Technology

Overcoming the Top Technical Challenges in Metalworking

Don Sears | Apr 10, 2018

When it comes to cutting metal, time and quality are often at odds with each other, unfortunately. Part quality and machine problems will arise that may require a change in the status quo, say metalworking specialists in the field. See how three specialists diagnose and treat systemic challenges.

Thermal cracking. Deformation. Crater wear. No, these are not science fiction terms about barren and desolate moons and planets, damaged spacecraft or a description of strange, otherworldly aliens. These are terms about the heat-related failures of cutting tools when viewed up close at microscopic levels. But there are plenty of other types of tool damage out there—some of which have to do with mechanical failures.

So what, you say? Cutting tools are supposed to do their job and then be swapped out and scrapped. You pop in a new tool, get back to work and forget it, right? If only it were that simple. Extensive tool damage is often a symptom of larger systemic and interconnected factors—and it requires the proper diagnosis for treatment.

MSC metalworking specialists Ray Gavin, Brian Laffey and Mac Allsup recently talked to us about common and uncommon technical cutting tool challenges they observe and investigate regularly. It is absolutely true that cutting tool inserts are expected to wear and be replaced, they explain. The issue is how manufacturers use their cutting tools in machines to deliver quality parts on a production-run schedule—meaning a specific number of parts made daily.

“When it comes to customers, we start assessing where they’re at and where they need to be,” says Gavin. At the most basic level, it’s about understanding their goals, “such as do they need to make more parts per day, or do they want to produce higher quality parts?”

Often, the answer is both, but then problems begin—and over time it impacts business. Time and quality are at odds with each other, unfortunately. Tools are having to be changed out with higher frequency—which might not seem like a big deal the first few times—but then the machine downtime can really start to impact product delivery, they explain. Understanding how to treat the underlying issue can require deeper root cause analysis.

Concerned about tooling costs? Learn how to better measure the value of tooling with technical guidance.

Spotlight: Metalworking Specialists

Name: Ray Gavin

Title: Metalworking Specialist

Industry Background: 40 years of machining and metalworking experience at AMG, Cadillac Plastics, Guill Tool & Engineering Co., American Tool

Years at MSC: 16

Region(s): Gulf Coast

Name: Mac Allsup

Title: Metalworking Specialist

Industry Background: 33 years of industrial manufacturing experience

Years at MSC: 10

Region(s): Rocky Mountain, Colorado; Southern Wyoming

Name: Brian Laffey

Title: Metalworking Specialist

Industry Background: 29 years of industry experience as machinist, programmer, application sales specialist at Stellram, Sandvik Coromant

Years at MSC: 6

Region(s): Columbus, Cincinnati, Ohio (Midwest)

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Everyday Cutting Tool and Machining Problem Areas

What kinds of issues do they see on the job every day? Collectively, these field technicians find that tools are being damaged and parts are not coming out correctly by not having the right coolant application or because the cutting angle or "geometry" of the insert is not set correctly—or the machine is not being run at the right speed for the material being cut and tool type.

Anecdotally, the type of failures they see the most are more mechanical as opposed to the failures of too much or too little heat, and they include: Flank wear, chipping, depth of cut notches and fracturing. Temperature, however, is almost always a factor in everything that has to do with cutting metal—so grouping things in terms of heat vs. mechanical failure might be too simplistic.

Root cause failure is not as binary as temperature or mechanical wear, which speaks to the complexity of diagnosing metalworking problems. When it comes to cutting metal, heat and mechanical issues are intimately connected. It mostly means that the cause of the failure can be attributed more to one area over the other, the specialists explain.

Of the heat-related failures, one of the more common ones experienced is thermal cracking. Why is that? "Coolant is not applied correctly at the point of cutting," says Gavin. "As chips are created from cutting and coolant is being applied, the chips themselves can get in the way. Through-the-tool cooling can help."

This "at-the-point-of-the-cut" technology allows coolant to be applied at two different positions from above and below the tool holder. When used, the result is usually much better chip control and less chance for chip-related injuries when machinists go in to remove long chip strands and are cut, Gavin says.

All three specialists say they see very little crater wear or deformation, but it does happen in applications using titanium, iron and high-temperature alloys and in some super high-speed operations. To better illustrate some of the more common technical problem areas, here are several real-world situations the specialists have encountered—and how they resolved the issues.

> **"We went 180 degrees differently on this one and thought outside the box. We were able to lower the 'time-in-cut' drastically."**
> Ray Gavin
> Metalworking Specialist, MSC Industrial Supply

Challenge: Fracturing

Real-World Example: A large aerospace manufacturer was machining with Iconel (of "50 Rockwell" strength) using a ***face mill***. The part being built is 50 to 60 inches in diameter, and machinists were using carbide cutters and face pads (machining pads on the part). It was taking 20 hours to mill one part because the material was super tough, and they had to run the machine very slow, then stop it as the tools stopped being effective. Tool life was terrible and productivity was predictably poor.

Solution: Laffey advised using a ***ceramic-milling cutter*** and made a small adjustment to the cutting path so the material could be better cut. The part could now be made in four hours.

Outcome: Productivity took off: The machining time was reduced by 80 percent from 20 hours to four hours.

"Despite the individual tool price costing twice as much, it was pretty hard to argue with the time that was gained—and that the tool just worked better with the material," says Laffey.

Challenge: Built-Up Edge from Poor Chip Control, Depth of Cut Notch

Real-World Example: A major automation and power generation manufacturer had a large machine with a 36-inch diameter chuck for very large stainless steel parts that had chips wrapping up around the chuck, causing lots of downtime and burning through tools. Every time it happened, there were 20 minutes of unproductive work for every 30 minutes of cycle time. And, the manufacturer was underfeeding the carbide indexable turning tool, which caused the edge to build up. It was also a safety hazard, as machinists were reaching into the machine and being cut. They were using leather gloves, not cut-resistant gloves.

“A good place to look is in the customer’s recycled scrap to see all of the issues a tool may be experiencing,” says Allsup. “I use a 30x D loop magnifying glass to see exactly what’s going on. In this case, they had a lot of built-up edge from going too slow. It was like they were trying to cut frozen butter with a butter knife. So, the material was sticking to the coating of the tool.”

Solution: Allsup recommended changing the parameters, adjusting the depth of cut and the surface footage, using a sharper geometry, and increasing the speed and feed rates.

“They had the right grade, but their depth of cut was less than the recommended level for that type of chip breaker,” says Allsup.

Outcome: Production levels returned to normal, and downtime was completely eliminated.

“The cost savings were $2,500, but the main savings was from stopping the machine and pulling the chips out of the machine every 15 minutes,” says Allsup. “The process changes allowed the customer to run the part complete without stopping the machine and eliminating the safety hazard.”

Challenge: Chipping, Fracturing

Real-World Example: An aerospace subcontractor was milling a large engine part that was a 30 inches in diameter with 36 pockets on a horizontal CNC 5-axis machine. Those pockets were a very hard nickel-based alloy material, Rene 41, which Laffey describes as “nasty and almost refuses to be machined.” With the ***end mill*** they were using, the machinists were only able to cut four pockets before it was getting destroyed—and had little way to gauge the end mill’s condition. The manufacturer would have to stop the machine, reset a new tool, then do a test cut to make sure the new one worked—which was very time-consuming and frustrating.

Solution: Laffey advised using an exchangeable-head ***end mill*** that has a tool clamp with a threaded end that can be easily screwed in and unscrewed for easier tool changeover and setup. The manufacturer was now able to make 10 pockets per run over the four it had been doing.

Outcome: The manufacturer gained 24 hours a week back. The time savings net the customer three eight-hour shifts.

“The price per tool went from $25 to $75 to gain 24 hours back,” says Laffey. “The math was a no-brainer, as was the increase in pockets created in the part with the tool. And they did not have to re-gauge it, there was no test cutting needed, and no new measuring needed—just by changing the clamping mechanism, they were able to work with part better … They didn’t know that clamping technology existed.”

Challenge: Poor Part Finish, Poor Tool Life

Real-World Example: A large aerospace company making specialty parts with 17-4 PH stainless steel had material being cut at roughly 40 inches per minute in a cell of four machines that work in a 24/7 operation. The manufacturer was performing high-speed machining with ***ball end mills*** using a 4-axis machine rotating on the A axis at a high volume. The most important thing was making the most parts possible, but the part finish was poor quality and the tool life was weak.

Solution: Gavin advised changing to high-feed mills and using a different profiling approach. He worked with the manufacturer to reprogram the toolpath in a completely new way.

“We went 180 degrees differently on this one and thought outside the box,” says Gavin. “We were able to lower the ‘time-in-cut’ drastically.”

Outcome: Cut cycle time was reduced from roughly 18 minutes per part to 4.5 minutes. The material cut went from 40 ipm to 300 per minute. The cost per part was reduced nearly 300 percent.

The other outcome: Another division on the campus of this manufacturer heard about the improvements, and the same approach was then implemented on another eight machines.

Are your machines cutting as optimally as you’d like? How is your shop dealing with output issues happening on the machine? Share your experience.

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