Laser Processing of 3M™ Electrically Conductive Single-Sided Tape 3304BC-S

- 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 tape 3304BC-S to a high degree of dimensional accuracy

PROCESSING EXAMPLE

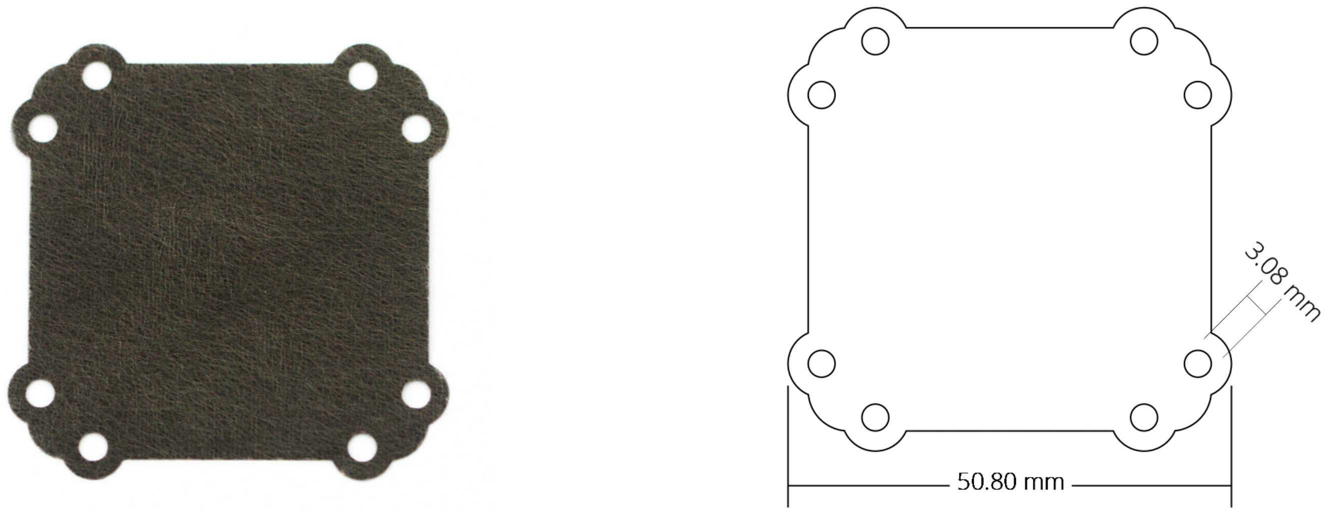

Figure 1. *3M tape 3304BC-S diagram showing the conductive black foil tape consisting of a conductive black copper foil carrier and a unique conductive non-woven carrier-based acrylic adhesive and protective PET release liner. The product is available in a standard thickness of 45μm.*

3M Electrically Conductive Tape 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 tape 3304BC-S material is shown in ***Figure 1***.

MATERIAL OVERVIEW

3M Electrically Conductive Single-Sided Tape 3304BC-S is an XYZ-axis electrically conductive adhesive. The material has a unique construction with a conductive nickel/copper-coated nonwoven carrier based acrylic adhesive and black copper foil backing. It is designed for EMI shielding and grounding applications, enabling devices to meet electromagnetic compatibility requirements. 3M tape 3304BC-S has a very low electrical resistance, which performs well with microelectronics that have a small grounding area. It is commonly used in EMI shielding & grounding applications, shield can lid replacement, display wrapping, and electrostatic discharge (ESD) protection. The material is available in a standard thickness of 45μm and is protected with a PET release liner on the adhesive surface. A diagram depicting the layers of the 3304BC-S material is shown in ***Figure 2***.

Figure 2. *3M tape 3304BC-S product construction*

LASER PROCESSING NOTES

3M Tape 3304BC-S was tested to assess laser processing compatibility and determine the best system configuration of laser peak power and wavelength. The PET liners absorb 9.3µm energy more efficiently than other wavelengths, meaning less peak power was necessary to produce good results with minimum heat effects. The acrylate adhesive layer also absorbs the 9.3µm wavelength efficiently with a nominal recession of the adhesive layer from the Ni/Cu woven fabric and copper foil carrier along the processed path. Microscopy images taken at 69X magnification of the processed edge of the 3M tape 3304BC-S 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 acrylate adhesive layer shows nominal recession from the woven fabric.

3D-rendered microscopy images of the processed surfaces are shown in ***Figures 3*** and ***4.***

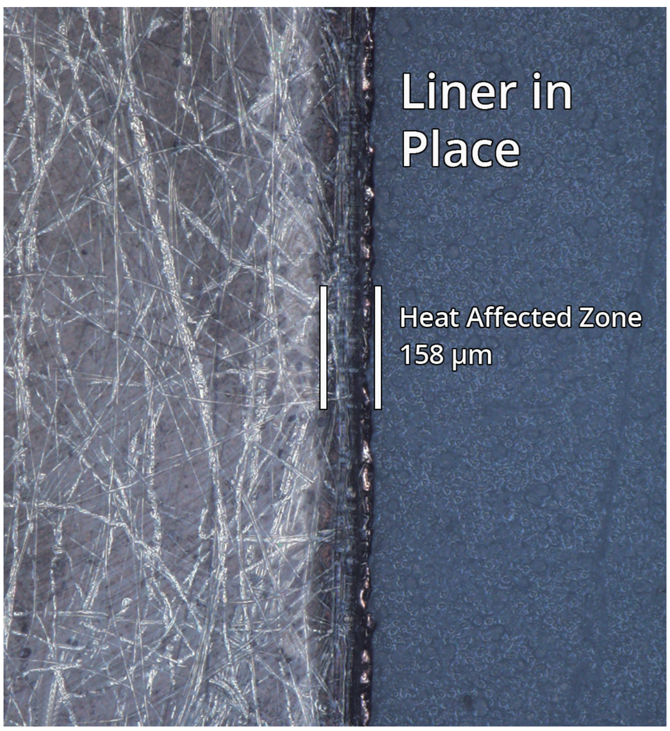

Figure 3. *Microscopy image (69X) of the laser-processed edge of 3M tape 3304BC-S with the PET liner in place. The heat-affected zone measures 158µm.*

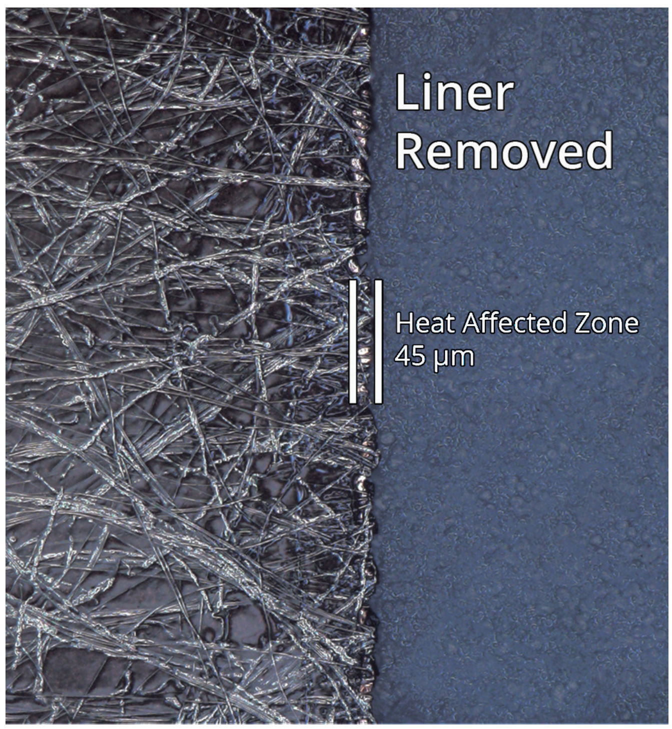

Figure 4. *Microscopy image (69X) of the laser-processed edge of 3M tape 3304BC-S with the PET liner removed from the material post-processing. The heat-affected zone measures 45µm.*

Further inspection of the laser-processed material shows that the acrylate adhesive layer is cleanly processed along the processed path with the dual 75 watt 9.3µm CO_2 laser sources. ***Figures 3*** and ***4*** depict microscopy images of the processed surfaces and the resulting heat-affected zones of each wavelength.

ALTERNATIVE SYSTEM CONFIGURATION ANALYSIS

3M tape 3304BC-S was also tested with an alternate system configuration of 10.6µm laser energy at equivalent laser power level 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 shown photographically in ***Figure 5***. Both system configurations appear viable with some reduction in quality of the results for the 10.6µm configuration as stated in the comparison.

Table 1. System Configuration Comparison

System Configuration	Heat-Affected Zone	Process Characteristics	Post-Processing Requirements
9.3µm (strongly recommended)	Minimal heat-affected zone of approximately 158µm.	The 9.3µm laser energy has the advantage of better absorption by the material resulting in a consistent edge along the processed path with a reduced heat-affected zone.	Processing of the 3M tape 3304BC-S material with either the 9.3µm or the 10.6µm configuration did not require additional post-processing.
10.6µm	Increased heat-affected zone compared to 9.3µm wavelength of approximately 221µm.	This configuration results in an increased heat-affected zone in the PET liner and produces a rougher edge along the processed path in the adhesive layer when compared to the 9.3µm configuration.	

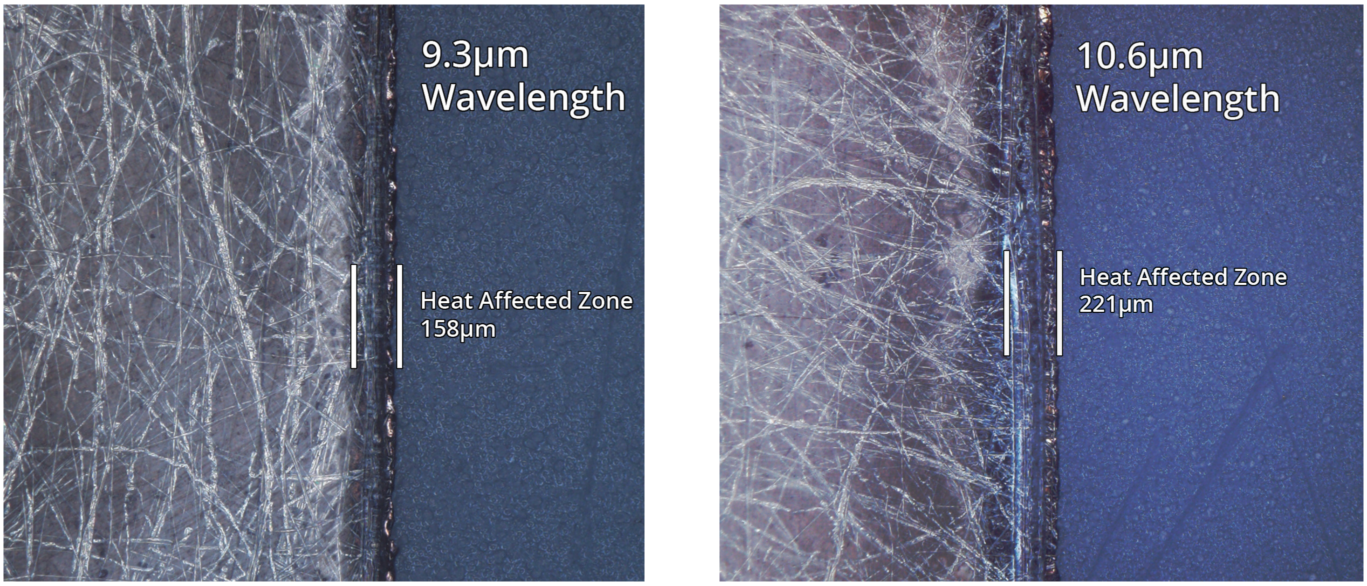

Figure 5. *Comparison microscopy images (100X) of the processed edge resulting from 9.3µm processing (left), and 10.6µm processing (right). The PET liners were left in place for both samples.*

CONCLUSION

3M tape 3304BC-S 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 a dual 75 watt 9.3µm CO_2 laser source configuration is the best configuration of wavelength and power for the processing of this material. The PET liners and acrylate adhesive layer efficiently absorb the 9.3µm wavelength laser energy and, coupled with the peak power of the dual 75 watt laser sources, produce a processed edge that has a minimal heat-affected zone.

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