Laser Processing of 3M™ Thermally Conductive Silicone Interface Pad 5519

- Smooth laser-processed edges and minimal heat-affected zones
- No degradation to the physical properties of the materials
- Eliminates material deformation during processing
- Consistently and repeatedly process 3M pad 5519 to a high degree of dimensional accuracy

PROCESSING EXAMPLE

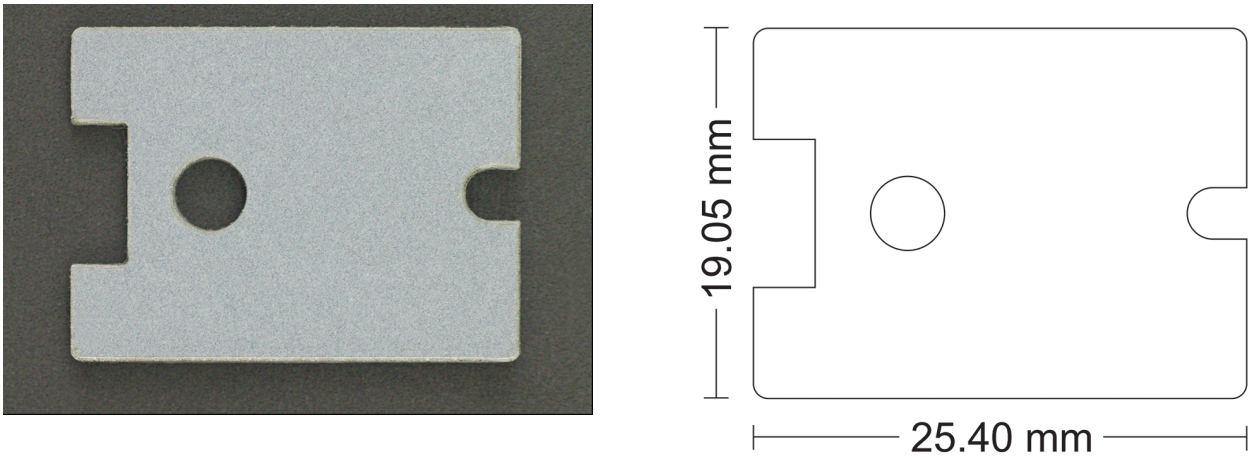

Figure 1. *Example of the fine geometry possible with laser processing 3M pad 5519.*

3M™ Thermally Conductive Silicone Interface Pad applications requiring fine geometry and intricate detail without degrading the physical properties of the material can be achieved with Universal Laser Systems technology. An example demonstrating the results of laser processing the 3M pad 5519 material is shown in ***Figure 1***.

MATERIAL OVERVIEW

3M™ Thermally Conductive Silicone Interface Pad 5519 (TCSIP) is one of 3M's TCSIPs similar to 5514, 5516, and 5595S. 3M pad 5519 is a highly conformable and medium-soft pad with high thermal conductivity. 3M pad 5519 has a medium-soft pad layer that conforms to uneven substrates, providing excellent wettability to fill gaps for improved thermal performance. It is designed to transfer heat from heat-generating components to heat sinks and cooling devices, improving device reliability and extending the component's life. 3M pad 5519 consists of a slightly tacky silicone elastomeric conformable sheet filled with thermally conductive ceramic particles and is protected with PET release liners on both the top and bottom surfaces. A diagram depicting the layers of the 5519 material is shown in ***Figure 2***.

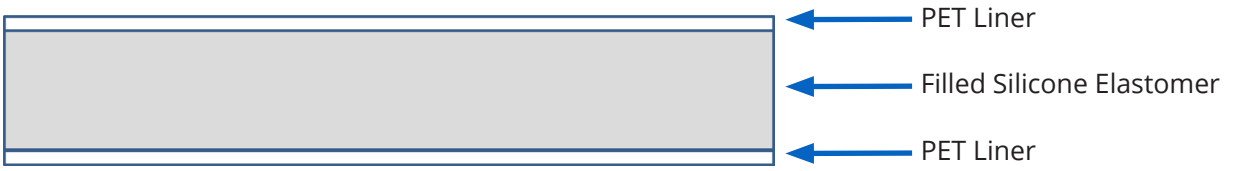

Figure 2. *3M pad 5519 diagram showing PET liners located on top and bottom of the thermally conductive silicone elastomer adhesive layer. The product is available with a conductive layer in thicknesses from 0.5mm to 2.0mm.*

The non-contact nature of laser processing enables the processing of applications with fine geometry and intricate detail. Universal Laser Systems makes it simple to consistently and repeatedly process 3M™ Thermally Conductive Silicone Interface Pads.

LASER PROCESSING NOTES

3M pad 5519, specifically 5519-10, was tested to assess laser processing compatibility and determine the best system configuration of laser peak power and wavelength. The combination of 9.3µm and 1.06µm laser wavelengths in the ***MultiWave Hybrid***™ system configuration, which combines the two wavelengths into one simultaneous beam, produces a smooth processed edge with minimal heat effects.

The 1.06um fiber laser energy transmits through the PET liners to be absorbed by the ceramic filled silicone adhesive pad, producing a clean processed edge with minimum heat effects to both the pad and liners. The 9.3µm laser energy is absorbed by both the PET liners and adhesive pad where the absorption aids in processing both the liners and pad. Microscopy images taken at 100X magnification of the processed edge of the 3M pad 5519 post-processing with the liners in place and the liners removed are shown in ***Figures 3*** and ***4***, respectively. In these images, it is shown that the PET liners contain most of the heat effects and discoloration, while the silicone adhesive layer itself is relatively free of heat effects and discoloration. Further inspection of the laser-processed material shows that the ceramic filled silicone adhesive layer is cleanly processed along the processed path with the ***MultiWave Hybrid***™ system configuration of dual 75 watt 9.3 CO_2 laser sources combined with a 50 watt 1.06µm fiber laser source.

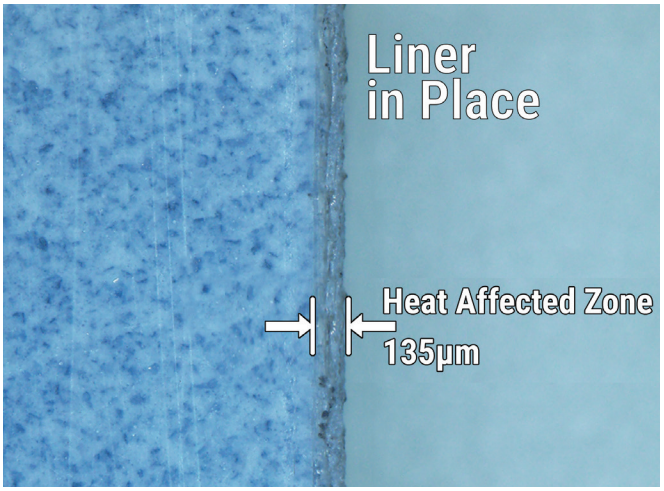

Figure 3. *Microscopy image (100X) of the MultiWave Hybrid™ laser-processed edge of 3M pad 5519 with the PET liners in place. The heat-affected zone measures 135µm.*

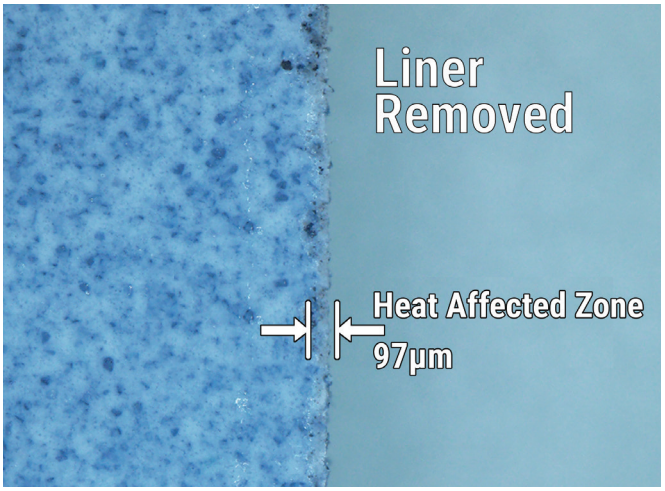

Figure 4. *Microscopy image (100X) of the laser-processed edge of 3M pad 5591 with the PET liners removed from the material post-processing. The heat-affected zone measures 97µm.*

Surface measurements of the heat-affected zones of processed regions are shown in ***Figures 5*** and ***6***.

*The image in **Figure 5** below shows that the PET layer reacts to the laser energy by forming a "wave" of melted material along the top surface of the processed edge.*

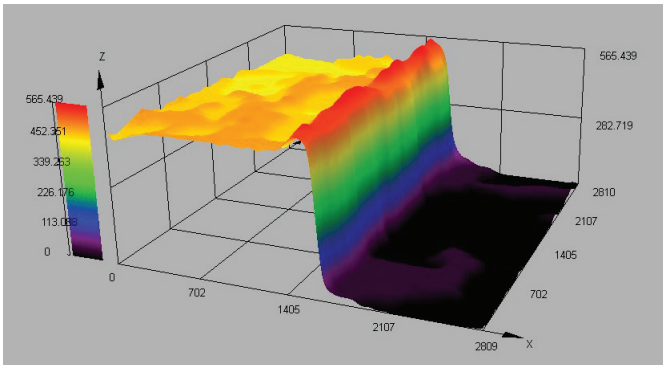

Figure 5. *3D-rendered microscopy image (100X) of the laser-processed edge of the 3M pad 5519 with the PET liners in place.*

*The image in **Figure 6** below shows the PET liners removed from the material, showing the smooth flat surface, free of adverse heat effects.*

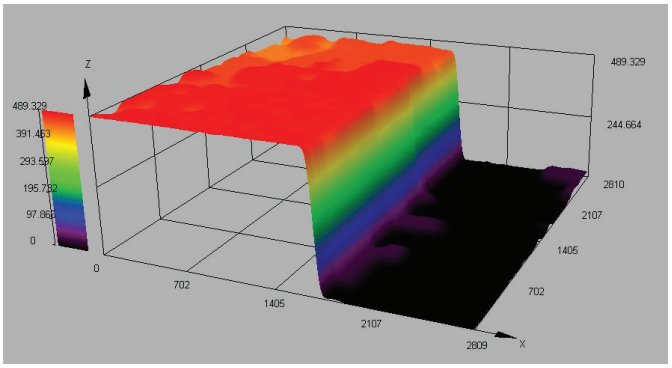

Figure 6. *3D-rendered microscopy image (100X) of the laser-processed edge of the 3M pad 5519 with the PET liners removed.*

ALTERNATIVE SYSTEM CONFIGURATION ANALYSIS

3M pad 5519 was also tested with alternate system configurations of 9.3µm only and 1.06µm only for comparison and determination of the effectiveness of each system configuration. The results of these tests were compared by analyzing the heat effects, quality of the processed edge, and post-processing requirements. The results of the comparison of these system configurations are listed in tabular form in ***Table 1*** and a comparison of the ***MultiWave Hybrid™*** and 9.3µm laser only process is shown photographically in ***Figure 7***.

Table 1. System Configuration Comparison

System Configuration	Heat-Affected Zone	Process Characteristics	Post-Processing Requirements
MultiWave Hybrid™	Minimal heat-affected zone of approximately 135µm.	The 1.06um laser energy cleanly cuts the silicone adhesive while transmitting through the PET liners, while the 9.3um energy cuts both the liners and adhesive.	Simple wiping of surface with a lint-free wipe.
9.3µm Only	Increased heat-affected zone compared to the MultiWave Hybrid™configuration.	This configuration results in significant thermal damage to both PET liners as well as to the silicone adhesive.	Physical removal of solid ceramic layer along processed edge and surface debris.
1.06µm Only	Incomplete process	Without the 9.3µm laser energy, the PET liners are not fully processed.	This configuration requires simple wiping of the surface with a lint-free wipe.

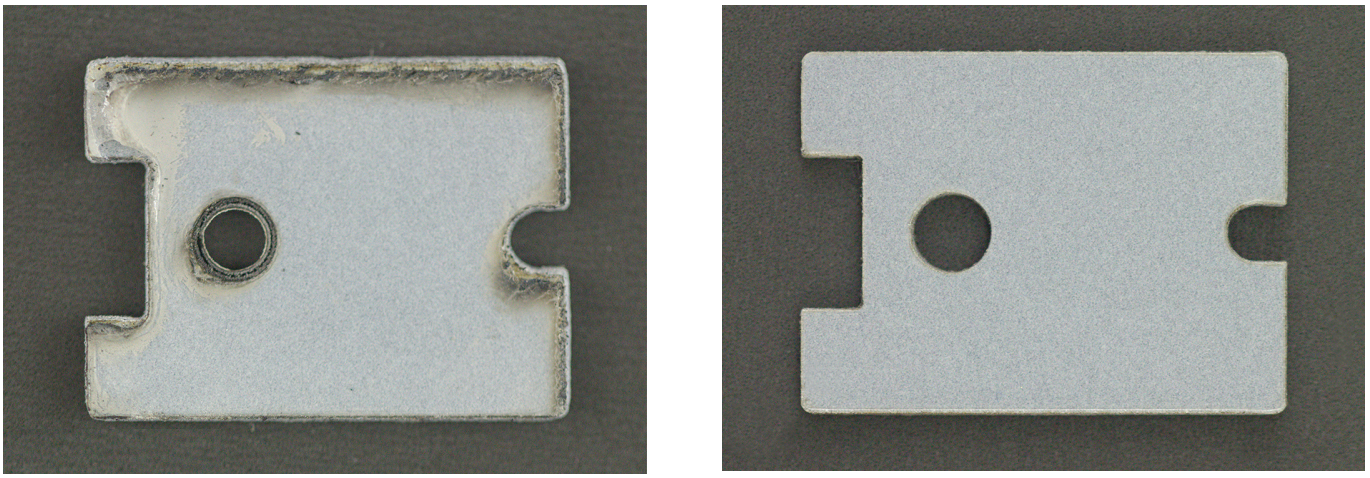

Figure 7. *Comparison images of the processed samples resulting from 9.3µm processing only (left), and the MultiWave Hybrid™ configuration processing (right). The PET liners were left in place for both samples.*

CONCLUSION

3M pad 5519 is very well suited for laser processing and was extensively tested to determine the most efficient processing configuration. Through this testing, it was determined that laser processing is viable with this material, and dual 75 watt 9.3µm CO_2 lasers combined with a 50 watt 1.06µm fiber laser in the ***MultiWave Hybrid™*** configuration is the best configuration of wavelength and power for the processing of this material. The 1.06µm wavelength transmits through the PET liners and is absorbed by the ceramic filled silicone adesive to produce a clean smooth processed edge. The 9.3um wavelength laser energy is absorbed by both the top and bottom PET liners as well as the silicone adhesive pad, producing clean smooth processed edges that have minimal heat-affected zone and discoloration.

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