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Tflex HD80000 Thermal Reliability

This report summarizes the thermal reliability testing of Tflex HD80000. This reliability test procedure is designed to characterize the long term performance of the dispensable thermal gap filler by subjecting the material in the test fixtures to isothermal conditions, repeated thermal shock conditions, and moderate heat and high humidity conditions. The test fixtures feature an isolated sample platform with an area of 12mm x 14mm. Three of these isolated sample platforms are featured on a single test fixture with isolated heating and temperature monitoring for each sample.

Test Equipment

- Tflex HD80000, in horizontal positions with fixed gaps of 1.5mm and 4.25mm.
- Thermal Shock and Environmental Chambers
- Reliability Test Fixtures
- Power Supply with cartridge heaters
- Data acquisition system for temperature monitoring

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 (approximating the sample surface temperatures at the substrate interface). The thermal resistance (R_{th}) can be represented as the temperature differential (ΔT) between the two surfaces for a given heat flow (ΔQ).

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

For this procedure, actual thermal resistance is not required as the same sample with test fixture is tested repeatedly. It is sufficient to record the temperature differential and compare the increase or decrease over time to the original performance prior to aging. Thus, the thermal resistance and thermal performance can be inferred from the temperature differential. In essence, an increase in ΔT

over the reliability testing can be attributed to an increase in thermal resistance of the thermal gap filler.

Test Procedure

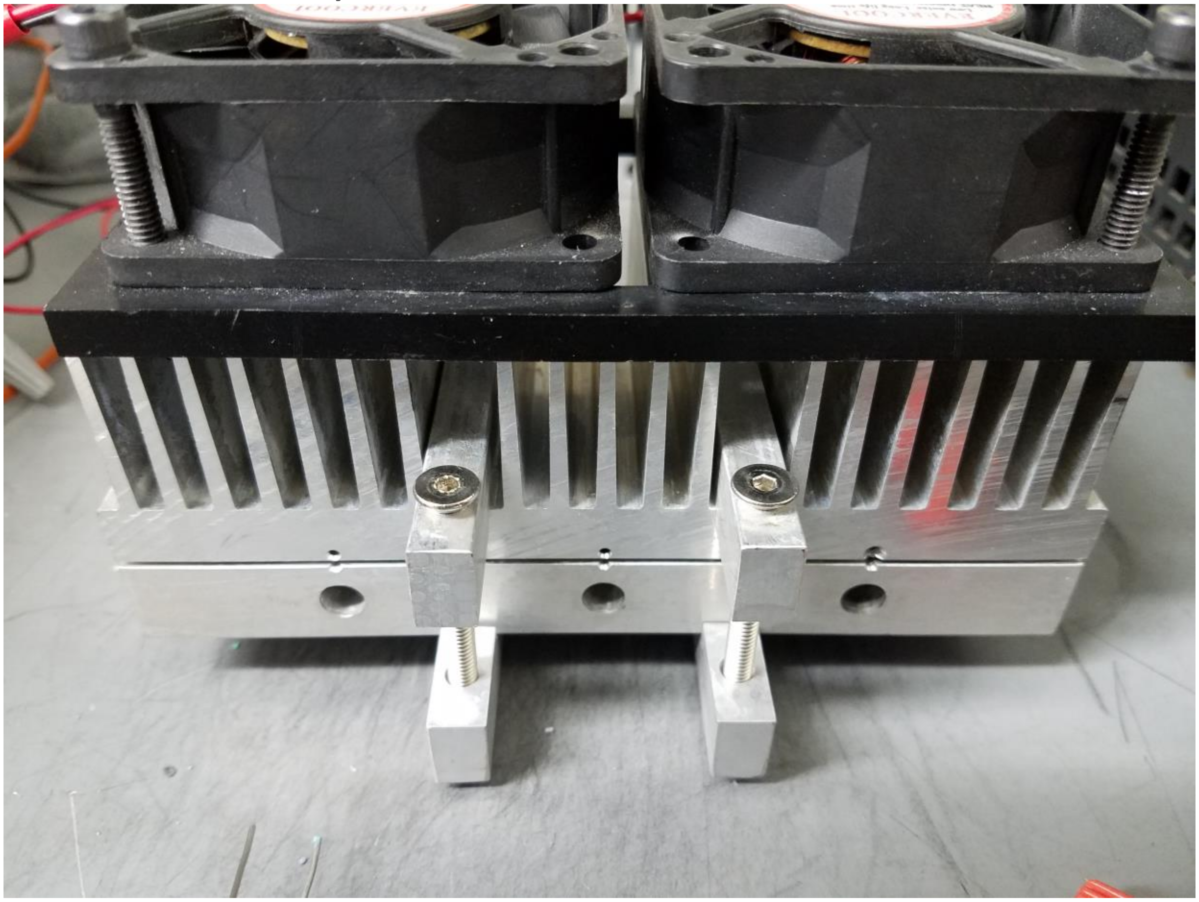
Test Fixture and Sample Preparation

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 is placed on the 12mmx14mm raised pedestals (1.1mm height) on the hot plate surface and the fixture assembly is fastened by two metal straps. Each test fixture accommodates 3 samples of 12mmx14mm. Final testing gap was set by using metal shims of appropriate height to achieve a sample gap of 1.5mm or 4.25mm. During testing, a dual fan unit is placed on top of the aluminum heat sink and air flow is directed from the heat sink to the atmosphere. 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 sample 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. Figure 1 shows a detail of the hot plate surface, providing a visual of the isolated and raised sample platform. See figure 2 for an image of the test fixture with dual fan in place for testing.

Figure 1: Test Fixture Hot Plate Sample Surface

Figure 2: Test Fixture Assembly with Fan



Results

Thermal Shock

Thermal shock was performed for 1000 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. The thermal shock condition had 2 test fixtures with each gap configuration. See figures 4 and 5 for thermal shock results.

Figure 4: Thermal Shock Results – -40°C to 125°C – 1.5 mm

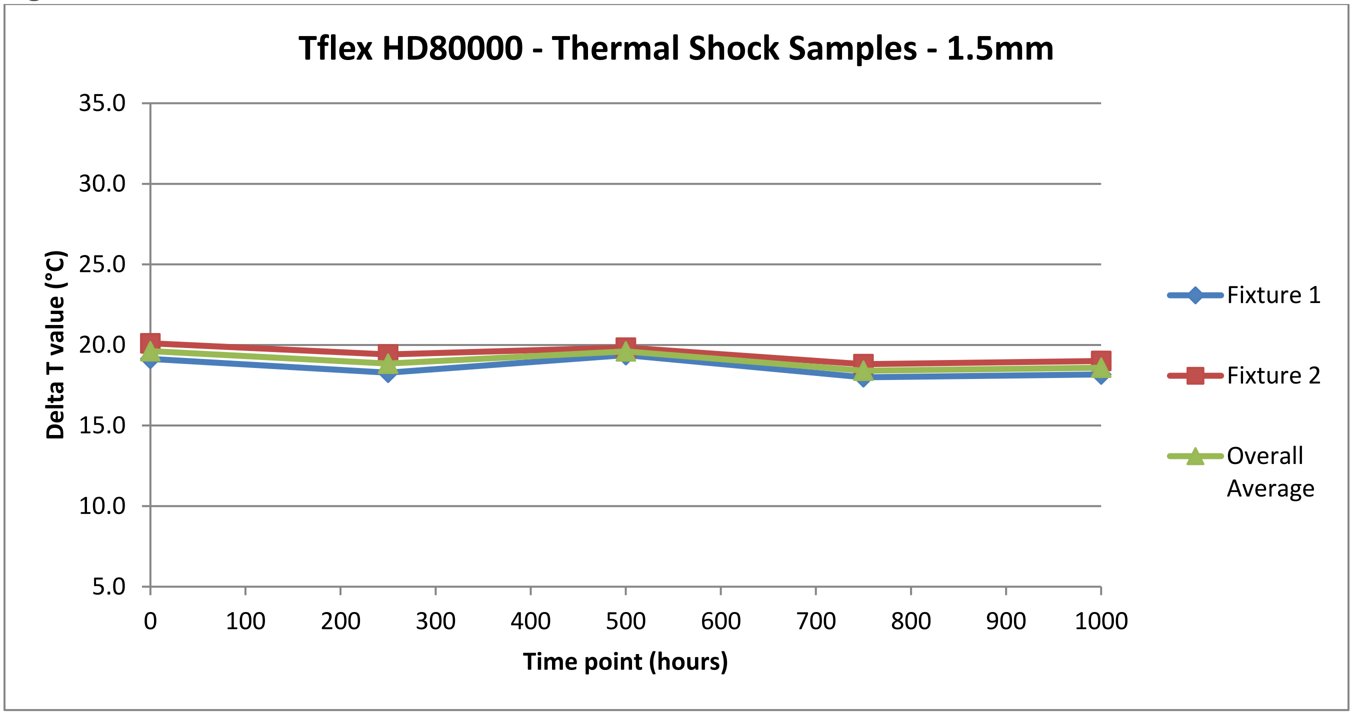
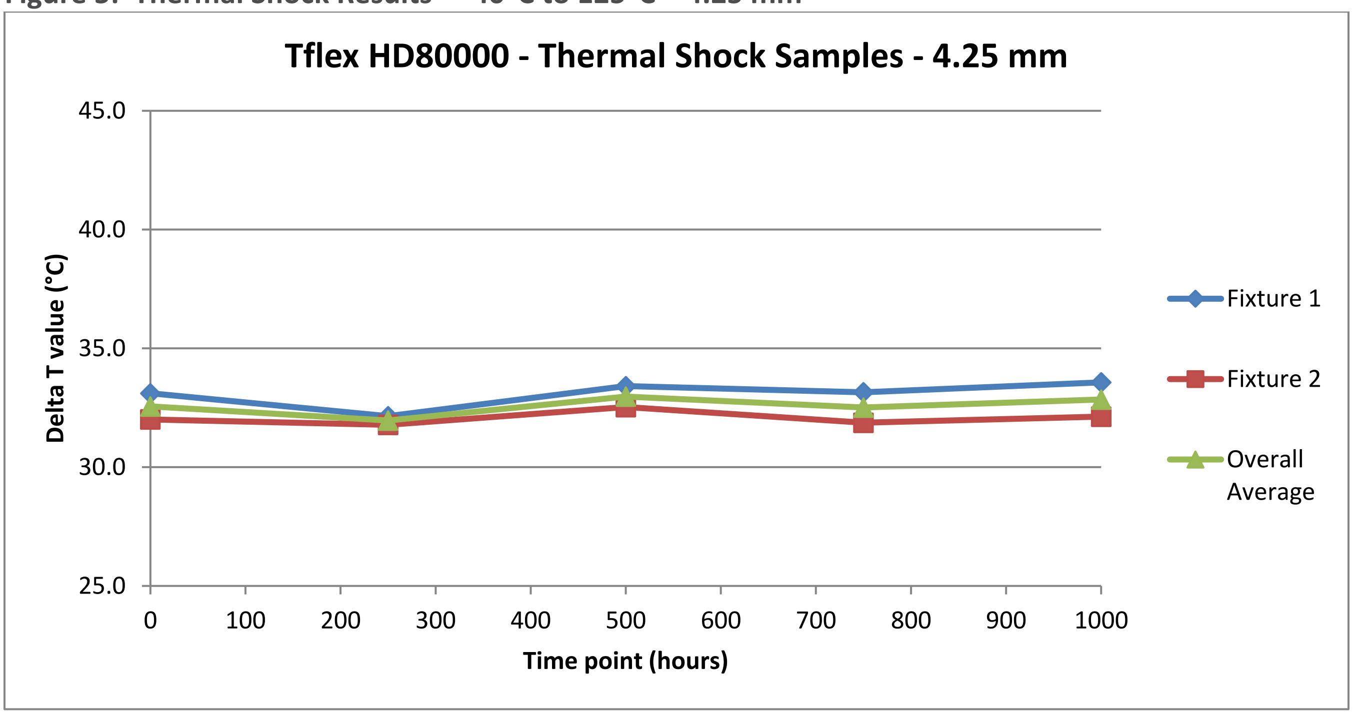


Figure 5: Thermal Shock Results – -40°C to 125°C – 4.25 mm



Isothermal Bake

Isothermal bake was performed for 1000 hours at 150°C. The isothermal bake condition had 2 test fixtures with each gap configuration. See figures 6 and 7 for isothermal bake results.

Figure 6: Isothermal Bake Results – 150°C – 1.5 mm

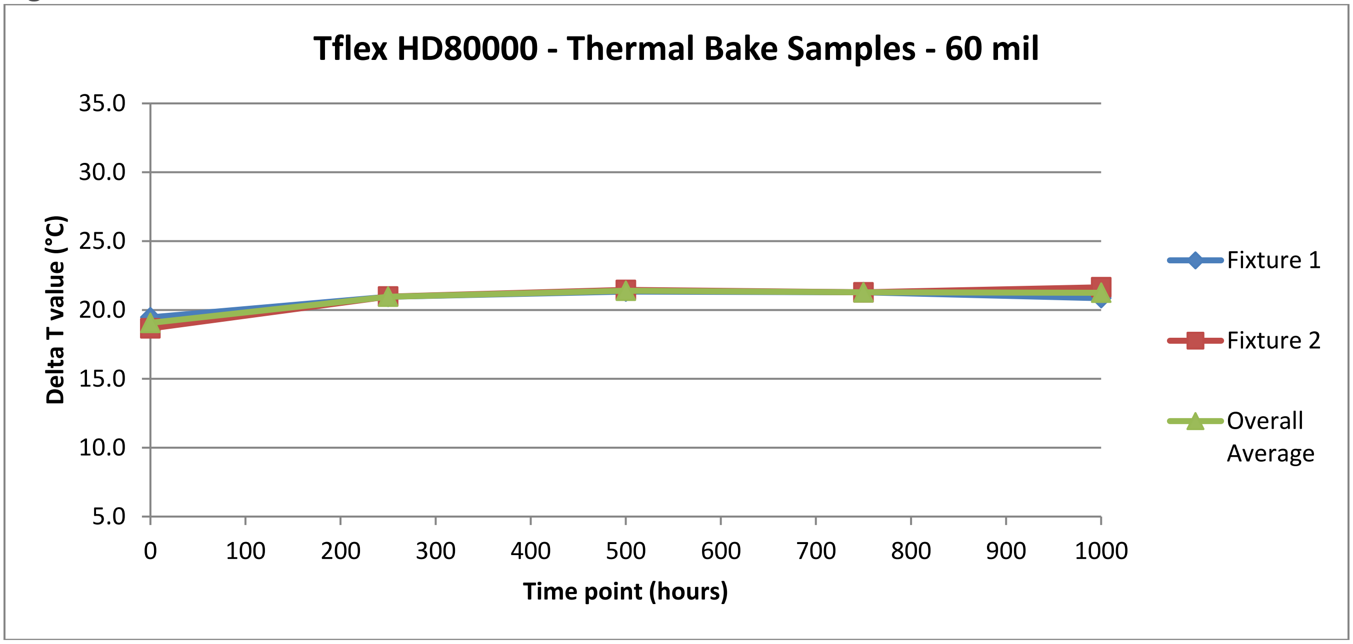
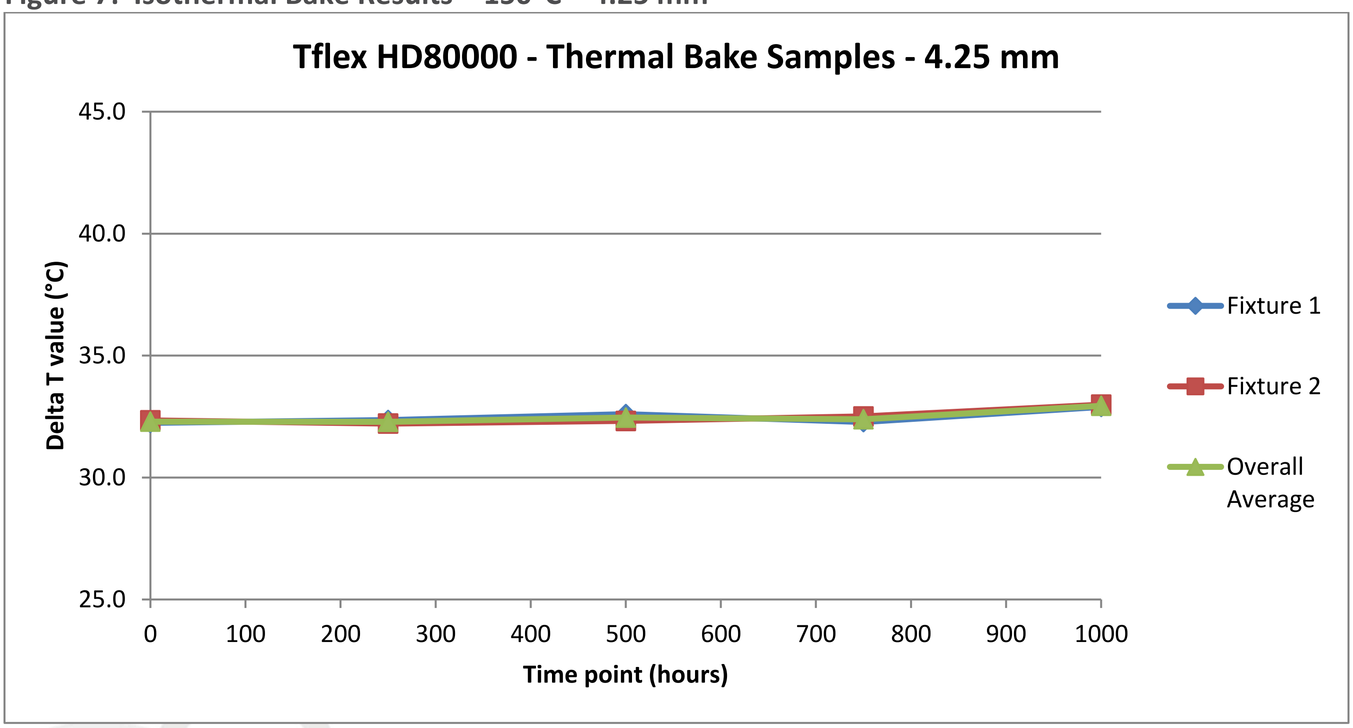


Figure 7: Isothermal Bake Results – 150°C – 4.25 mm



HAST

HAST was performed for 1000 hours at 85°C and 85% relative humidity. The HAST condition had 2 test fixtures with each gap configuration. See figure 8 and 9 for HAST results.

Figure 8: HAST Results – 1.5mm

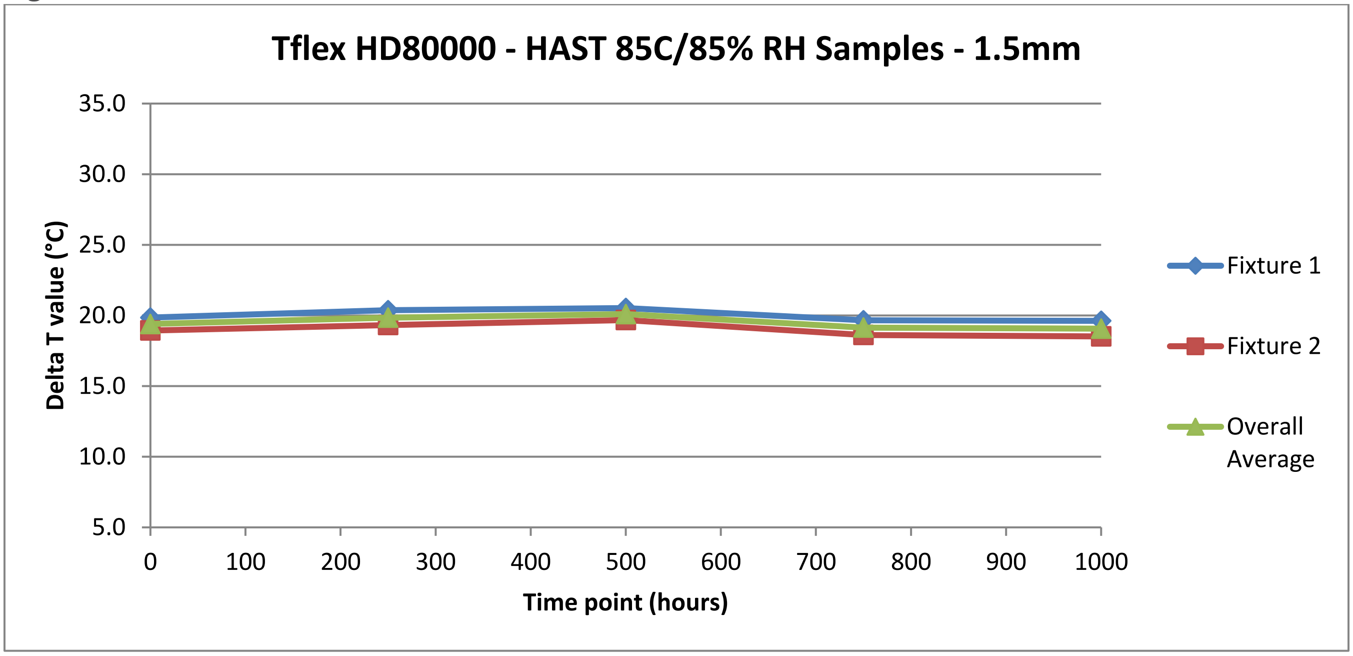
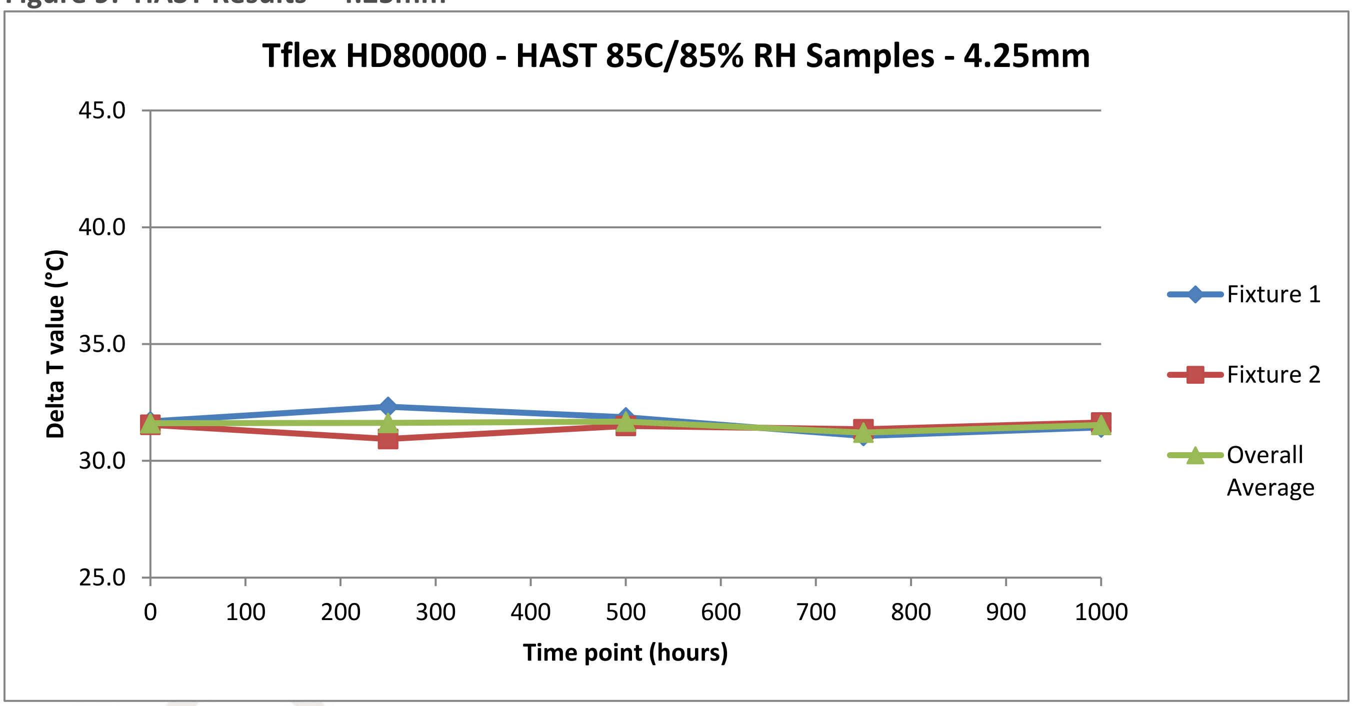


Figure 9: HAST Results – 4.25mm



Conclusion

In conclusion, Tflex HD80000 showed very little change in temperature differential (ΔT) in all aging conditions and at both gap configurations. The results indicate that the material will be a reliable thermal interface material and will continue to perform well under rigorous conditions similar to those simulated in this report.

Reported By:
LeeAnn Pekelnicky – Scientist II – 09/18/2019