Tpcm 580SP
Reliability Report
October 2009

Contents

Section: 1 Overview

Purpose: To test the reliability of Tpcm 580SP as well as confirm that the thermal resistance of Tpcm 580SP does not degrade as a result of thermal cycling, high temperature baking, or baking in a high humidity environment.

Reliability is defined as:
1. The ability of an item to perform a required function under stated conditions for a specified period of time.
2. The probability that a functional unit will perform its required function for a specified interval under stated conditions.

The required function of Tpcm 580SP is to transfer heat from a hot component to a heat dissipating device. Its functionality is measured by testing its thermal resistance. The thermal resistance range that defines the functionality of the Tpcm 580SP is 0.008°Cin2/W to 0.018°Cin2/W at 50psi as measured by modified ASTM D5470.

Conditions:
Thermal bake @ 100°C for 2000 hours
Thermal bake @ 125°C for 2000 hours
Thermal shock cycling 125°C to -55°C for 2000 cycles
HAST @ 85°C and 85% relative humidity for 2000 hours

After each 250 hour/cycle interval, sample disks from each condition were evaluated for thermal resistance.

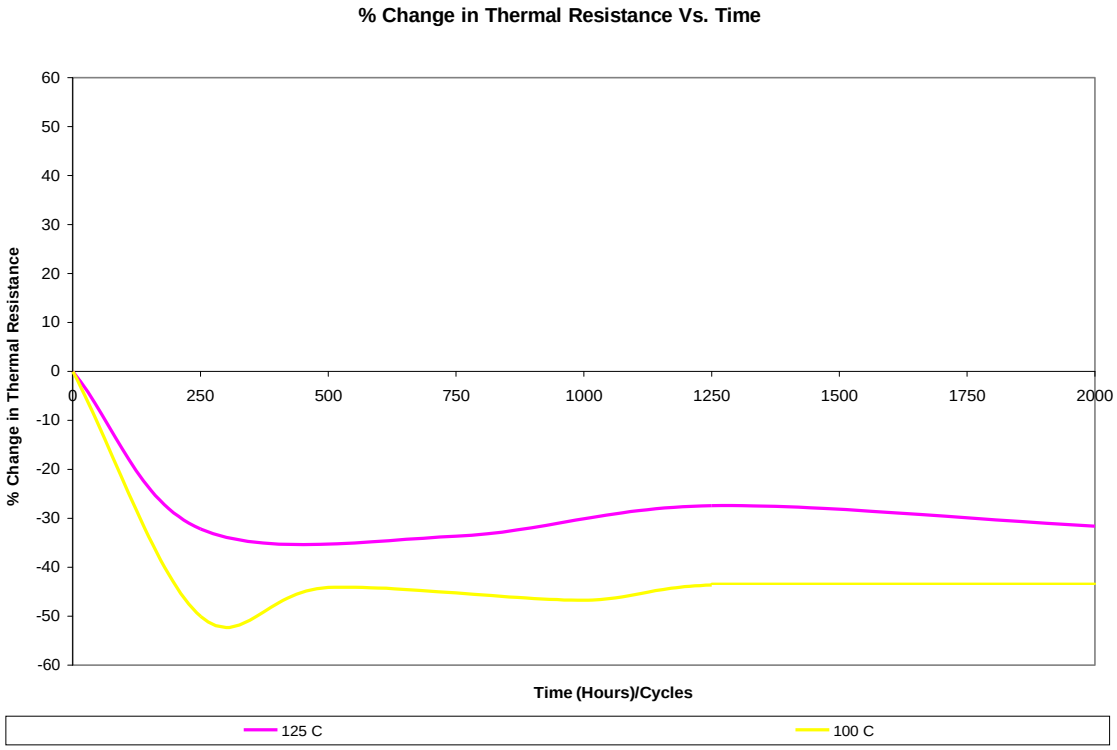
The lot used for this evaluation is 235700.

Section: 2 Thermal Bake

TEST #1 – ASTM D5470

- The bake samples were tested for thermal resistance on a modified ASTM D5470
- During testing and baking, the samples were maintained between two round aluminum disks measuring one square inch in surface area. During baking, clamps were used to hold a constant pressure on the samples.
- See Appendix: Pictures 1 – 4

Results:



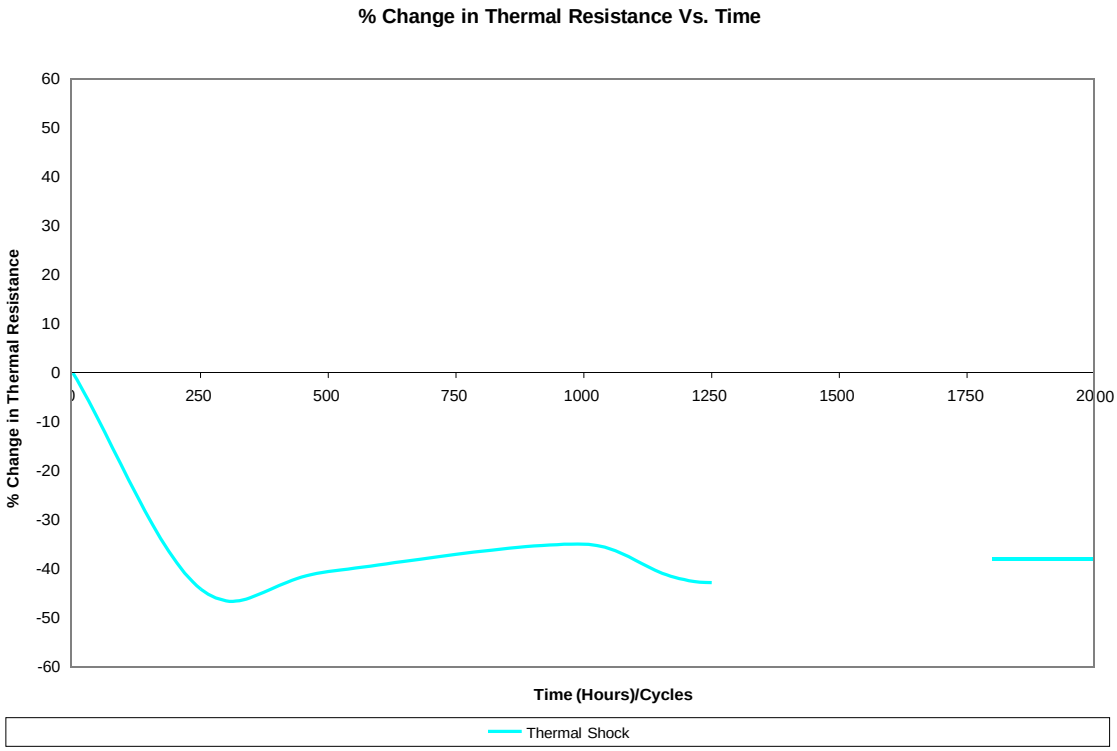
The thermal bake results at 100 and 125°C show a decrease in thermal resistance over time resulting in better overall thermal performance.

Section: 3 Thermal Cycling

TEST #1 – cycling in a Shock Chamber (-55°C to 125°C)

- The cycling samples were tested for thermal resistance (using a modified ASTM D5470) prior to cycling and every 250 cycles up to 2000 cycles.
- During testing and cycling, the samples were maintained between two round aluminum disks measuring one square inch in surface area. During cycling clamps were used to hold a constant pressure on the sample.
- The disks were held at each temperature for 30 minutes and the transfer time between temperatures is approximately 2 seconds. This allows for 24 cycles per day.
- See Appendix: Picture 1-4

Results:

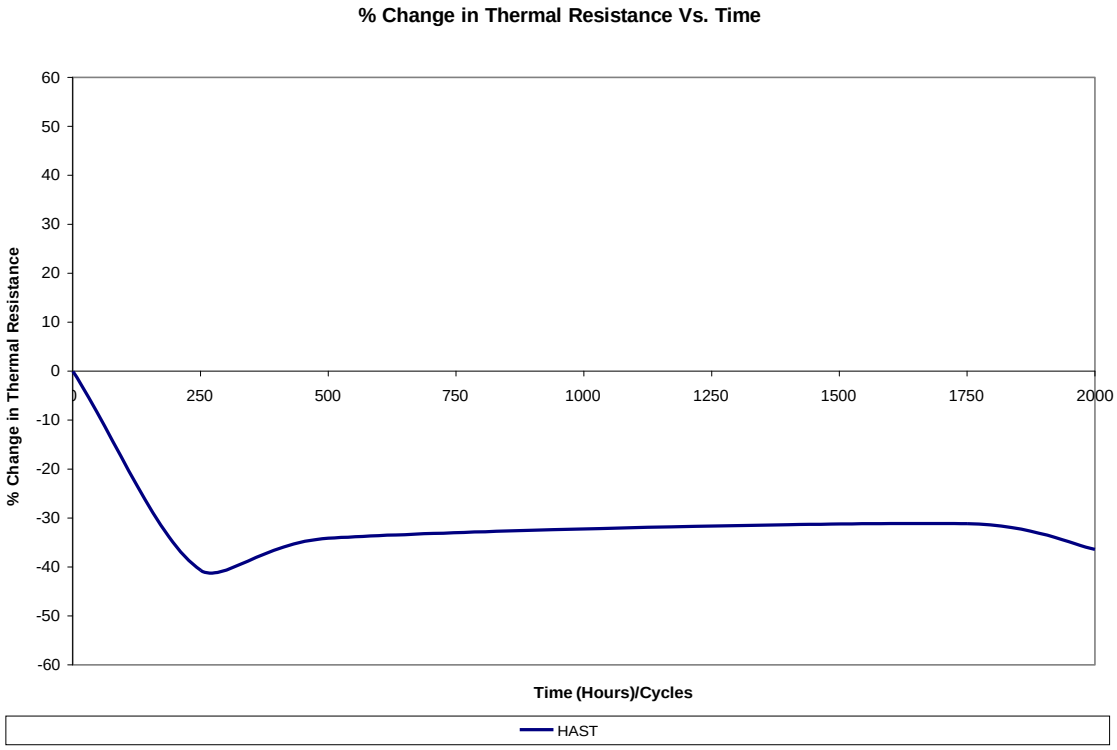


The thermal cycling results -55°C to 125°C show an initial reduction in thermal resistance after the first 250 cycles. The thermal resistance remains lower than the resistance at time zero.

Section 4: Thermal Bake in a HAST Chamber (85°C and 85% relative humidity)

- The HAST samples were tested for thermal resistance using a modified ASTM D5470 prior to HAST conditions, every 250 hrs, and after HAST conditions were completed (2000 hrs).
- During testing and HAST conditions, the samples were maintained between two round aluminum disks measuring one square inch in surface area. During HAST conditions, clamps were used to hold a constant pressure on the sample.
- See Appendix: Picture 1-4

Results:



The HAST results show a decrease in thermal resistance show a decrease in thermal resistance over time resulting in better overall thermal performance.

Section 5: Drip Test

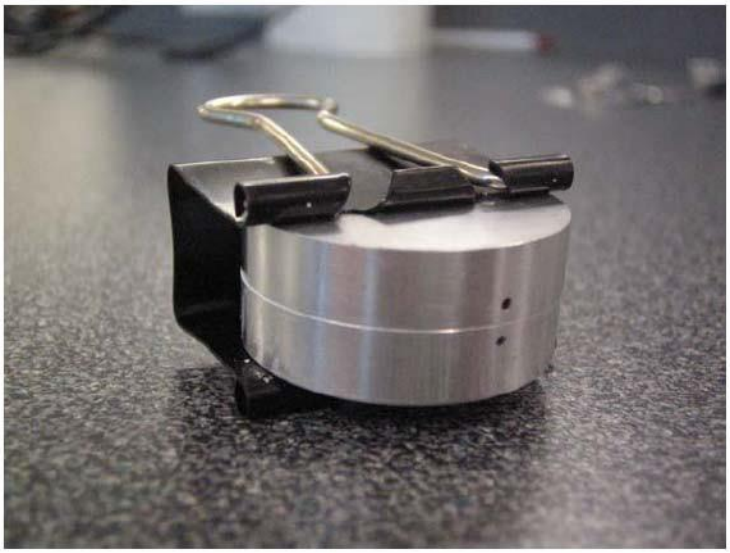
- Tpcm 580SP was applied to an aluminum disks and allowed to dry.
- The aluminum disks with the applied Tpcm 580SP were mounted to an aluminum plate with binder clips to maintain a constant pressure (picture 5).
    - The aluminum plate representing a heat sink or heat spreader and the aluminum disk representing a heat generating component.
    - Typically a heat generating component is smaller than the heat sink which will result in some material squeeze out from the thermal joint.
- The assembly was placed vertically in a thermal shock chamber and cycles from -55 to 125 for 400 cycles (picture 6).
    - The disks were held at each temperature for 30 minutes and the transfer time between temperatures was approximately 2 seconds.
    - As the material was heated, it flowed under the binder clip pressure and resulted in a ring of squeeze out from underneath the aluminum disk simulating what would occur in a typical application
- The squeeze out was observed after the 400 cycles to determine if any of the material dripped or migrated away from the joint during the thermal cycling.
    - None of the sample showed any migration or dripping as show in pictures seven and eight in the appendix.

Section 6: Conclusion

In all thermal resistance tests, the Tpcm 580SP shows a reduction in thermal resistance from time zero or the first cycle. This reduction in thermal resistance remains through the completed test periods. The reduction in thermal resistance is potentially explained by a further reduction of bond line thickness as well as improved surface wetting over time meaning that more and more interstitial voids are filled removing air from the interface resulting in a lower thermal resistance. Tpcm 580SP when subjected to the stress tests above only improves in performance. Tpcm 580SP will perform its required function under the conditions tested. Furthermore Tpcm 580SP will not drip, slide or migrate when vertically mounted and subjected to 400 thermal cycles from -55 to 125^{o}C.

Appendix
Picture #1 Aluminum disk used for reliability testing

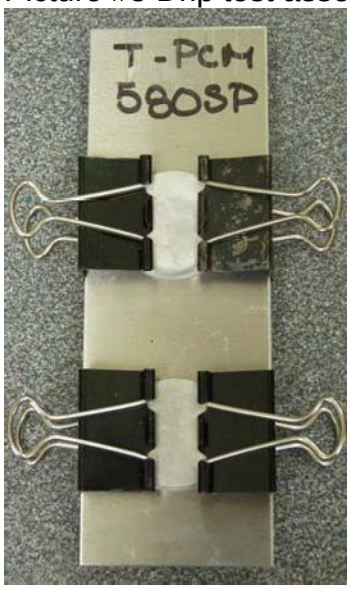
Picture #2 Aluminum disks clamped with PCM between them



Picture #3 Close-up of the aluminum disks in the thermal tester

Picture #4 ASTM D5470 thermal resistance tester

Picture #5 Drip test assembly



Picture #6 Shock Chamber set up

Pictures #7 and 8 Close-ups of Tpm 580$P after 400 cycles during Drip Test

Sample 1

Sample 2