

Acceptable outer edge sweep limits for 3M™ Trizact™ Pad Conditioners

Bringing together 3M's know-how in abrasives, ceramics and microreplication, the 3M™ Trizact™ Pad Conditioner is an innovative pad conditioner for chemical mechanical polishing (CMP) for advanced node semiconductor manufacturing.

The Trizact pad conditioner uses precisely engineered three-dimensional micro-replicated ceramic structures coated with chemical vapor deposition (CVD) diamond. These structures are located on the surface of each “element” mounted on the pad conditioner substrate. A pad conditioner may have five or more elements mounted on the substrate.

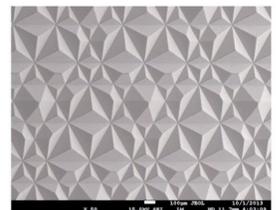
During use, all pad conditioner elements must remain in contact with the pad surface at all times. To ensure all elements remain in contact with the pad surface, please review this paper and the acceptable Outer Edge Sweep Limits defined in **Table 1**.

Configure your CMP tool

The Trizact pad conditioner working surface is comprised of five or more elements which must remain in contact with the pad. When configuring your CMP tool pad conditioner sweep profile, ensure the sweep limits are established to prevent the conditioner from traveling beyond the pad edge.



3M™ Trizact™
Pad Conditioner



Scanning Electron Microscope (SEM) image of the B5-M990 microreplicated surface.
(50x magnification with image tilted at 15°)

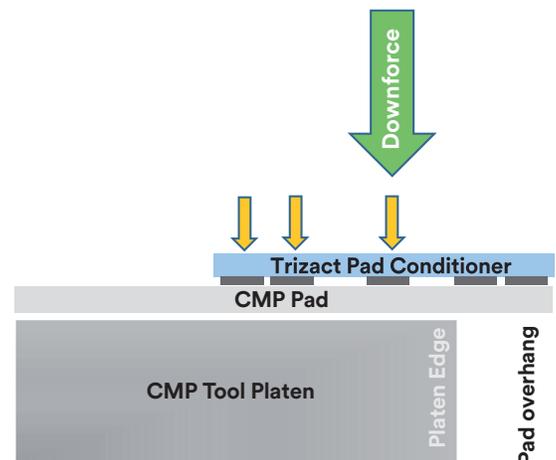
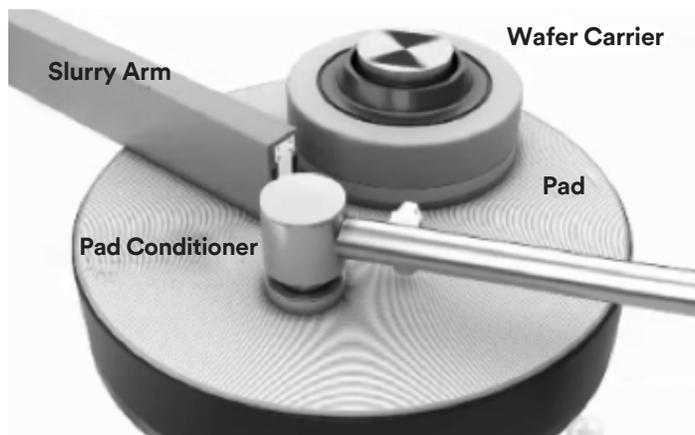


Figure 1: Ensure the Pad Conditioner sweep does not exceed the pad diameter.

For some CMP tools, the diameter of the pad may exceed the platen diameter, causing the pad to overhang the platen unsupported. For this scenario, ensure the pad conditioner sweep does not exceed the pad diameter, as illustrated in **Figure 1**.

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Avoid pad edge damage

If the 3M™ Trizact™ Pad Conditioner is allowed to sweep beyond the pad edge of an unsupported pad (**Figure 2**), the result may include damage to the pad, pad conditioner, or the platen. Such damage is illustrated by using a soft, suede type pad, whereby the pad conditioner sweep was allowed to exceed the pad diameter, see **Photo A**.

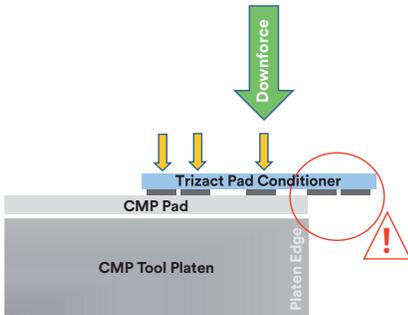


Figure 2: Pad conditioner sweep exceeding the pad diameter is not advised.

Using the same tool sweep recipe with an industry standard hard pad constructed with a stiff subpad (**Photo B**), there may be no visible damage to the pad edge upon inspection.

However, the sweeping action across the edge of a hard pad has potential to increase the stress on the Trizact working tips and potentially damage the conditioner.

Sweeping beyond the pad diameter of an unsupported pad may have consequences of higher pad wear along the pad edge. The Trizact pad conditioner is constructed with five or more discrete elements that distribute the applied downforce to the pad (**Figure 2**). If elements travel beyond the pad edge, the downforce is increased for the elements remaining on the pad. This scenario creates greater depth of penetration and friction near the pad edge and increases the amount of pad wear at the pad edge.

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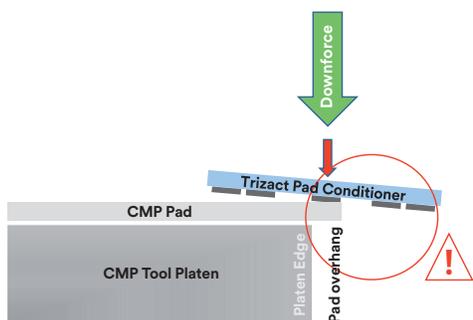


Figure 3: Pad Conditioner center-of-mass exceeding the platen diameter is not advised and may result in damage.

Another concern is that as the conditioner spins at the edge of the pad the elements leaving and returning to the pad could cause an oscillation at the location downforce is applied, **Figure 3**. In turn, the oscillation could cause rocking and gouging of the pad edge. Ultimately, this could cause increased stress on the Trizact pad conditioner working tips, increase the potential for vibration and potentially damage the conditioner.



Photo A: Sweeping over the pad edge when using a suede-type soft pad may tear the pad edge.

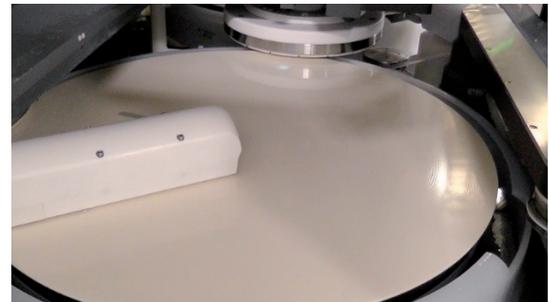


Photo B: Sweeping over the edge of a hard pad may show no visible damage; however, high pad wear along the edges and potential damage to the conditioner is possible

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Optimizing the sweep settings

Adjustments to the sweep settings may be required for your CMP tool if the current recipe allows the pad conditioner to sweep beyond the pad diameter.

As an example, a customer replaced their traditional diamond grit conditioner with the 3M™ Trizact™ Pad Conditioner and obtained the pad profile of **Figure 4**. The tool recipe allowed the conditioner to sweep beyond the pad edge.

By implementing an “outer edge sweep limit” and optimizing the dwell times, the pad profile was dramatically improved, **Figure 5**. The improved pad profile also improved the wafer edge non-uniformity results throughout the pad life.

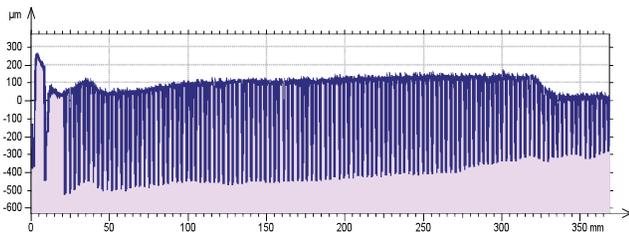


Figure 4: Laser profilometer scan of a customer’s hard pad conditioned with Trizact B6-M990 conditioner. The sweep was beyond the pad diameter with a longer dwell time in the outer-most zone. High pad wear observed at the pad edge.

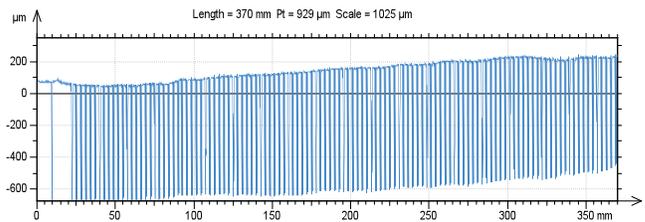


Figure 5: Laser profilometer scan of a customer’s hard pad after implementing an “outer edge sweep limit” and optimizing dwell times. Notice the improved pad profile at the edge.

Recommendations for Sweep Settings

In light of the information above, 3M recommends the conditioner should only sweep so far as the pad conditioner center-of-mass is always supported by the underlying platen and that no element should travel completely off of the pad. Typical limits to be observed for both AMAT and Ebara CMP tools are listed below.

Table 1.

CMP Equipment	Platen Size	Outer Edge Sweep Limit*
Applied Materials (300mm)	30 inches / 760 mm platen	13.50 inches / 343 mm
Applied Materials (200mm)	20 inches / 508 mm platen	8.25 inches / 210 mm
Ebara (300mm)	29 inches / 740 mm platen	12.75 inches / 324 mm

*The “outer edge sweep limit” locations is defined as the distance from the center of the pad to the center of the pad conditioner. These limits apply to all 5, 7, and 10 element conditioners regardless of the carrier they are mounted on (4.00” or 4.25”).

Make sure to avoid collision between the conditioner and the wafer head when in-situ conditioning by synchronizing the conditioner and wafer head sweeps appropriately

Note: Consult the operating guide for your CMP tool before implementing changes to the sweep.

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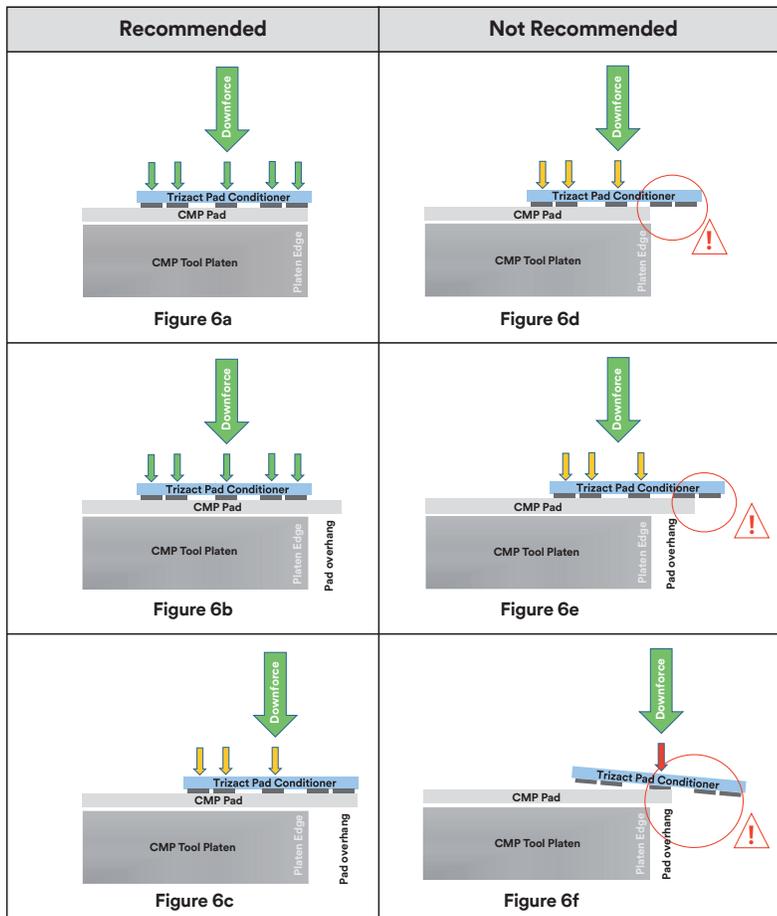


Figure 6: Summary of pad sweep scenarios.

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Electronics Materials Solutions Division

3M Center, Building 224-3N-11
 St. Paul, MN 55144-1000
 1-800-251-8634 phone
 651-778-4244 fax
www.3M.com/electronics

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