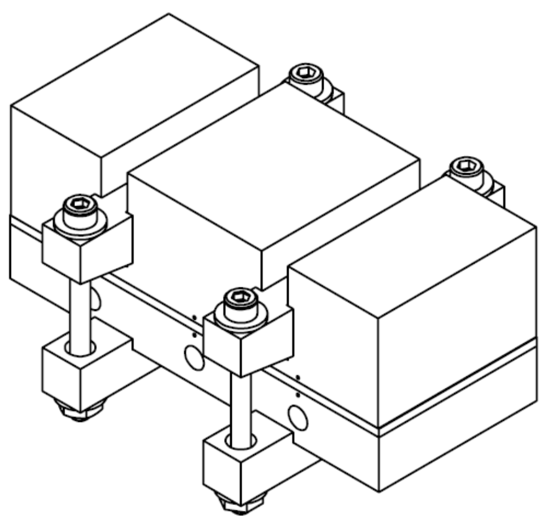
Tflex HR400 Thermal Reliability Report

Summary
The Laird Technologies' gap filler reliability test procedure has been designed to characterize the long-term performance of a gap pad while being subjected to isothermal conditions, repeated extremes in temperature, and moderate heat - high humidity environments. Specimens are placed within application-related fixtures under set conditions and at regular intervals the thermal properties of the specimens are measured.

Fixture Setup
The test fixture is rectangular with dimensions of 2" x 5" (surface area of 10 in^2). It consists of an aluminum heater plate and an extruded aluminum heat sink "cooler plate". The heater plate contains 3 holes for insertion of cartridge heaters. Both plates contain 3 sets of thermocouple holes drilled for measurement of the temperature very near the surfaces mated by the gap pad. Each test fixture accommodates 3 test positions. The heater and cooler plates are held together by metal straps which span the width of the plates (2 sets per test fixture) and are bolted to each other. Cartridge heaters are inserted into the heater plate holes. A specified power from a power supply is input to the heaters to obtain a constant 70^0C across the heater plate. This will ensure a constant heat flow is maintained through the gap filler during data acquisition. A cooling fan (not pictured) is centered on top of the heat sink during testing to facilitate realistic air flow and cooling. Test values are measured in an ambient laboratory environment.



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Theory

Throughout the test period, the measured variable is the temperature difference of the surfaces of the heater and cooler plates. Thermal resistance (R_{th}) is defined as the temperature difference (dT) between two surfaces for a given heat flow (dP). That is: $R_{th} = dT / dP$. In this testing, heat flow is controlled and constant, therefore, $R_{th} \alpha dT$. This relationship indicates that a constant value of dT throughout the test program requires R_{th} to also remain constant, which indicates a highly reliable system and thus a gap pad that is not influenced by the exposure conditions.

Types of Reliability Testing

Thermal Shock

In thermal shock testing, test fixtures containing the specimens are transitioned between -40^{0}C and 160^{0}C with a 0.5 hour hold to reach thermal equilibrium at each temperature extreme. The transfer time between the oven temperatures is quick, typically less than 20 seconds. 1000 cycles or “Shocks” are performed on each fixture.

Isothermal Bake

In isothermal bake testing, fixtures are maintained at 160^{0}C for 1000 hours.

HAST

In HAST testing, the fixtures are maintained in conditions of moderate temperature (85^{0}C) and high humidity (85%) for the duration of the test.

Results

The materials under test were Tflex HR420, Tflex HR440, and Tflex HR4200. Two units of each were assembled and tested for isothermal bake, HAST and thermal shock. The data reported is the average of the six test positions for the two fixtures for each test. The change in temperature (dT) over time or cycle number is reported below:

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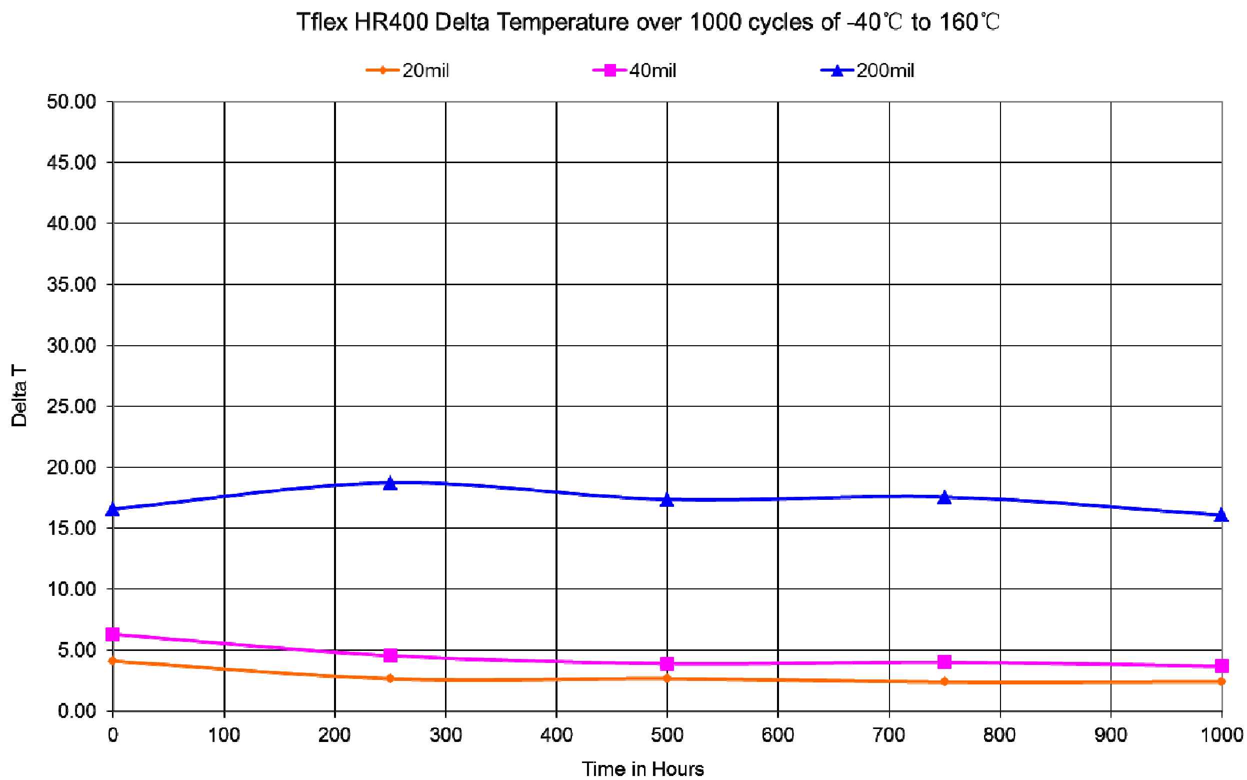
Thermal Shock



Material	Hours	Avg dT
Tflex HR420	0	4.12
	250	2.68
	500	2.68
	750	2.41
	1000	2.44
Tflex HR440	0	6.32
	250	4.56
	500	3.92
	750	4.03
	1000	3.70
Tflex HR4200	0	16.60
	250	18.74

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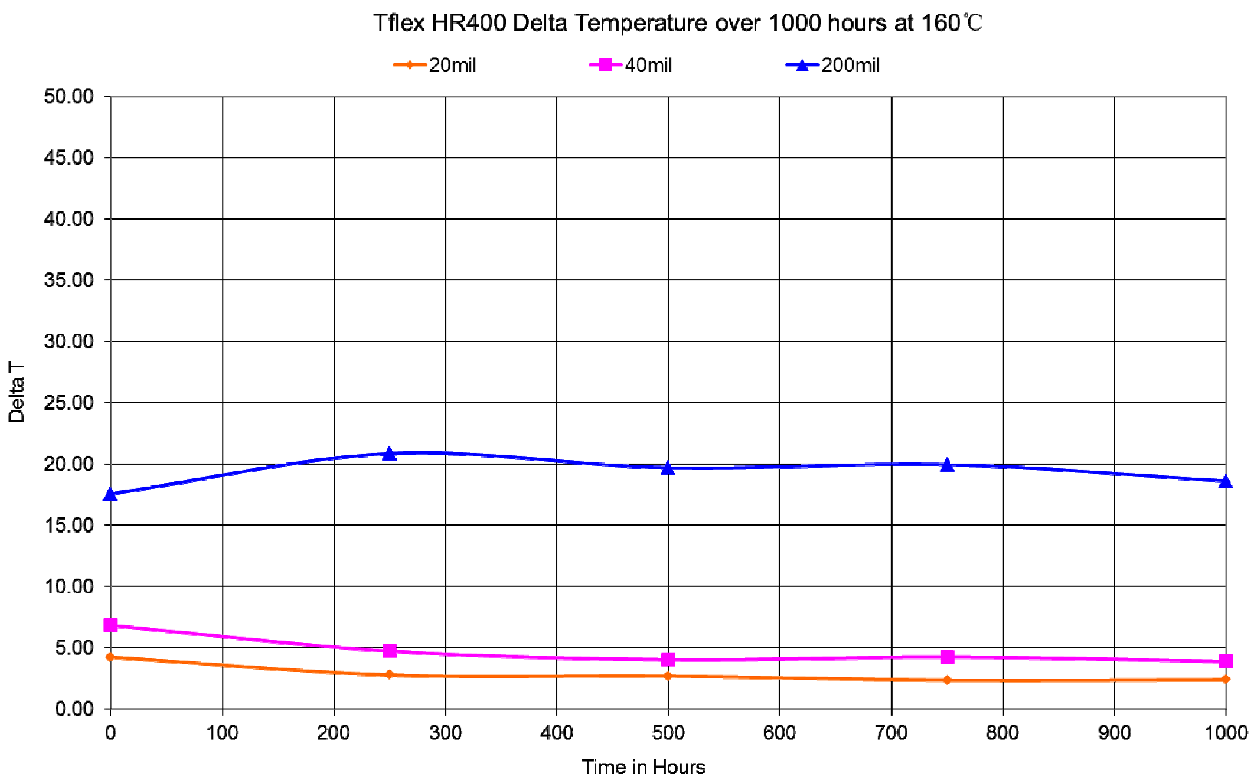
	500	17.37
	750	17.57
	1000	16.10

Isothermal Bake



Material	Hours	Avg dT
Tflex HR420	0	4.25
	250	2.78
	500	2.69
	750	2.35
	1000	2.40
Tflex HR440	0	6.83
	250	4.74
	500	4.03
	750	4.26
	1000	3.90

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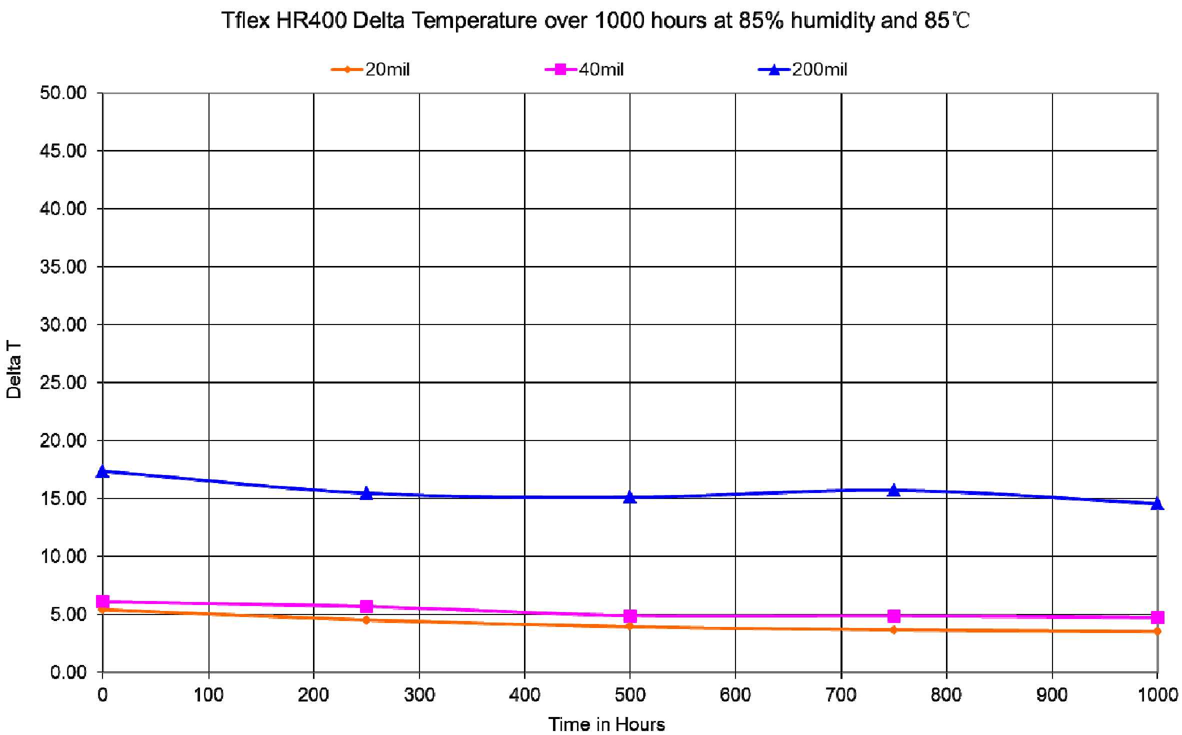
Tflex HR4200	0	17.57
	250	20.85
	500	19.69
	750	19.96
	1000	18.61

HAST



Material	Hours	Avg dT
Tflex HR420	0	5.43
	250	4.54
	500	3.96
	750	3.70
	1000	3.55
Tflex HR440	0	6.11
	250	5.71
	500	4.91
	750	4.89

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	1000	4.75
Tflex HR4200	0	17.37
	250	15.48
	500	15.13
	750	15.73
	1000	14.58

Conclusion:

The graphs and data show that Tflex HR400 performed better (lower thermal resistance) or very near at the end point for Thermal Shock, Isothermal Bake, and HAST testing as compared to the time T_0 value.

Based upon this data, no thermal degradation was evidenced and therefore, it is shown that Tflex HR400 will continue to perform as designed in applications under harsh environmental conditions similar to those tested.

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