



The Economics of Using Ultra High-Performance Toolpaths: McMillan Machine Company Sees Windfall of Savings Using VoluMill™ Toolpaths

THE BUSINESS

Machining components for the firearms manufacturing industry

THE CLIENT

McMillan Machine Company
Phoenix, Arizona
www.mcmillanusa.com

TOOLPATH

VoluMill™ from Celeritive Technologies, Inc.
www.volumill.com

The Business Challenge

When a Navy Seal takes aim at a target through the scope of his TAC™-50 McMillan Tactical Rifle, he does so with confidence in his weapon-maker's nearly 40 years of precision firearms manufacturing.

Gale McMillan, founder of the seven-entity McMillan family of companies, began producing firearm stocks in 1973 for his use in highly demanding and competitive bench-rest shooting matches. Fellow competitors, always in search of the next competitive edge, asked him to produce stocks for their rifles as well. From these roots, McMillan has grown into one of the most well-known and respected brands in the firearms industry.

In 1987, McMillan decided he could save time and money while improving quality by producing firearms hardware in-house, rather than buying, dismantling, and rebuilding components from Remington. McMillan Machine Company was born.

"It ballooned from there," said Duncan Davis, general manager of McMillan.

"Then we started building the .50-calibers, which is the firearm for which McMillan is best known."

Although McMillan has produced aftermarket parts for Harley-Davidson and components for Cessna, the company primarily machines parts for weapons systems. Barrels, firing components, housings, chassis, mounts, adapters, and couplers comprise the majority of McMillan's workload. McMillan Machine Company is one of seven companies in the McMillan family, which also includes McMillan Fiberglass Stocks, McMillan Operator Development, McMillan Firearms Manufacturing, McMillan Tactical Products, McMillan Hunting Products, and McMillan Group International.

The Business Solution

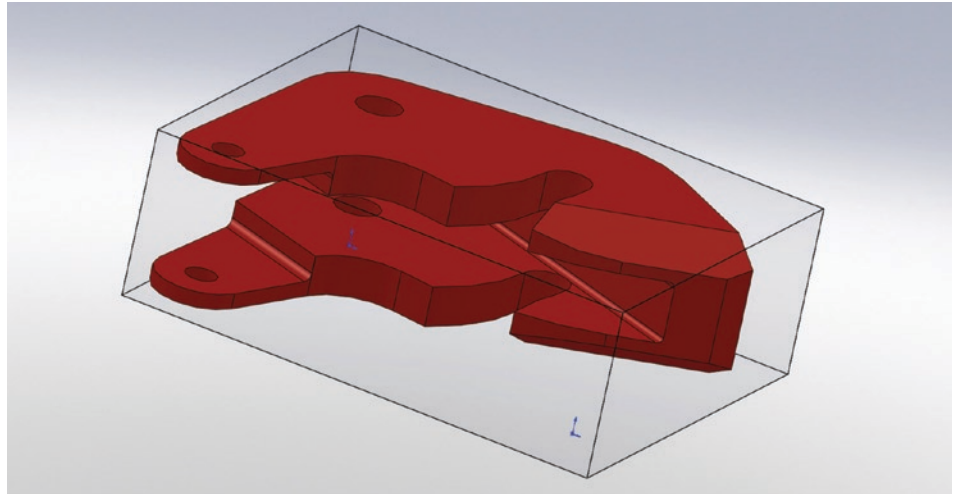
The McMillan dedication to quality and continuous improvement that has made its products the weapons of choice for America's elite troops led it to try a new advancement in manufacturing software—the ultra high-performance toolpath engine VoluMill™.

“We decided to purchase it after the first week. It impressed us enough right off the bat that I didn’t even bother looking at other options. It did more than I expected it would do.”

Duncan Davis, General Manager, McMillan Machine Company

VoluMill is a plug-in toolpath engine used in place of traditional roughing methods when ease of programming, reducing cycle times, extending tool life, and reducing the stress on machine tools is a priority. This easy-to-use software program dynamically manages material removal rates to keep an even and user-controllable load on the cutting tool. Ideal machining conditions are established and maintained throughout the program for any combination of part geometry, material, machine, and cutting tool. Machine tools are fed commands that enable them to operate at peak efficiency levels, enabling the use of machining parameters that both reduce cycle times and extend cutting-tool life.

“I like to try the latest and greatest new stuff,” Davis said. “I’m always curious to see if I can do something better.” According to Davis, VoluMill is something better. “We decided to purchase it after the first week,” he said. “It impressed us enough right off the bat that



This titanium part took just 30 minutes with VoluMill™ toolpaths.

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Davis put VoluMill to work on a 6Al4V titanium mount component that required a lot of rough machining and was hard on tools. “The results were so dramatic that the one order paid for the software,” Davis said. “It’s been all profit after that.”

Davis said the titanium part previously took 80 minutes to rough, at 1,225 RPM and 6.25 IPM, using a .315” axial depth of cut and a 0.220 radial depth of cut with traditional parallel offset toolpaths. When ultra high-performance toolpaths were applied, the radial depth of cut was reduced to 0.035” using the same 1/2-inch diameter, 5-flute, solid-carbide end

Application Parameters

Material: 6Al4V Titanium

Machine:
3-axis Vertical Machining Center

Tool Holder:
Techniks® BT-40 Side Lock

Coolant:
QualiChem® Xtreme Cut 251C

	OLD PARAMETERS	NEW PARAMETERS
Toolpath	Parallel offset	VoluMill™
End Mill	5-flute solid carbide	5-flute solid carbide
End Mill Dimensions	500 diameter with 1.25" LOC and .030 corner radius	500 diameter with 1.25" LOC and .030 corner radius
SFM	160	400
RPM	1,225	3,056
IPM	6.25	100
ADOC	.315"	1.180"
RDOC	.22"	.035"
MMR	.433 CIM	4.13 CIM
Tool Life	4 parts per tool	40 parts per tool
Spindle Load	Up to 80%	Steady 18%
Cycle Time	80 minutes	30 minutes

“We ran a total of 40 pieces (using VoluMill™ toolpaths). We were able to save an estimated \$4,800 in machining time and an additional \$2,400 in tooling cost.”

Duncan Davis, General Manager, McMillan Machine Company



A VoluMill™ toolpath in the process of reducing a 28-pound block of 17-4 stainless steel into a 2.8-pound weapon-mount component.

mill, but the axial depth of cut was increased to 1.180”, the spindle speed to 3,056 RPM, and the feedrate to 100 IPM. The use of the new parameters, which would not even be possible with traditional toolpaths, produced a nearly tenfold increase in the material removal rate, reducing the roughing time to 30 minutes, a savings of 50 minutes per part. Tool life was also extended tenfold, from four parts per tool previously to the current efficiency level of 40 parts per tool.

A new part, which required machining a 28-pound block of 17-4 stainless steel down to a 2.8-pound finished part took two hours. The bulk of the material removal took one hour and 15 minutes. Before using VoluMill, Davis said that per their established practices, he would have used a series of five indexable tools and estimates that the first tool alone would have taken two hours

and 20 minutes. “We ran a total of 40 pieces,” Davis said. “We were able to save an estimated \$4,800 in machining time and an additional \$2,400 in tooling cost.”

McMillan has utilized VoluMill ultra high-performance toolpaths on several jobs that were already in the shop with the prices previously established. “We reprogrammed some jobs that were not so profitable in the past,” Davis said. “I can now manufacture them more efficiently and get to a good margin.” He said that his programming team most recently re-programmed three different parts using VoluMill and the resulting savings added up to \$8,400.

The VoluMill™ Advantage

VoluMill’s positive impact on the bottom line extends far beyond mere cycle time improvements. It affects programming time, tool life, energy consumption, machine tool spindle life, coolant longevity, and labor. According to Davis, it even makes his job quotes more accurate, which saves on lost shop hours.

“It’s safe to say that we see a 5 to 10 percent savings in lost quotes,” Davis said. “I quote more accurately now. Since VoluMill is so quick and easy to use, I’ll generate a couple of simple geometries in our CAM system and run VoluMill on them just to look at the run times. So I’ve already got part of the job programmed before I even get it and it only takes 30 minutes to give me a ballpark of where I’m going to be on run time. If a customer gives me a model on which to base my quote, it’s even better.”



VoluMill™ toolpaths were used to machine this receiver for McMillan’s famous .50-caliber BMG 50 rifle.

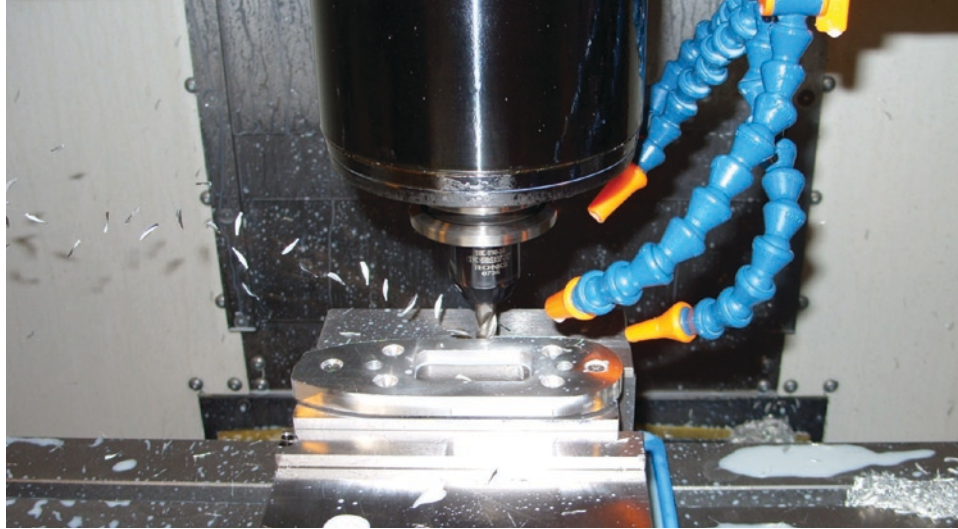
Davis estimates that in the first four months of using VoluMill, he saved \$5,000 in programming time and 200 hours—or \$16,000—in cycle time. The increased tool life that VoluMill toolpaths provide has saved \$3,000 in cutting-tool costs. Furthermore, Davis said McMillan likely saves 65 percent on energy costs when running a VoluMill toolpath since the machine is running more efficiently and for less time to complete a job.

McMillan’s coolant bill also has decreased, by 20 to 25 percent. “We’re keeping things a lot cooler with the consistent tool load and by taking the shallower radial depths of cut, and the solvent isn’t breaking down as fast and is lasting a lot longer,” he said.

Jobs using VoluMill toolpaths are creating savings in man hours, which can then be deployed to other projects.

"In every VoluMill™ sale I've made, it's paid for itself in the first job or two. It's probably the most dynamic and important CAM development in many years. Every one of my customers who has tried it has bought VoluMill."

CAM Reseller



Chips fly as a VoluMill™ toolpath goes to work on a component at McMillan.

Davis said McMillan saves \$900 to \$1,000 per week on labor costs when a VoluMill job is running. "The operators can get that many more jobs done due to VoluMill," he said.

An obvious but difficult-to-quantify benefit is VoluMill's impact on machine-tool wear. Davis said VoluMill toolpaths reach a maximum spindle load of 18 percent in titanium, compared to 70 to 80 percent using traditional

toolpaths. "Common sense tells me that it's saving wear and tear on our machines," Davis said.

The CAM reseller that introduced McMillan to VoluMill is a firm believer. "In every VoluMill sale I've made, it's paid for itself in the first job or two," he said. "It's probably the most dynamic and important CAM development in many years. Every one of my customers who has tried it has bought VoluMill."

Celeritive Technologies, Inc. was founded to develop and market advanced productivity-improving CAD / CAM technologies. VoluMill™ is a patent-pending ultra high-performance toolpath engine that significantly increases machining productivity and tool life. VoluMill is a full-featured, CAM-neutral, 2- and 3-axis toolpath engine for any geometric configuration. For more information, visit the VoluMill web site at www.volumill.com.

For more information and to take advantage of the 15-day free trial offer, visit the VoluMill™ Web site at www.volumill.com

