Tgrease 1500 Reliability Report

Summary

This study was designed to test the reliability of Tgrease 1500, from a thermal resistance perspective, under 3 severe environmental conditions. Samples were placed between 0.25 inch thick aluminum discs and held under pressure. The thermal resistance was measured at time 0 and at regular intervals throughout the testing. Triplicate testing was conducted and the results are reported below. Specimens were also prepared for visual observation at each interval.

Fixture

The test fixtures were 1 in^2 round aluminum discs. Each disc contained a thermocouple hole drilled near one surface. To maintain a constant surface condition, each disc was polished using 600 grit sandpaper prior to applying the Tgrease 1500. Clips were used to apply pressure to discs when not in the thermal tester.

Procedure

Fixture Preparation:

1) Ensure thermocouple holes are free from any obstruction.
2) Polish the inside surface (closest to the thermocouple hole) of each disc using the polishing wheel and 600 grit sandpaper.
3) Clean all surfaces of the discs with acetone.

Specimen Preparation:

1) Place approximately 0.2 g of Tgrease 1500 on inside surface of one aluminum disc.
2) Using a tongue-depressor, smooth material so it evenly coats the entire surface.
3) Align the thermocouple hole of another clean, polished aluminum disc with the thermocouple hole of the first disc and gently, but even apply the second disc on top of the Tgrease 1500.
4) Place the specimen in a binder clip for applied pressure.
5) Prepare seven specimens per each environmental condition. (Three for thermal resistance testing and 4 for visual observation at each interval.)
6) Label the 3 specimens for thermal resistance testing. Label the visual observation specimens 250, 500, 750, & 1000 for pulling at those time intervals.

Initial (T_0) Test Procedure:

1) Preheat ASTM D5470 (Stand 5 or equivalent) to 70°C.
2) Cut two 1 in^2 round pieces of LMA foil for use with the interfaces.
3) Sandwich the test material between the two pieces of LMA foil and place in thermal tester with thermocouple holes facing toward the back of the unit.
4) Close cylinder with 50 psi of pressure.
5) Heat stand to 90°C and ensure the LMA foil on top and bottom of specimen flows.
6) Insert the 2 auxiliary thermocouples into the holes in sample discs.
7) Cool stand to 70°C and run test.

Calculation:

1) When the test is complete, retrieve the data from the D5470 testing database.
2) Calculate the temperature differential (delta T) using the two auxiliary thermocouples.
3) Calculate the power using the bottom platen as a calorimeter (or use the power calculation supplied by the tester).
4) Calculate the thermal resistance from the actual delta T and the supplied power.

Aging:

1) Place the 7 specimens in each of the following three environmental conditions: 125°C, 150°C thermal bake, and H.A.S.T (85°C / 85% R.H.).
2) At 250, 500, and1000 hours, pull all the samples and allow them to cool to room temperature.

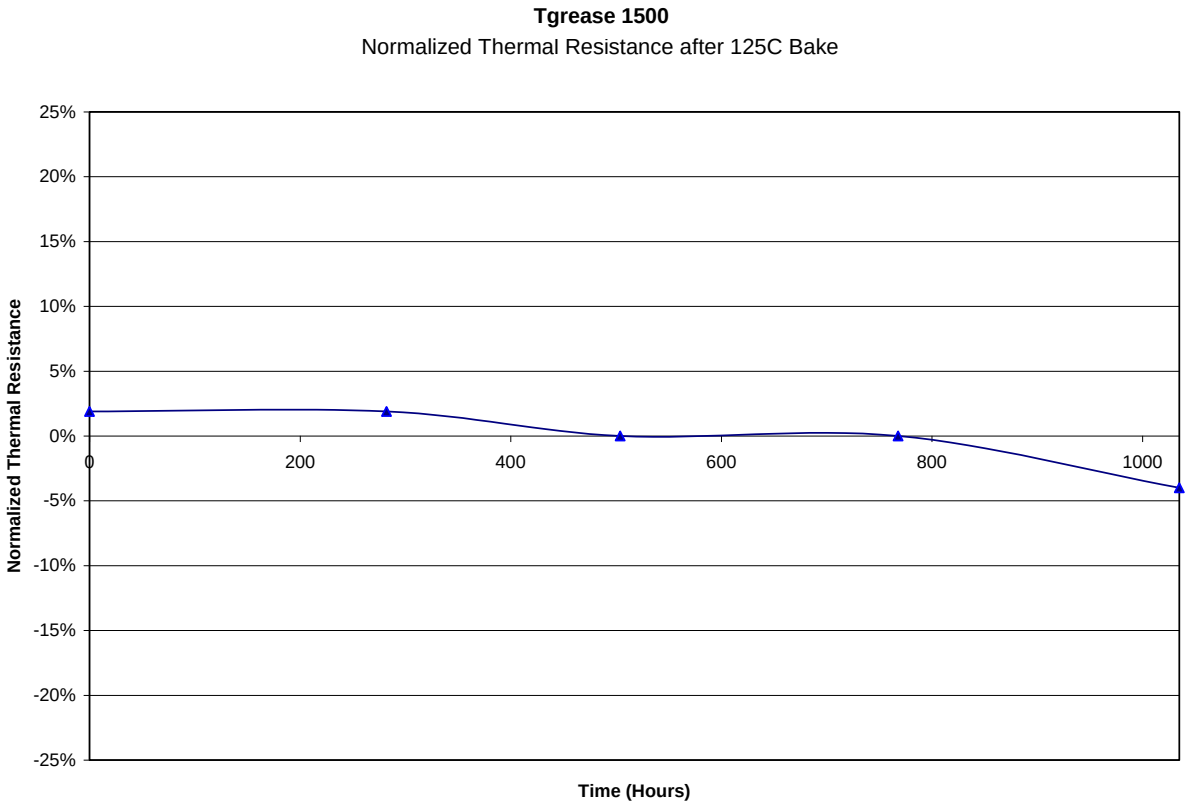
Testing:

1) Measure the thermal resistance of the 3 specimens using the procedure above.
2) Disassemble one of the visual specimens and observe any physical changes that may have occurred to the material.

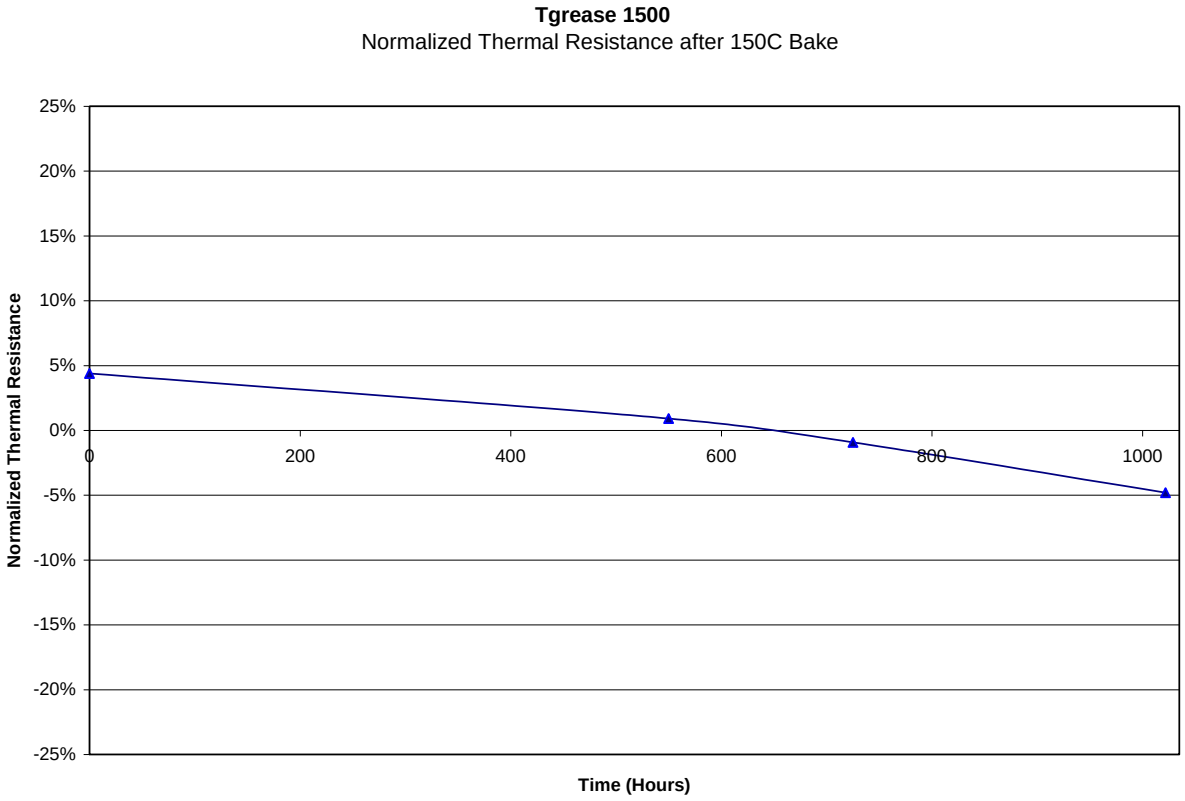
Results

The following tables and graphs report the Time, Average Power (Watts) during test, and the Average R_{th} ($°C \cdot in^2/W$) for the samples that were measured for each environment.

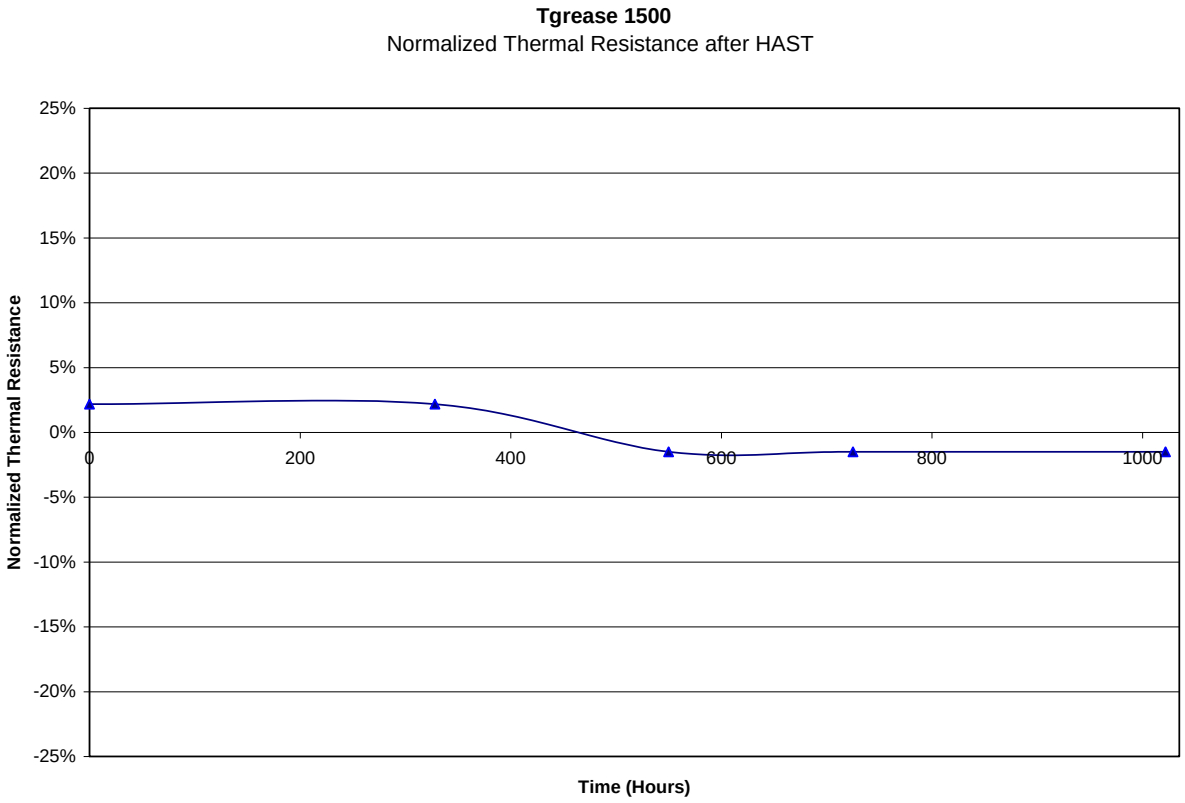
125°C Thermal Bake Data:



150°C Thermal Bake Data:



H.A.S.T. Thermal Bake Data:



Visual Observations

At each of the intervals, specimens were pulled and disassembled to observe any physical change in the material under the environmental conditions. After 250 hours in both conditions, some changes could be noted. All of the specimens were noticeably more difficult to separate than when originally assembled. Once separated, the Tgrease 1500 material appeared to have dried out, but on closer examination and manipulating with a spatula, it was still grease-like and movable. The Tgrease 1500 material appears to have "set up," but under shear became similar to its original state.

Summary

Because all of the initial samples were prepared and measured at the same time, one would expect that the T_0 thermal resistance values for the 3 environmental conditions would be similar, and, in fact, they are.

As time progressed all three of the environmental conditions displayed a general decrease in the thermal resistance of the samples. Comparing the three conditions, the highest temperature environment (150°C) decreased the most and the quickest. The 125°C environment was similar to the 150°C, but the overall decrease was not as significant. This indicates that the higher the burn-in temperature, the better the overall performance will be.