Tputty 508 Thermal Reliability

This report summarizes the thermal reliability testing of Tputty 508. The Laird reliability test procdure is designed to characterize the long term performance of the thermal putty by subjecting the material and test fixture to isothermal conditions, repeated thermal shock conditions, and moderate heat and high humidity conditions. This is an interim report which covers the isothermal bake and shock conditions.

Test Equipment

- Tputty 508, held to 60 mil (1.5mm)
- Thermal Shock and Environmental Chambers
- Reliability Test Fixture
- Power Supply with cartridge heaters
- Data acquisition system for temperature

Theory

Thermal resistance of the material is directly proportional to the temperature differential of the surface of the hot plate and the surface of the cold plate. The thermal resistance (R_{th}) can be defined as the temperature differential (ΔT) between the two surfaces for a given heat flow (ΔQ).

$$R_{th} = {}^{\Delta T}/_{\Delta Q}$$

For this procedure, heat flow is controlled and the temperature differential is recorded at steady state with a constant power or heat flow. Thus, the thermal resistance can be inferred from the temperature differential. Thus, an increase in ΔT over the reliability testing can be attributed to an increase in thermal resistance of the thermal putty.

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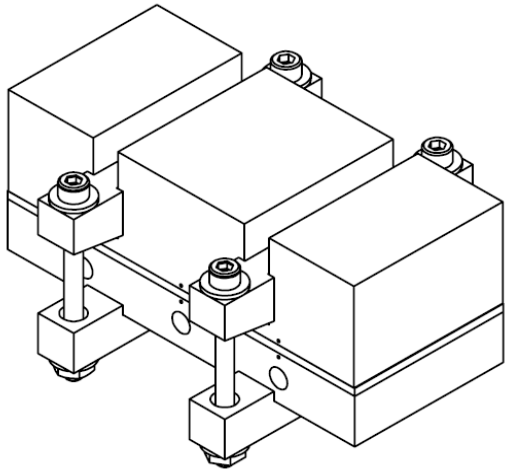
Test Procedure

Test Fixture and Sample Preparation

The test fixture is a rectangular fixture with dimensions of approximately 2 inches x 5 inches, or 10 square inches. It consists of an aluminum hot plate and an extruded aluminum heat sink. The hot plate has three machined holes at even intervals for insertion of cartridge heaters. Both hot plate and heat sink have three smaller precision machined holes for thermocouples. The thermocouples can be inserted in very close proximity to the surface of the plates and precisely in alignment for each set of "hot" and "cold" thermocouples. The sample material is placed on the hot plate surface and the fixture assembly is fastened by two metal straps. Shims are placed in the four corners of the hot plate surface and each of the four nut and bolt positions are tightened until the sample is compressed to the thickness of the shims (60 mil). A dual fan unit is placed on top of the aluminum heat sink and air flow is directed from the heat sink to the atomosphere. The completed assembly is operated in an ambient laboratory environment. Once fully assembled, the cartridge heaters are connected to a power supply and power is applied to maintain a hot plate temperature of approximately 70°C across the hot plate surface. This is monitored by the data acquisition system. Steady state condition is achieved in approximately forty five minutes to one hour.

Each assembly, with sample, is tested at time zero and then placed into the conditioned chambers for the specified period of time. Generally, every 250 hours the assembly is removed, tested and then placed back into the chamber. The average temperature differential across the test fixture is plotted graphically for the length of the realibility testing (2000 hours for Tputty 508). See figure 1 for a visual of the assembly, with the exception of the fan. Two fixtures were assembled and tested for each of the reliability conditions.

Figure 1: Text Fixture Assembly

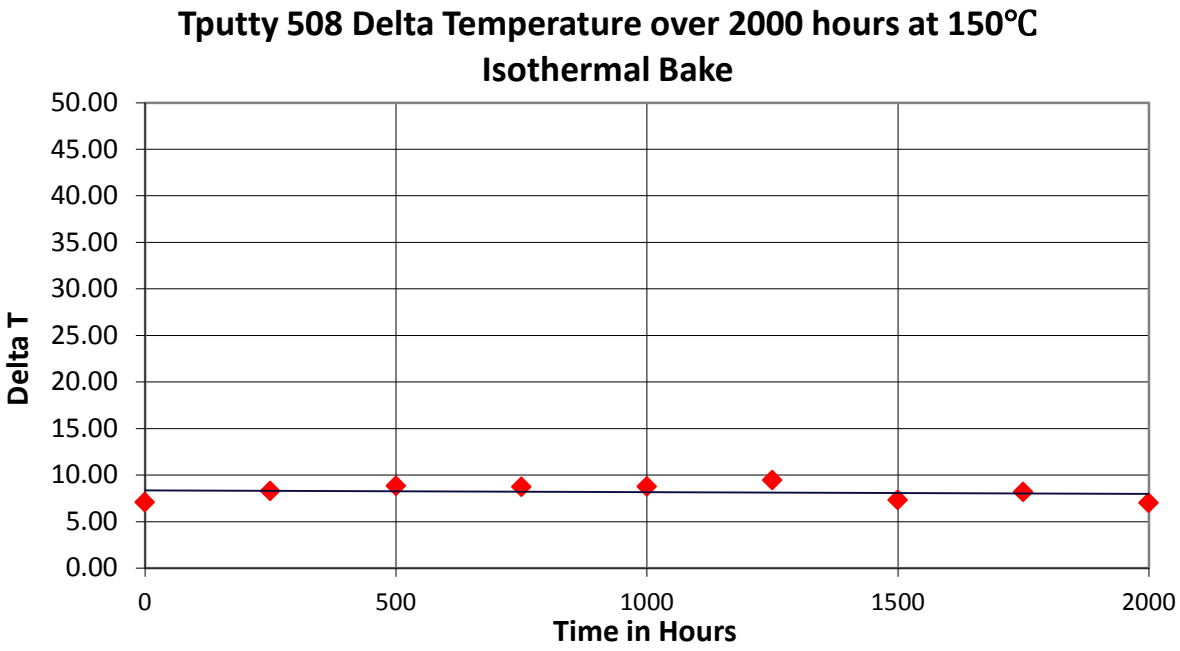


Results

Isothermal Bake

Isothermal bake was performed at 150°C for 2000 hours. The average thermal resistance displayed an overall constant state throughout the 2000 hours.

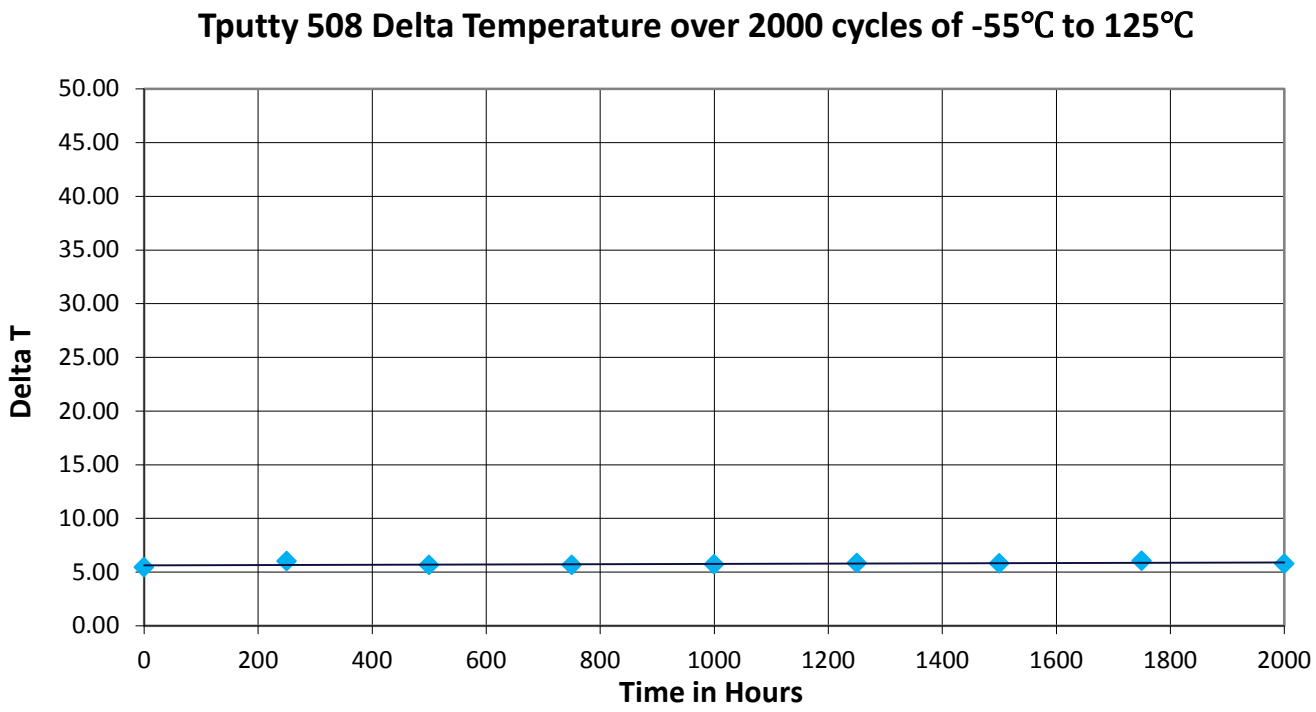
Figure 2: Isothermal Bake Results



Thermal Shock

Thermal Shock testing was performed by cycling the samples between temperatures of -40°C and 125°C. Samples were held at each extreme temperature for 30 minutes. The transfer time between the oven temperatures was less than 20 seconds. Each sample was subjected to 2000 "shock" cycles. The average thermal resistance displayed an overall constant state throughout the 2000 hours.

Figure 3: Thermal Shock Results



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