THERM-A-GAP TC50™ Reliability Report
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Executive Summary

THERM-A-GAP™ TC50 is a high-performance, one-component, dispensable thermal interface material. The paste-like consistency enables superior performance and long-term thermal stability. This material is designed to be dispensed in applications requiring low compressive forces and minimal thermal resistance for maximum thermal performance. This document outlines the examination of the thermal reliability of this high-performance gap filler. Samples of manufacturing batches of THERM-A-GAP™ TC50 were compared after being subjected to long-term environmental aging under dry heat and heat & humidity conditions, as well as temperature cycling from -40°C to 125°C.

The thermal performance of THERM-A-GAP™ TC50 was examined after being subjected to multiple environmental stress tests. The thermal impedance of the aged samples did not experience a significant increase after any of the treatments studied. After 1000-hour dwell at 125°C and 1000 temperature cycles from -40°C to 125°C, there was no statistically significant change in impedance according to one-way ANOVA with the Tukey method for multiple comparisons at a 95% confidence level. There was a substantial decrease in impedance after 1000-hour dwell at 85°C/85% relative humidity, which is indicative of improved thermal performance. This decrease in impedance may be a result of decreased interfacial resistance caused by the thermal interface material wetting out the substrate surface.

Based on these results, THERM-A-GAP™ TC50 demonstrates the ability to withstand long-term aging without a reduction in thermal performance.
1.0 Introduction

The purpose of this document is to examine the thermal reliability of this high-performance, dispensable thermal interface material. Samples of production-scale batches of THERM-A-GAP™ TC50 were subjected to long-term aging conditions, and the thermal performance was measured over time.

Successful survival of long-term aging is demonstrated by a lack of statistically significant increase in thermal impedance of the reliability fixtures after the full aging duration. The reliability fixtures comprise TC50 sandwiched between two stainless-steel coupons, with thickness set by PTFE spacers. It is worth noting that the exact impedance value of the reliability fixture is not representative of the impedance value of the thermal interface material itself, but it can be used to measure changes to thermal performance over time.

2.0 Methodology

2.1. Purpose

Long-term aging was performed on TC50 between stainless-steel substrates to evaluate the reliability of thermal performance over time. The material was subjected to an extended dwell time of 1000 hours at 125°C, 1000 cycles of temperature cycling from -40°C to 125°C, and long-term heat and humidity aging at 85°C and 85% relative humidity.

2.2. Materials

2.2.1. Twenty-four 1” x 1” x 0.040” 316 stainless-steel coupons.
2.2.2. PTFE shims, 0.040” thick.
2.2.3. Twenty-four clamps.
2.2.4. RTV silicone adhesive.
2.2.5. Russells Humidity Chamber GD-16-3-3-AC.
2.2.6. Sun Electronics Systems PTL-001 Temperature Cycling System.

2.3. Sample Preparation

2.3.1. 2.5 g samples of TC50 were dispensed onto the center of each stainless-steel coupon.
2.3.2. The 0.040” PTFE shims were placed at each corner of the coupon.
2.3.3. A second stainless-steel coupon was placed on top of the dispensed material.
2.3.4. Two clamps were placed onto the assembly to hold the substrates at a constant thickness of 0.040”.
2.3.5. A small amount of RTV silicone adhesive was dispensed into the space at the center of each PTFE shim.
2.3.6. The above procedure was performed for all remaining sample assemblies.
2.4. Test Procedure

2.4.1. Waited at least 24 hours after dispensing RTV silicone adhesive onto fixtures before measuring thermal impedance.

2.4.2. The assemblies were removed from their clamps and one drop of 500 cSt silicone oil was applied by pipette to the outside of each stainless-steel substrate.

2.4.3. The samples were tested initially for thermal impedance at 50°C and 100 psi per ASTM D5470.

2.4.4. After testing each assembly, the silicone oil was gently removed from the surfaces and the clamps were placed back onto the assemblies.

2.4.5. Four assemblies were subjected to each aging condition:

2.4.5.1. Dry heat aging: oven at 125°C;

2.4.5.2. Heat/humidity aging: humidity chamber at 85°C, 85% relative humidity;

2.4.5.3. Temperature cycling: thermal cycling chamber from -40°C to 125°C; 10°C C/min ramp; 15-minute dwell.

2.4.6. After 250 hours of dry heat or heat/humidity aging, or 250 temperature cycles, the samples were removed from their respective environments, allowed to equilibrate at room temperature for at least two hours, and re-tested for thermal impedance.

2.4.7. Once tested, the samples were returned to their respective aging environments and the aging intervals were repeated until the samples had been subjected to a total of 1000 hours of dry heat or heat/humidity aging, or 1000 temperature cycles.

3.0 Results
Figure 2: Heat & humidity aged thermal impedance versus time

Figure 3: Temperature cycling thermal impedance versus elapsed cycles
4.0 Analysis

THERM-A-GAP™ TC50 is a one-component, dispensable thermal compound. The thermal performance of TC50 was measured after exposure to multiple accelerated aging conditions. The aging treatments featured in this study include 1000 hours of dry heat aging at 125°C, 1000 hours of heat and humidity aging at 85°C and 85% relative humidity, and 1000 temperature cycles from -40°C to 125°C. There was no statistically significant change in the thermal impedance of the sample assemblies subjected to dry heat aging or temperature cycling according to one-way ANOVA with the Tukey method for multiple comparisons at a 95% confidence level. There was a significant and substantial decrease in impedance for the heat and humidity aging treatment that remained at that low point for the remainder of the study.

The average impedance values after dry heat aging, heat and humidity aging, and temperature cycling decreased by 3%, 21%, and increased by 1% respectively. The increase of 1% is not considered representative of decreased performance, because the change is not statistically significant. A decrease in impedance represents improved thermal performance, and this phenomenon may be attributed to enhanced wetting at the interface between the thermal compound and the substrate.

5.0 Conclusion

The results of this study provide evidence that THERM-A-GAP™ TC50 maintains thermal performance after long-term aging.