

Hard Lessons

A mold and die shop shares the lessons it has learned about hard milling.

Hard milling is being performed more and more by moldmakers across the country. Moldmakers Inc., a plastic-injection and die-cast moldmaker, is no exception. For several years, the company has invested the time and money needed to hard mill on a regular basis.

“Hard milling really started taking off for us about 3 years ago when the software, tooling and toolholders began to mesh together with the technology of the machine,” said Paul Klett, manufacturing engineer for Moldmakers, Germantown, Wis.

The company is part of the MGS Manufacturing Group—a group of companies that offers design and engineering services, toolmaking, prototyping, mold polishing, production molding, including multishot and blow-mold capabilities, and automated assemblies.

Hard milling provides many benefits. Eliminating the need to use a sinker electrical discharge machine is the obvious one. With that, the costs of programming the electrode-producing machine, the electrode material and the time EDMing the steel are eliminated. Depending on the steel, workpiece shape and amount of stock being removed, it is also possible to eliminate roughing before heat treating.

Tolerance buildup is also eliminated.



The core of a mold for a food storage container is machined out of P-20 on a Roeders 800.

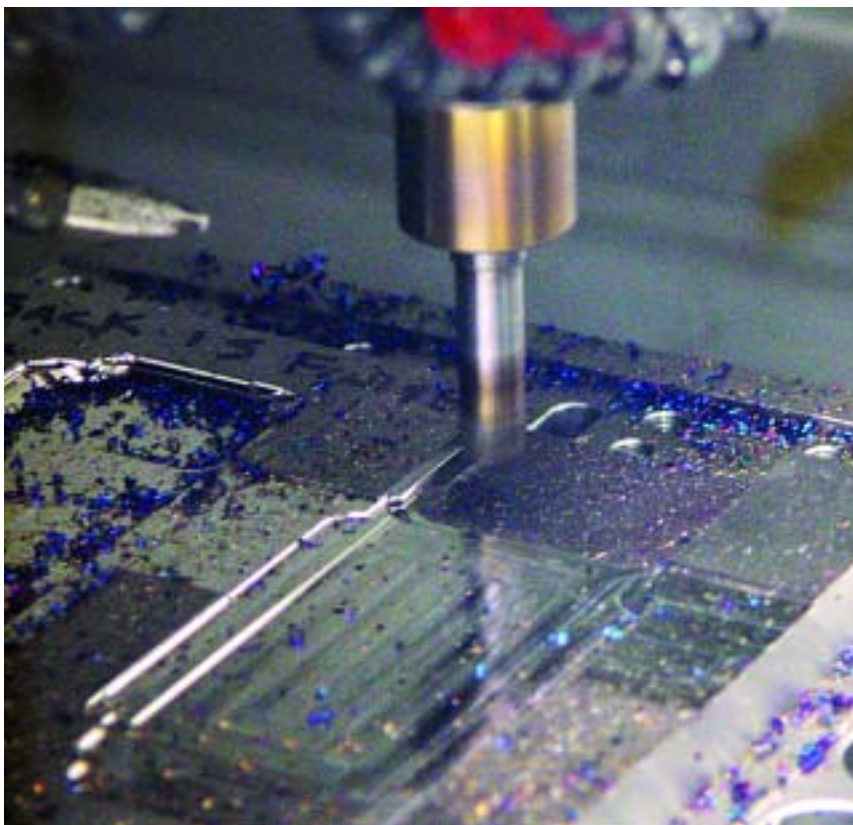
“Going from one machine to another creates a lot more variables for which you have to try and control tolerances,” said Klett. “Hard milling is definitely more accurate. We can take the part right off the machine and basically do little or no fitting.” Accuracy down to ± 0.0002 can be achieved, and even closer if needed.

Decision Time

At Moldmakers, the toolmaker, programmer and designer are involved in

the decision-making process regarding where and when hard milling can be utilized. Together, they try to determine if a whole part or only certain areas will be milled. “Our shop is unique in that the toolmaker gets involved with the job early in the build,” said Klett.

The decision to hard mill depends, in part, on what kind of concessions Moldmakers can get on the part itself, such as whether a sharp corner can have a radius. The company tries to



A rigid setup is needed when hard milling H-13 on a high-speed machine.

become involved up front with the design so it can get the customer to agree to any concessions that facilitate machining. Most of the time, the concessions do not affect the fit and function of the part.

“It’s easier for the designer modeling the part to keep edges straight and corners sharp,” said Klett. “But he may not be familiar with the difficulty of machining those sharp edges and corners. If we can educate part designers to optimize parts so they can be [more easily] machined, it benefits everyone involved.”

Machine Requirements

To hard mill successfully, a number of factors are involved, including the capabilities of the machine. For hard milling, Moldmakers has six 3-axis machines with spindle speeds ranging from 30,000 rpm to 42,000 rpm. When using these machines, a super-rigid setup is needed because the machine needs to be able to stay on course when it is moving fast and changing vectors. It is also critical that the toolholder and machine be rigid.

When hard milling, the company applies an oil mist. The oil mist extends

tool life and allows a better surface finish to be imparted.

It is also important for the CNC to process a lot of information quickly because the machine moves so rapidly. It must look-ahead and anticipate the next move. “Otherwise, it would starve for information and consequentially slow the machine down,” said Klett.

Moldmakers starts with the feed recommended by the cutting tool manufacturer. “We found that this is only a general guideline to start out with,” said Klett. “As you gain experience, you know when to step it up or knock it down a little bit. We are at the point now where we are getting pretty good at getting the number right away. It really depends on the length of the tool and if that tool is cutting with the tip or outer diameter.”

CNC machines offer a variety of parameters that increase flexibility. These parameters are adjustable and can influence the outcome of the part. Moldmakers sets these parameters ahead of time for roughing and finishing so it can derive peak performance from the machine. Adjustments can be made at

the machine, if needed.

Moldmakers uses shrink-fit toolholders because tool life is increased. The toolholders maintain the accuracy, balance and rigidity needed for hard milling, even for smaller diameter tools.

Moldmakers uses mostly solid-carbide tools and inserts when hard milling. “We typically use higher-quality cutting tools,” said Dennis Barkow, CNC specialist.

The inserts have to be held in a solid-carbide tool body because an HSS tool can expand at the same rate as the holder, depending on the induction unit. If this occurs, the chances are slim that the HSS tool is going to come back out, rendering the holder useless for future projects that require a different tool.

The company has tested several different cutting tools. However, the tools are constantly evolving and Moldmakers has to keep tweaking its processes. Cutting tool companies alter the coating, substrate or grind to allow for more rapid stock removal.

“We try to push the tool to its recommended chip load,” said Klett. “Sometimes, the machine does not necessarily get up to the feed rate it is programmed for and it is difficult to control that continuously. Our experience allows us to compensate for this.”

Programming

All of the company’s programmers are toolmakers who have hands-on experience in the shop. New programmers work on the shop floor for 6 months. “It is pretty important that they get to know processes, systems and fellow toolmakers,” said Klett. “We share information pretty openly here. If something is really working well or has room for improvement, we share that info.”

The operator has to have confidence in the programmer so the operator doesn’t have to adjust anything. “But if that does happen, the programmer will be involved,” said Barkow.

He added that there are times when small adjustments are needed, such as changing the spindle speeds, but not for any extended period of time. “If you have to do it for an extended period that

means the cutting tool is rubbing too much or the chip load is too high,” Barkow said.

Many of the company’s hard milling jobs run overnight or on the weekend. Verification software is used to double-check all programs before running to ensure that everything will meet the

job’s specifications.

In addition, toolmakers have the ability to check on jobs from their homes with a video feed.

“Everyone has a workstation at home so we can control the machines on the shop floor without having to actually be there,” said Barkow. “The ma-

chines have cameras on them so you can call up a job and see that part, and even fix it, all from home. I will check on it every once in a while, just for peace of mind.”

That is also one of the lessons Mold-makers has learned—it pays to have dedicated employees.