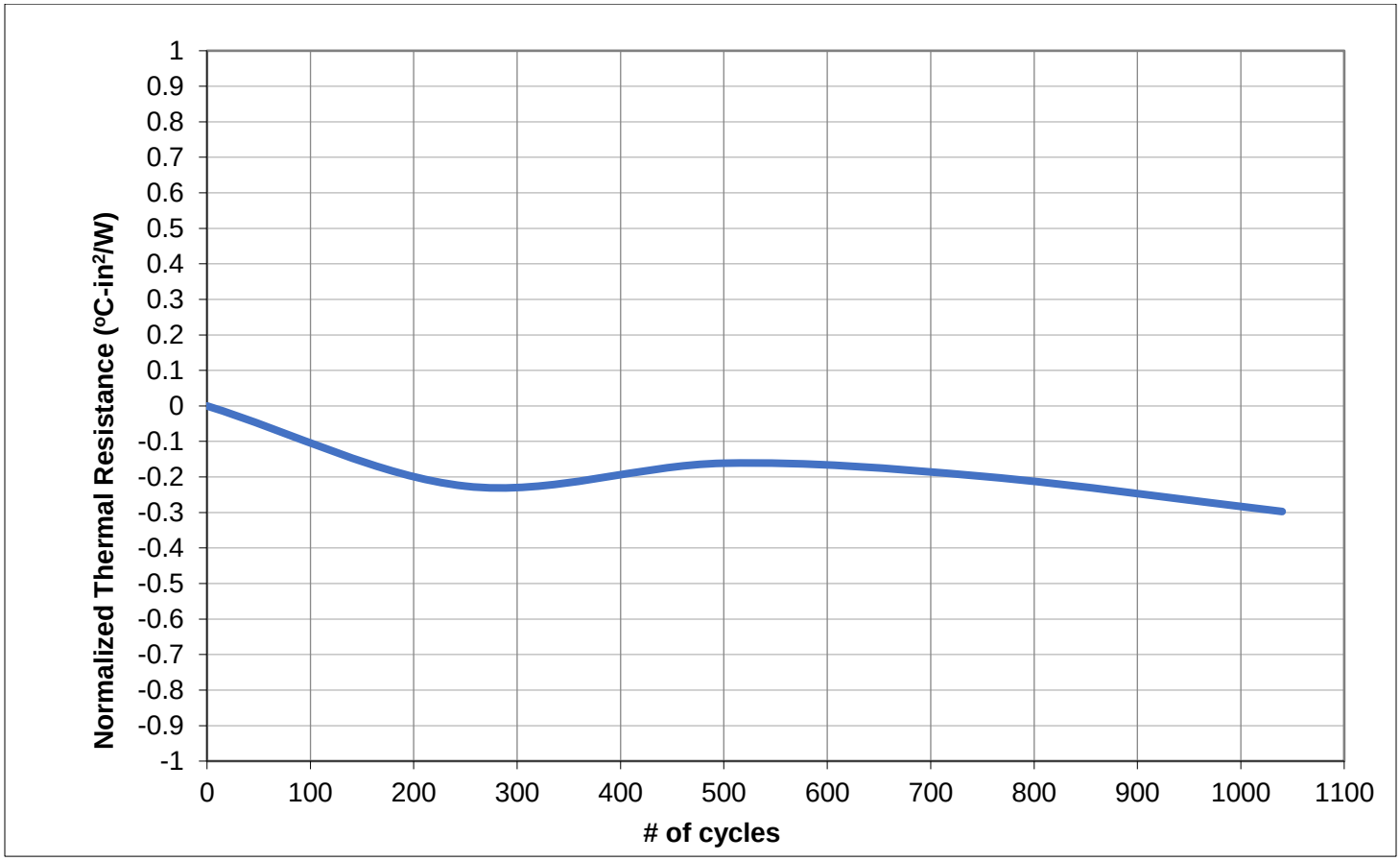
TEST REPORT

Tgrease 2500 and 2500S Thermal Reliability

Thermal Shock

Thermal shock was performed for 1000 cycles from -55°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 while in the environmental chamber.

Figure 3: Thermal Shock Results: -55°C to 125°C



TEST REPORT

Tgrease 2500 and 2500S Thermal Reliability

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. Long term positive, 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. Poor thermal performance from degradation was not observed.

The data from the testing completed demonstrates that Tgrease™ 2500 continues to perform well at each condition; high temperature bake, thermal shock, and HAST. Initial decrease in thermal resistance is most likely due to the material's natural ability to wet-out the surfaces further filling the microscopic voids on the surfaces of the mated components and reducing to bondline after the initial testing.

Tgrease™ 2500S is the same formulation as Tgrease™ 2500 except ~5% of solvent is added to improve dispensability. Prior to final assembly the solvent should be evaporated leaving just Tgrease™ 2500. Hence this reliability report will hold for Tgrease™ 2500S as well.

In conclusion, all conditions show optimal thermal performance at the end of the stated hours. Tpcm™ 2500 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.