

# Adhesives Engineered to Drive Cost Out:

## 3M Precision Cutting Adhesive Technology, A Case Study

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### Introduction by 3M:

At 3M Medical Materials & Technologies, we continuously strive to address the growing needs of the medical device manufacturers worldwide. We apply innovative technologies and capabilities from more than 40 platforms along with 55 years of Health Care experience to provide the value and service customers have come to expect from 3M. For many, affordability is a common patient care value; to be profitable and drive cost out are common business initiatives. In the fabrication of microfluidic medical devices, we listened to converters and device manufacturers alike of their day-to-day challenges in die cutting pressure sensitive adhesives and how adhesive build-up impacts productivity. As a result, we engineered an adhesive solution with the test strip and lab-on-a-chip manufacturers in mind. We are proud to introduce **3M Precision Cutting Adhesive Technology (PCAT)**, an acrylic based adhesive formulated to help drive economic value into our customers' products and ultimately, into the hands of their patients.

To share some insight into the capabilities of 3M PCAT, we worked alongside Auer Precision, a preferred 3M Medical Materials & Technologies' converter in a side-by-side comparison with a commercially available medical-grade adhesive. During our trials, **3M PCAT displayed the potential to help Auer Precision reduce their down time by more than 30% and increase throughput by 4 to 5x.** In the following, we are proud to have Eric Sanders, Auer Precision Company, share their story.

### Decreasing Equipment Downtime in Medical Device Converting by *Eric Sanders, Medical Device Engineer, Auer Precision Company*

Precision components are key aspects of the Medical Device industry, and Manufacturers are keenly aware of the importance of material selection that not only meet all

product specifications, but keep manufacturing costs low. This is especially apparent in converting pressure sensitive adhesives for laminate devices, as a common drawback is the amount of downtime needed for maintenance and cleaning. Auer Precision is a manufacturer of medical devices, using a variety of Class A punch and dies to fabricate laminate components.

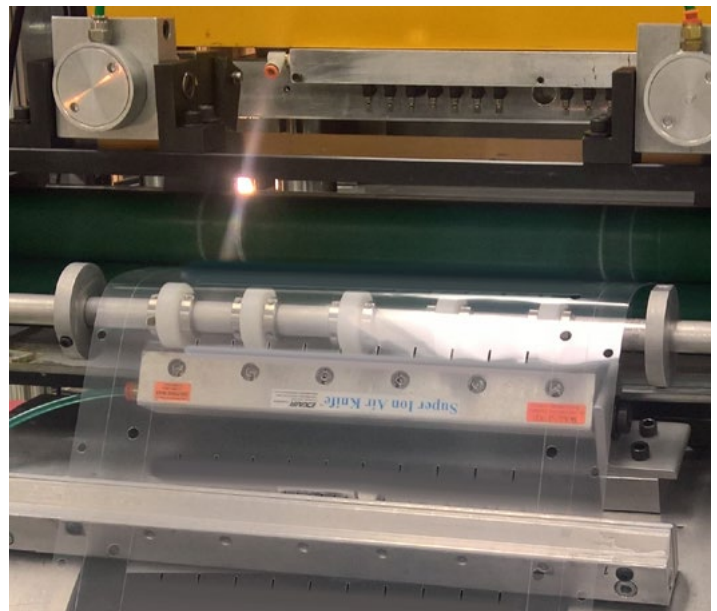
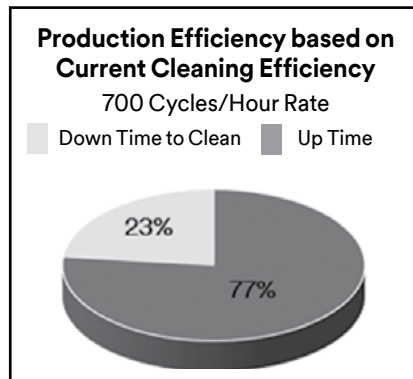


Fig A – Close-Up of Stamping Operation

We have been stamping thin, film, polymeric materials for over twenty years. In working with adhesives, we have learned of the need for a strong cleaning and maintenance regimen. During the stamping or punching operations, die cut quality of the material degrades as adhesive deposits appear on the edge of the stamping tool. Slugs or hanging die cuts also start to reattach themselves to the material. Generally, all of these conditions translate into a rejected part.

3M approached Auer regarding a new adhesive engineered to be more conducive for high volume, precision die cutting operations. We jumped at the chance to try out 3M PCAT. For our trials, 3M agreed to supply a double-coated adhesive tape format. It is a 3.2 mil (81.3 micron) double-coated spacer tape. The total stack thickness is 7.2 mils or 181 microns.

To evaluate the die cut performance of 3M PCAT, we chose to compare it to a commercially available double-coated spacer tape (“control”) specified in a point of care device we have manufactured for many years. This device consists of a multi-channel, capillary flow based test strip that is stamped out of the control tape. Based on its adhesive characteristics and geometry of the multi-array, we developed a stamping process that balanced quality with throughput. Our standard stamping rate is 50 cycles per minute (CPM) with 10 test strip units stamped per cycle. The cleaning regimen consists of a 2 minute in-press cleaning every 250 cycles or about 5 minutes. This is followed by a one-hour deep clean every 1000 cycles. In all, our average throughput rate is about 700 cycles per hour where more than 75% of our time is spent cleaning. **Our question is whether or not 3M PCAT can help us to reduce our down time overall?**



CURRENT CLEANING REGIMEN	
<b>Total Time</b>	<b>86 minutes</b>
<b>Total Up Time</b>	<b>20 minutes</b>
<b>Total Down Time to Clean</b>	<b>66 minutes</b>
Stamp Cycle 1-250	5 minutes
In-line Clean	2 minutes
Stamp Cycle 251-500	5 minutes
In-line Clean	2 minutes
Stamp Cycle 501-750	5 minutes
In-line Clean	2 minutes
Stamp Cycle 751-1000	5 minutes
Off-line Deep Clean	60 minutes

Fig B – Current Process Efficiency with Standard Spacer

### Trial 1: Comparison of 3M PCAT to Control at Normal Stamping Rate

For a fair side-by-side comparison, we decided to run both spacers without any in-line cleaning to determine the number of stamping cycles each could yield before failure. A failure occurs when excessive build-up of adhesive around the stamping tool causes the die cut material to tear.

The control was run first and it performed as expected. We

started seeing rejectable defects on the die cut parts at around 400 cycles and had to quit after 700. The adhesive buildup was so great on the tool (see Fig C), it led to frequent and incomplete die cuts. Eventually, the control tape tore.

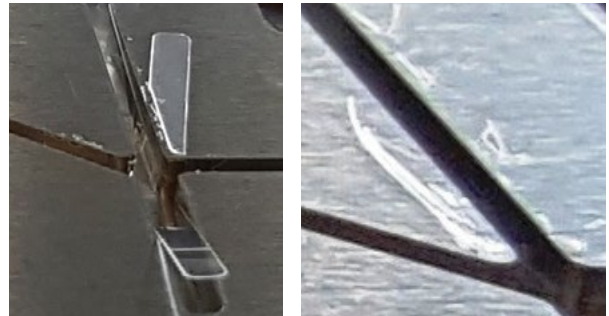


Fig C –Control Adhesive Build-Up on Stamping Tool after 700 cycles

After a thorough cleaning, we were ready to try 3M PCAT. This new material blew our minds! We stopped after 3000 cycles for no reason other than we were bored. Not only were the amount of defects lower, but there was very little visible adhesive buildup on the tool. This might suggest we could reduce the need for “in-line cleanings” if we switched to 3M PCAT in a standard production.

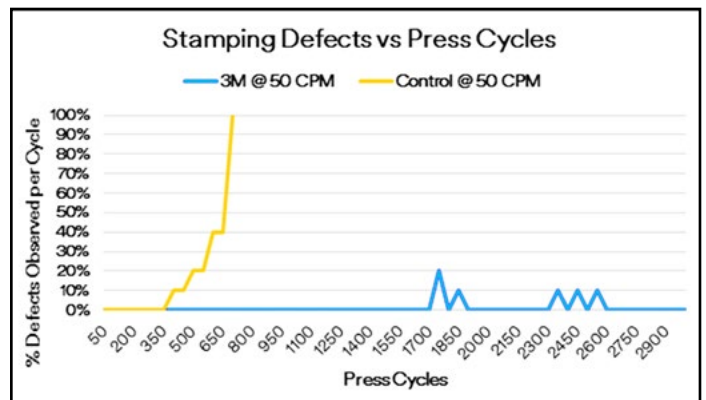


Fig D Comparison of Defect Rate

When we took the die apart for deep cleaning, we noticed that the entire tool had considerably less adhesive residue versus our control after only 700 cycles. To add, the 3M residue wasn’t as sticky. Because of this, the deep clean took a third less time using less solvent. We decided to run 3M PCAT again to confirm. We observed the same results but this time around, we reached 5000 cycles before having to stop. At this point, there were a few more incomplete die cuts and adhesive buildup on the tool versus 3000 cycles. The tool, however, was still very easy to clean.

In all, based on our standard stamping rate of 52 CPM, we saw an increase in throughput by a factor of 4 from 700 cycles with the standard spacer to 5000 with 3M PCAT. As we observed fewer defects and build-up of residue during the course of stamping, we may be able to reduce

the need to perform frequent in-line cleanings during an actual production run. This would also enable us to increase throughput even more beyond 5000 cycles. Lastly, it took about a third less time using less solvent to remove the 3M adhesive residue off the tool.

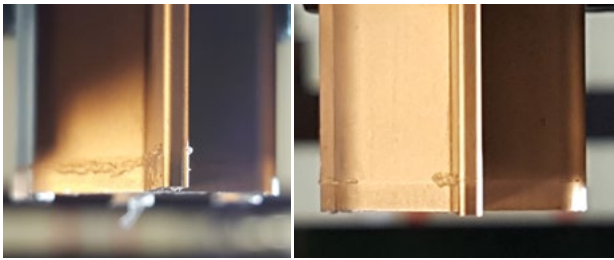


Fig E – Adhesive Residue Level on Stamping Tool, 50 CPM (Left- Control Adhesive after 700 cycles, Right - 3M PCAT after 1500 cycles)

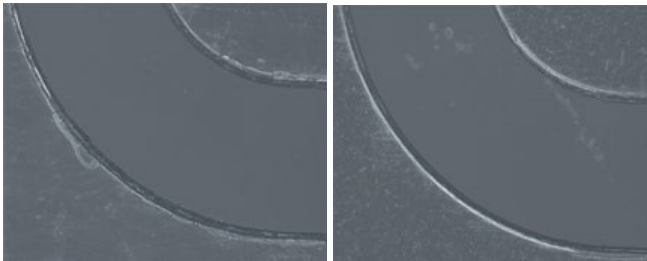


Fig F – Die Cut Edge Quality along Curved Channel (200x) (Left - Control Adhesive after 700 cycles, Right - 3M PCAT after 5000 cycles)

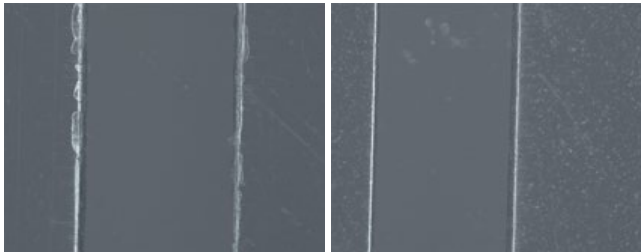


Fig G – Die Cut Edge Quality along Straight Channel (200x) (Left - Control Adhesive after 700 cycles, Right - 3M PCAT after 5000 cycles)

### Trial #2: Observation of 3M PCAT at Increased Stamping Rate

Based on the promising outcome of Trial #1, we decided to see how 3M PCAT would do if we increased the stamping rate from 50 to 75 CPM. We were excited with the results – we were still able to achieve 5000 cycles before failure. And, as before, we observed few die cut defects and the cleanup did not take much time or effort. Having the ability to increase stamping rate presents us with another option to help keep manufacturing costs low.

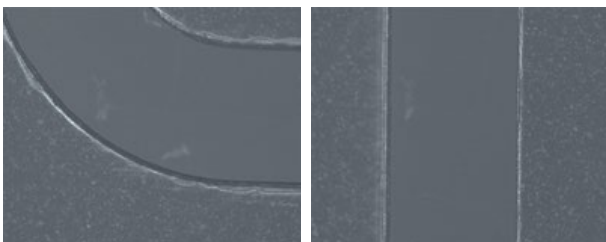


Fig H – 3M PCAT Die Cut Edge Quality after 5000 Cycles (200x) (Left - Curved Channel, Right - Straight Channel)

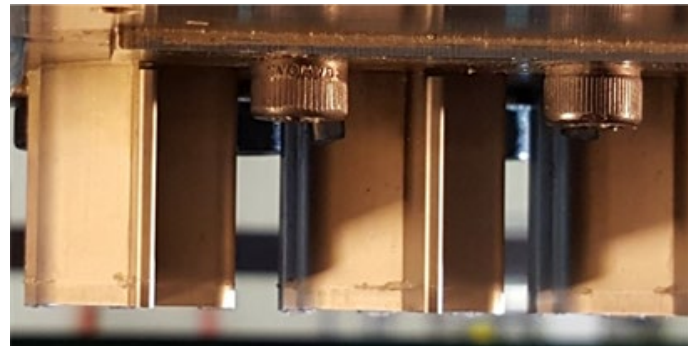


Fig I – 3M Adhesive Residue on Stamping Tool after 5000 Cycles, 75 CPM

### In Summary

At Auer Precision, we are encouraged with the trial results observed with 3M PCAT. We saw first-hand the benefits of this new adhesive, and observed the following when compared to the control spacer tape:

- We saw an increase in throughput by more than a factor 7. See Fig J.
- We observed the potential to increase our hourly throughput by a factor of 4 to 5x. See Fig K.

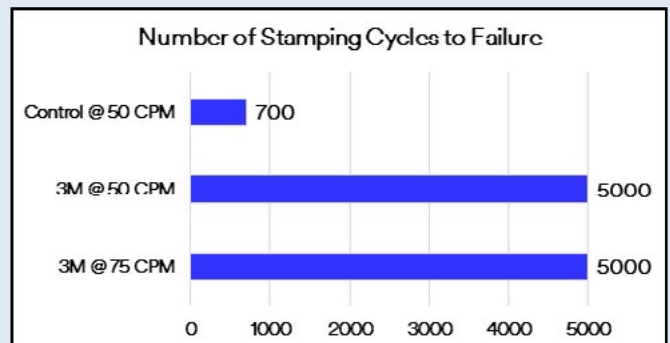


Fig J – Throughput Rate Comparison

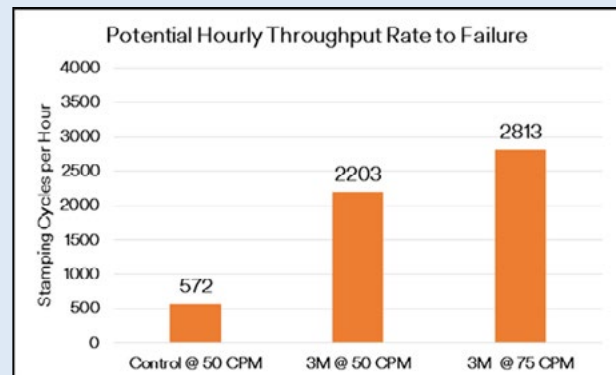


Fig K – Throughput Comparison

- We noted fewer defects and build-up of adhesive residue during the course of stamping. This would allow us to consider reducing the frequency of “in-line cleaning” during an actual production run or “clean-as-needed”.

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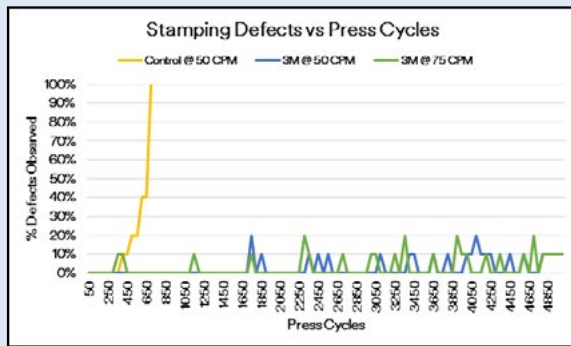


Fig L – Comparison of Defect Rate

- We observed the potential to increase “up time” by 3.5 to 4x. See Fig M.

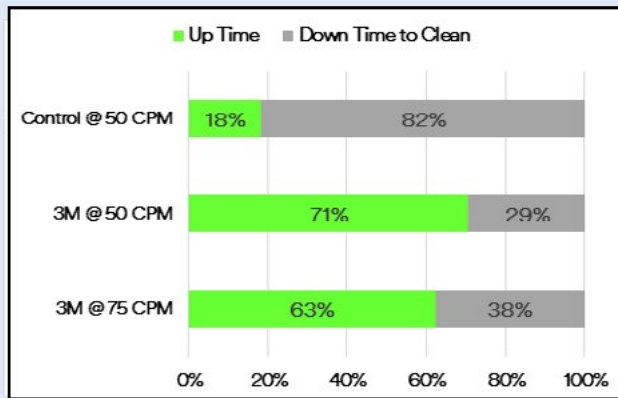


Fig M – Observed Throughout Efficiency

Overall, 3M Precision Cutting Adhesive Technology answered our question of reducing down time and more! If we considered a product build based on 1 million cycles, 3M PCAT has the potential to help us reduce the number of production hours required by more than 70% when operating at the standard stamping rate of 50 CPM and, by about 80% at 75 CPM! All of this to help keep manufacturing costs low and to move more quality product out the door.

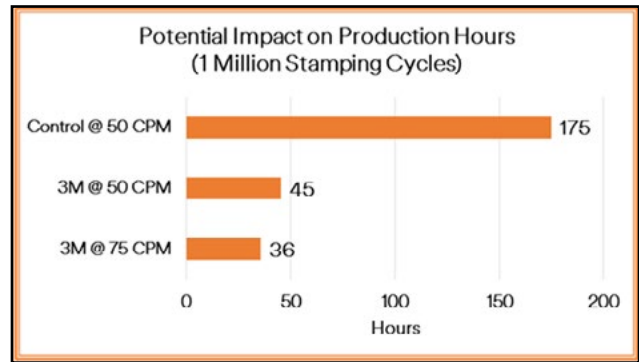


Fig N – 3M PCAT Impact on Production Hours

We look forward to introducing 3M PCAT to our clients and incorporating it into our projects. It is our belief this technology will not only benefit the fabrication of microfluidic devices but general medical devices as well. We thank 3M Medical Materials & Technologies for the opportunity to present our findings.

For more information on the trials and Auer capabilities, please visit [www.auerprecision.com](http://www.auerprecision.com) or contact Eric Sanders, Medical Device Engineer at 1-480-834-4637.

For more information on 3M PCAT or other microfluidic products, contact 3M at: 1-800-584-2787. Visit [3M.com/MedTech](http://3M.com/MedTech)

Disclaimer: Results presented are based on a limited trial and may differ with the adhesive composition for comparison, tape construction, die cut thickness, shape & size, converting equipment as well as process and cleaning conditions. It is the medical device manufacturer’s responsibility to determine the suitability and acceptability of 3M products in the design and manufacture of their final device.

Disclaimer: Images of the actual micro array are not shown to protect client-privileged information.



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