TEST REPORT

Laird™ Tpcm™ 7000Plus Reliability

Purpose

This report summarizes the thermal reliability testing of Tpcm™ 7000Plus utilizing reliability test fixtures ideal for high performance thermal interface materials under constant pressure 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

- Thermal Shock and Environmental Chambers
- Reliability Test Fixtures for constant pressure
- LonGwin ASTM D5470 Thermal Resistance Tester
- Data acquisition system for temperature monitoring

Samples

- Tpcm 7250Plus – 0.25mm thk, Batch No. 5813608

TEST REPORT

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Test Procedure

Tpcm™ 7000Plus was tested under constant pressure. The samples were applied and maintained between two aluminum plates, one with a raised pedestal, measuring one square inch in surface area. The combination of the plates comprises the overall test fixture. See figure #1. For constant pressure testing, the two plates are assembled with 4 binder clips one on each side maintaining ~20 psi total. Five fixtures are assembled for each test. There is a total of 15 fixtures (5 fixture x 3 test conditions. Aging conditions included an isothermal condition at 150°C, a HAST condition at 85°C/85% relative humidity, and one thermal shock conditions at -40°C to 125°C. The samples were aged in these conditions for a total of 2000 hours.

After each 250 hour/cycle interval, all samples were evaluated for thermal resistance. The samples maintained in the fixtures were placed in an ASTM D5470 thermal resistance tester (Mfg.: LonGwin). See figures #3, #4 and #5. Thermal resistance is measured (20psi & 70C) and recorded. The thermal resistance 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.

Laird Lab Procedure A17001-00 – “Operation of the LonGwin 9389 TIM Tester”

TEST REPORT

Laird™ Tpcm™ 7000Plus Reliability

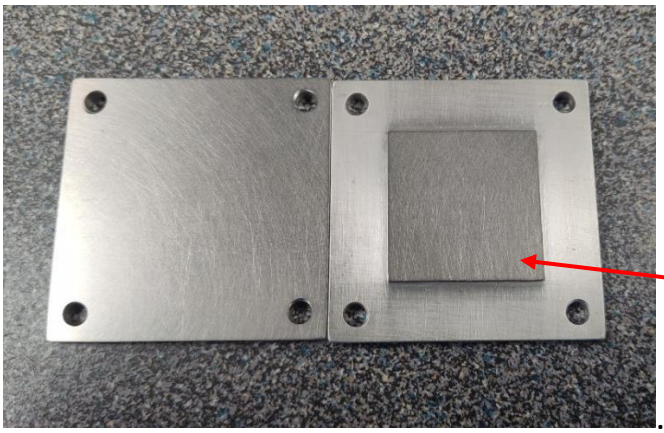

Figure 1: Aluminum Test Fixture - pedestal measuring 1in² in area

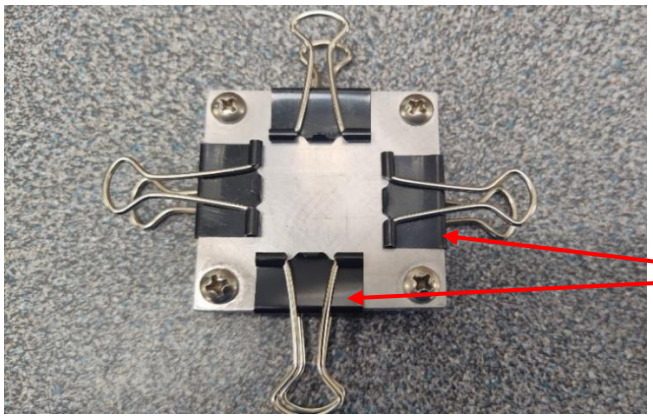

Figure 2: Aluminum Test Fixture under constant pressure ~ 20 psi

Figure 3: LonGwin ASTM D5470 Thermal Resistance Tester

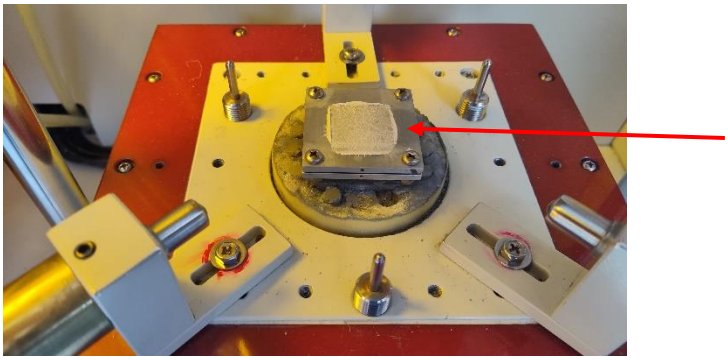

Figure 4: Test fixture assembled in bottom platen of the LonGwin Tester.

TEST REPORT

Laird™ Tpcm™ 7000Plus Reliability

Material under test

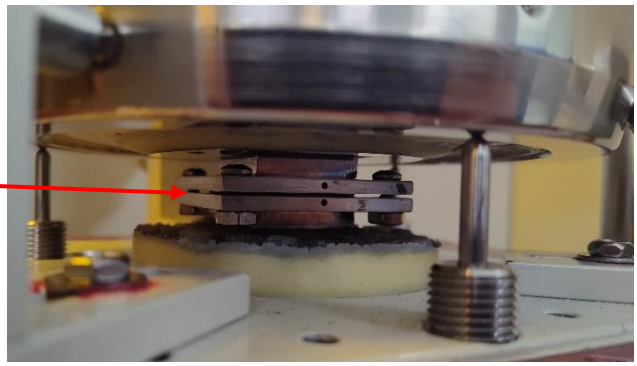

Figure 5: fixtures loaded into LonGwin tester

Thermal grease is added to the top and bottom for better measurement accuracy.

Test Conditions

- Isothermal @ 150°C
- HAST @ 85°C and 85% relative humidity
- Thermal shock from -40°C to 125°C (1 cycle is 30 minutes per condition, 10 second transfer)

TEST REPORT

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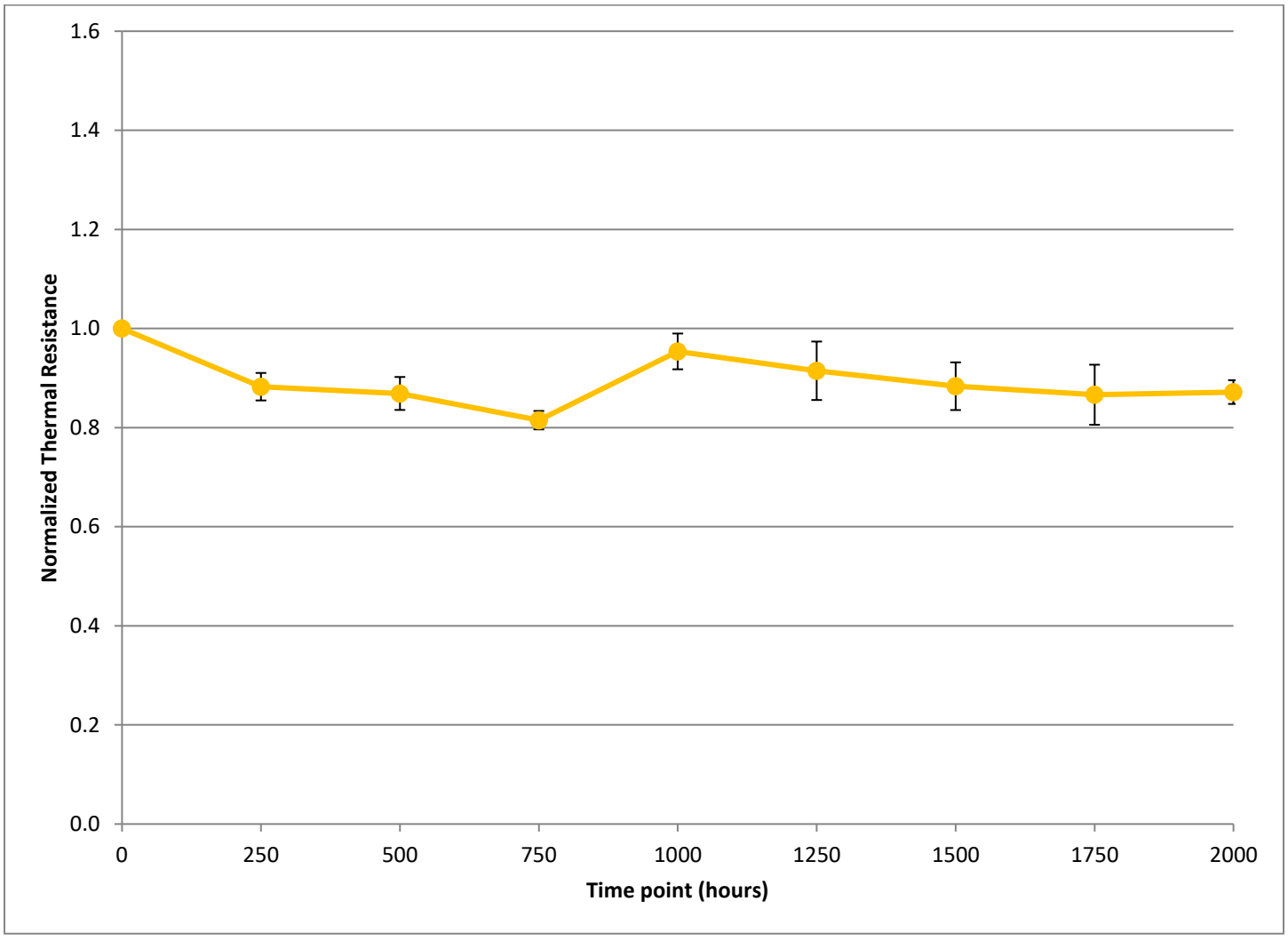
Results: Isothermal Bake under Constant Pressure

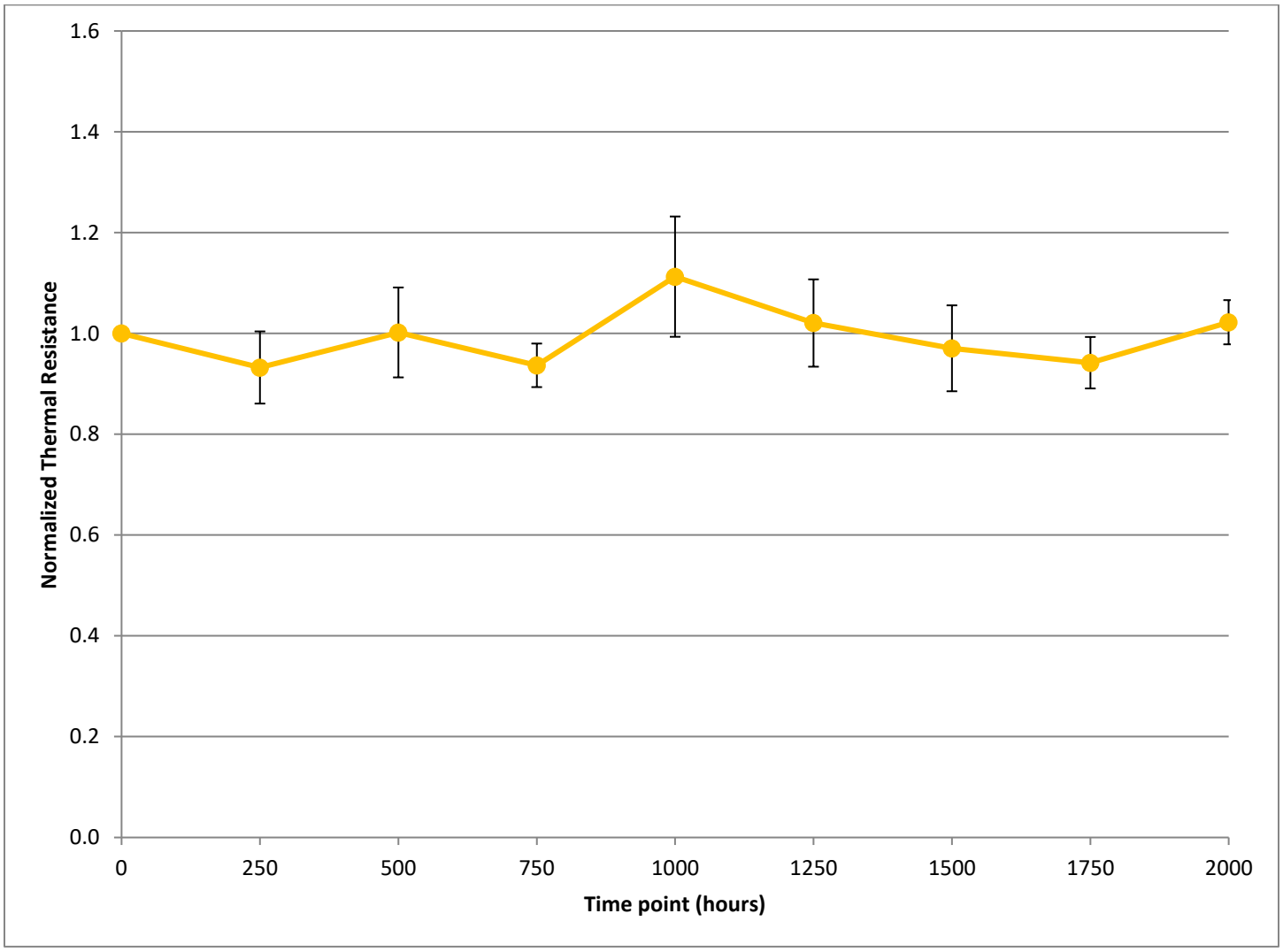
Figure 6a: Isothermal Bake Results: 125°C



TEST REPORT

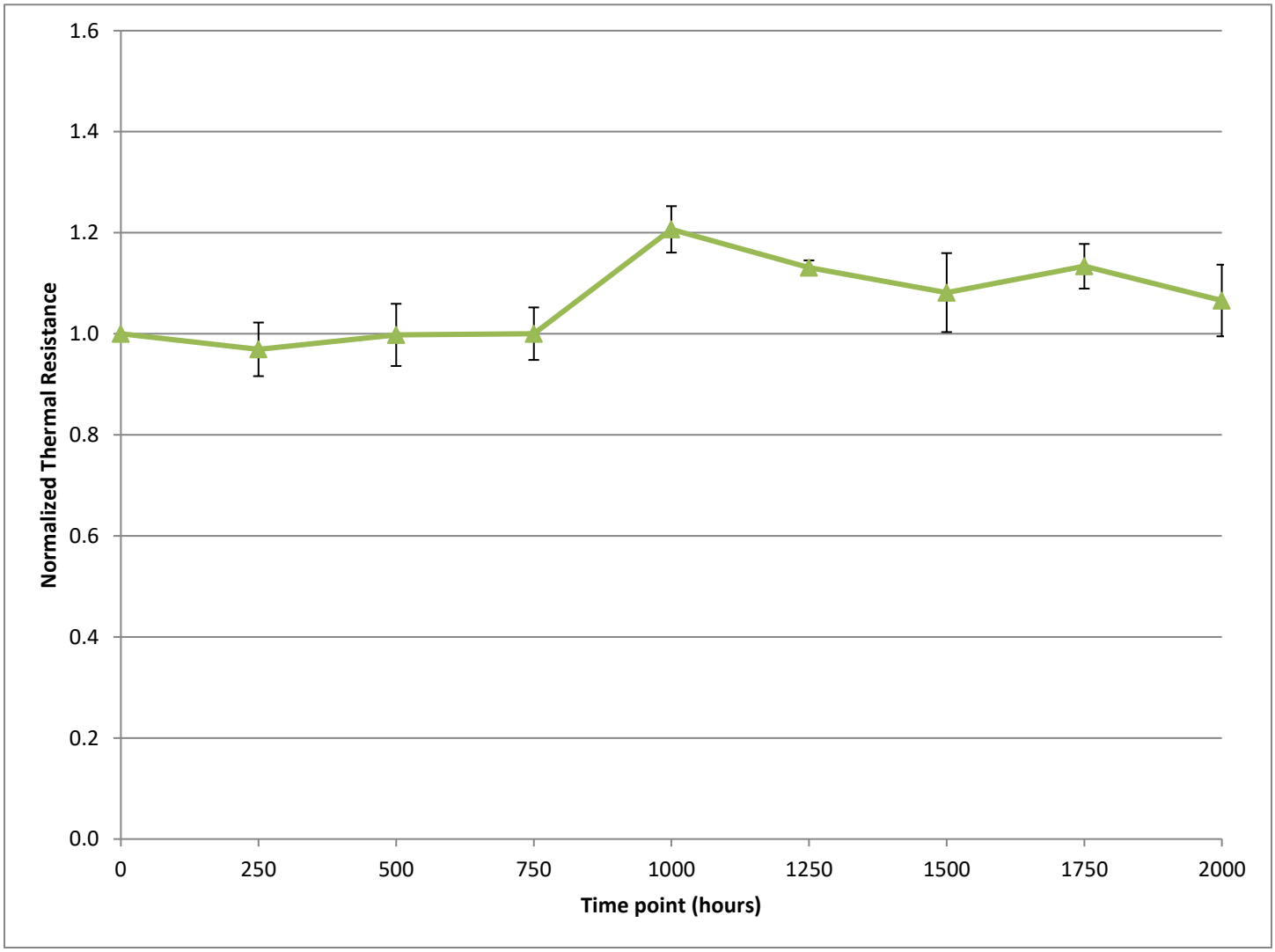
Laird™ Tpcm™ 7000Plus Reliability

Figure 6b: Isothermal Bake Results: 150°C



Results: HAST under Constant Pressure

Figure 7: HAST Results: 85°C/85%RH



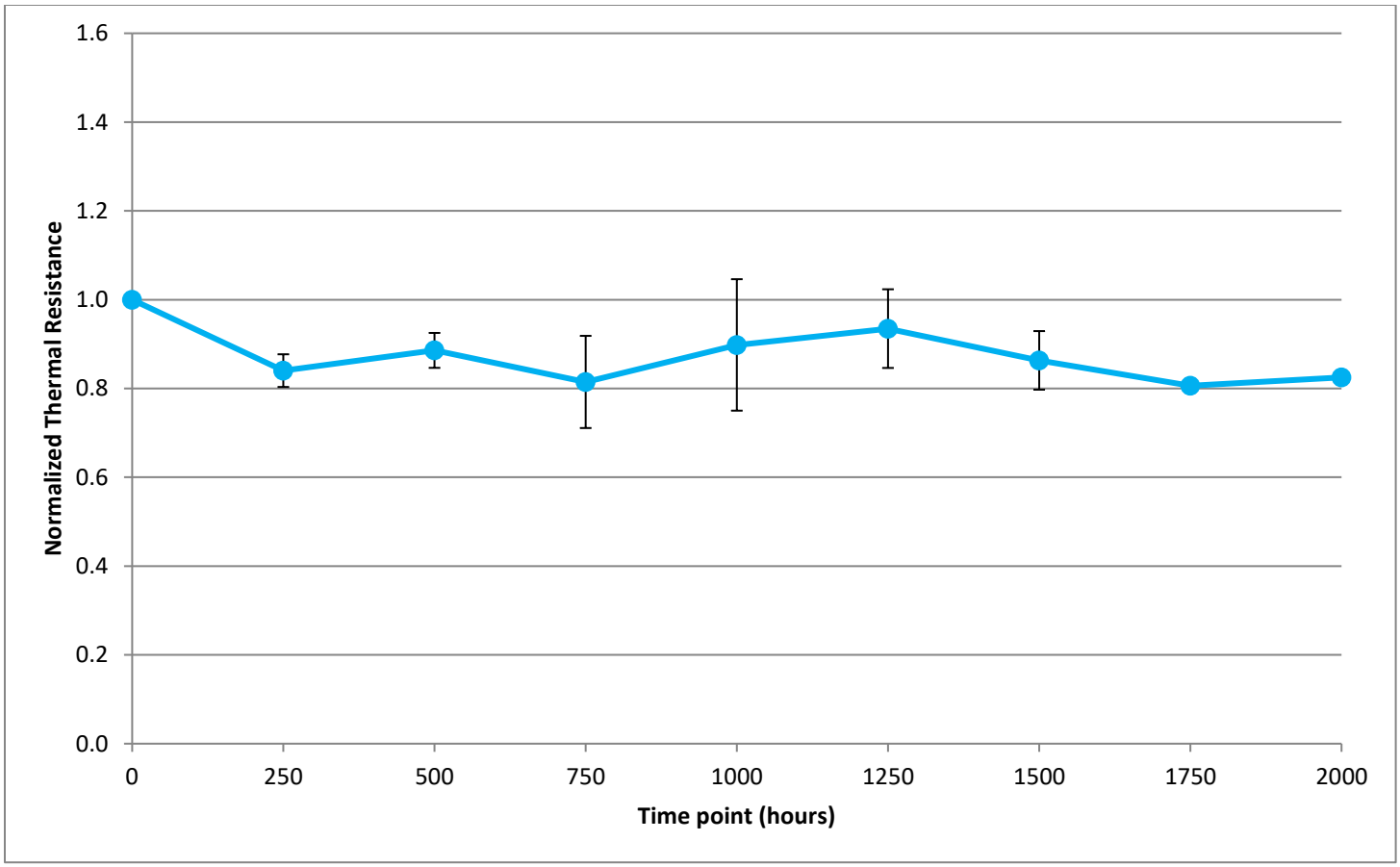
TEST REPORT

Laird™ Tpcm™ 7000Plus Reliability

Results: Thermal Shock under Constant Pressure

Thermal shock was performed for 2,000 cycles from -40°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.

Figure 8: Thermal Shock Results: -40°C to 125°C



TEST REPORT

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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. Variations from interval test point to interval test point will occur. Variability also exists in the test setup. Thus, 3 samples are used for each condition. Long term negative, or increase of thermal resistance, indicates a failing study and may indicate 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 Tpcm™ 7000Plus continues to perform well at each condition; high temperature bake, thermal shock, and HAST.