THERMFLOW ä T766
Removal Force Test Report

Prepared by:
Research and Development
Chomerics Div. of Parker Hannifin Corp
84 Dragon Court, Woburn, MA 01888

T766
Removal Force Tests

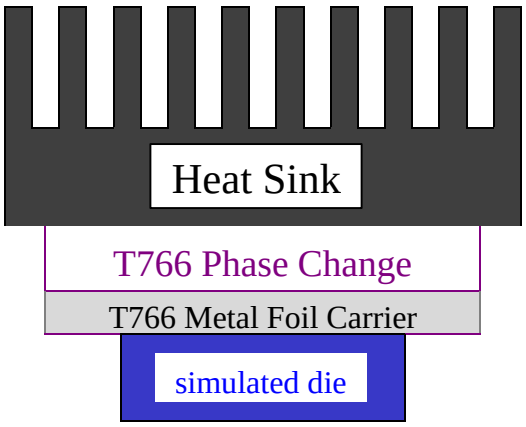
Introduction

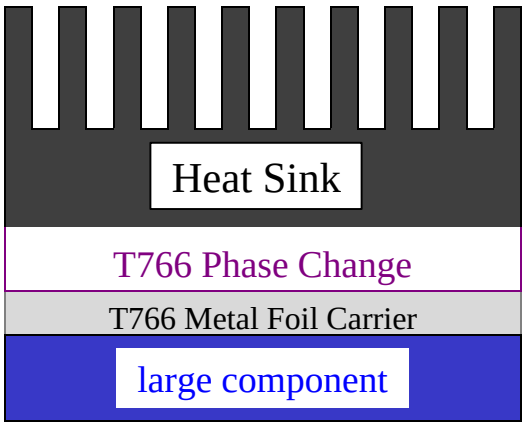
Thermflow™ T766 was tested for removal force of a heat sink from a die or component. Various pad sizes were tested in order to determine the best size pad to use when no removal force, or total clean break, is desired. Common 1.1 inch x 1.1 inch anodized aluminum heat sinks were used with two simulated components, sizes referred to as small and large in this report. The parts were assembled using a controlled force instrument along with a hotplate to heat the samples and ensure complete melting of the phase change material. The removal force was measured using a calibrated torque wrench.

This data is intended to be a reference only. Increased time and pressure will cause the phase change material to flow more, possibly increasing the force required to remove the heat sink from the die or component.

Examples of pad sizing used in this test.

Top picture represents an oversized T766 pad (i.e. T766 area > die)
Bottom picture represents a matched T766 pad (i.e. T766 area = component)





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I. Simulated small dies

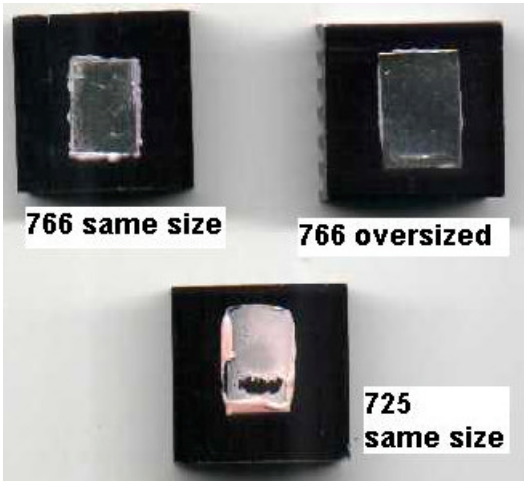
An aluminum panel was machined to simulate a 0.4 inch x 0.6 inch raised die. Samples of T766 were cut to the same size as the die and to approximately 20% greater in both length and width. Samples were applied to 1.1 inch x 1.1 inch anodized aluminum heat sinks by hand. The dies and heat sinks were heated beyond the material phase change temperature, and then exposed to an applied force for a specified time, tabulated below. This temperature, pressure and time combination allowed the phase change material to flow and a minimum bond line thickness of the material to be attained. The samples were allowed to cool for several hours before testing for removal. The force required to remove the heat sink from the die was measured using a torque wrench with a fixture specially made to fit the heat sinks. Chomerics T725 phase change material was also tested in order to demonstrate the differences between standard phase change materials and the clean break T766.

Results:

	Pad Size [dimensions given in inches]	Application Pressure [psi]	Application Time* [seconds]	Removal Force [inch-lbs]
T766	same as die (0.4 x 0.6)	10	20	0
T766	same as die (0.4 x 0.6)	20	60	2.0
T766	oversized (0.5 x 0.7)	10	20	0
T766	oversized (0.5 x 0.7)	20	60	0
T725	same as die (0.4 x 0.6)	10	20	5.5

* Pressure was applied to the heat sink assembly for this amount of time.

Figure 1. Thermflow pads attached to bottom of heat sinks, shown after removal from small dies.



II. Large Component PQFP's

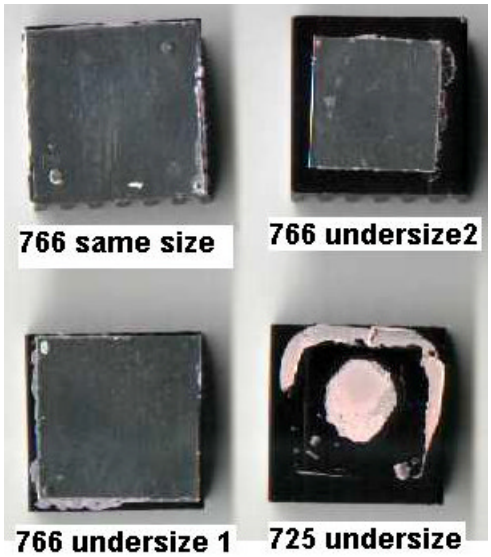
Flat plastic packages, 1.1 inch x 1.1 inch, were used for this portion of the testing. Samples of T766 were cut to the same size as the package, to approximately 10% less in both length and width, and to approximately 25% less in both length and width. Samples were applied to 1.1 inch x 1.1 inch anodized aluminum heat sinks by hand. The dies and heat sinks were heated beyond the material phase change temperature, and then exposed to an applied force for a specified time, tabulated below. This temperature, pressure and time combination allowed the phase change material to flow and a minimum bond line thickness of the material to be attained. The samples were allowed to cool for several hours before testing the removal force. The force required to remove the heat sink from the package was measured using a torque wrench with a fixture specially made to fit the heat sinks. Chomerics T725 phase change material was also tested in order to demonstrate the differences between standard phase change and clean break T766.

Results:

	Pad Size [inches]	Application Pressure [psi]	Application Time* [seconds]	Removal Force [inch-lbs]
T766	same as comp (1.1 x 1.1)	10	20	0
T766	same as comp (1.1 x 1.1)	20	60	0.5
T766	undersized 1 (1.0 x 1.0)	10	20	0
T766	undersized 1 (1.0 x 1.0)	20	60	3.5
T766	undersized 2 (0.8 x 0.8)	10	20	0
T766	undersized 2 (0.8 x 0.8)	20	60	2.0
T725	undersized (0.8 x 0.8)	10	20	>20.0

* Pressure was applied to the heat sink assembly for this amount of time.

Figure 2. Thermflow pads attached to bottom of heat sinks, shown after removal from PQFP's.



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Summary

Part one of the removal force testing utilized dies smaller than the heat sinks. T766 pads were sized to match the die in one test and oversized in the other. The pad sized the same as the die had phase change material flow out around the edges of the pad. Some of that material was allowed to flow down around the top edge of the die. In tests with low pressures (i.e. 10 psi) and short attachment times (i.e.20 seconds) there was no removal force required to remove the heat sink from the die for both pad sizes. Higher pressure (i.e. 20 psi) and longer attachment time (i.e. 60 seconds) required 2.0 inch-lbs of torque to remove the matched sized pad, where the oversized pad still had zero removal force. Comparatively, Chomerics T725 standard phase change material required 5.5 inch-lbs of torque to remove the heat sink from the die.

Part two of the testing used components that were approximately the same size as the heat sink. Once again, in tests using low pressures of 10 psi and short attachment times of 20 seconds, there was no removal force required to remove the heat sink from the die for all three of the pad sizes. Higher attachment pressure and time required 0.5 inch-lbs of removal force on a matched pad size and 2.0 - 3.5 inch-lbs on undersized pads. Comparatively, Chomerics T725 standard phase change material required >20 inch-lbs (torque wrench upper limit) to remove the heat sink.

Conclusion

Zero removal force is achieved when the Thermflow™ T766 pad is properly sized. The proper size for individual applications may vary depending on several factors such as die and heat sink dimensions, flatness tolerances, and pad and die placement tolerances. A properly sized pad is at least 20% greater than the die, in both length and width, providing a border around the die. The larger the pad area is in respect to the die area, the less chance there is for the phase change polymer to flow around it. As can be seen from these test results, increased time and pressure will cause the phase change material to flow more, possibly increasing the force required to remove the heat sink from the die.

Sizing the Thermflow™ T766 pad will be application specific, and this report is intended to be as a guideline and reference. Minor adjustments to the size of a T766 pad may need to be made, once the user has tested the material for a specific application.

Please contact our Applications Engineering Department at 781-939-4620 for recommended guidelines and additional information. Our website also includes T766 application instructions and test reports for reference.