How-to

# 8 Facts You May Not Know About … Milling Titanium

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## What You Need To Know

Overheating can be a problem.
Finding a safe speed means creating a better product.
Coolant pressure, volume and method of delivery matter.

**These insider tips will make you more comfortable with machining titanium.**

Titanium is a curious metal. It's nontoxic and resistant to corrosion. It has the highest strength-to-weight ratio of any metal, and it has a relatively low modulus of elasticity. And yet, working with it can be quite challenging. With all of its attributes, titanium is also a poor conductor of heat, has a tendency to acquire surface damage when certain machining techniques are used, and it requires substantial patience from machinists.

These reasons have bolstered titanium's reputation as a difficult metal to machine, but many manufacturers are finding ways around the challenges. With the correct methods, titanium can be machined and used with outstanding results.

We challenged industry experts to reveal eight surprising facts about milling titanium that you may not already know.

### Titanium can catch fire during milling.

Even if it doesn't combust, it can still overheat to the point where equipment is damaged and the process stalls. Tim Marshall, milling product manager at Kennametal, says titanium overheats because, unlike steel, it does not form chips that disperse heat easily from the surface when machined. As a result, thermal cracking can happen when tools cycle between higher and lower temperatures.

## Machining titanium involves chatter.

When tools begin to chatter, they move back and forth forcefully and cannot only damage the quality of the product but also the quality of the tools. The life of titanium-machining tools is typically 45 to 90 minutes. In an interview in *Modern Machine Shop*, Brian Hoefler, an advanced engineering manager at Sandvik Coromant, said machinists can prevent chatter by making sure there are stiff surface connections between tools and their tool holders. Using tools with eccentric reliefs, also known as margins, can help eliminate the chatter altogether.

## Patience is the virtue of choice.

Working with titanium, you may experience overheating, product quality issues and damaged tools and equipment. Marshall says slowing down the milling process to a safe speed can keep the heat accumulation under control, increase tool life and produce a better product. He suggests machining titanium from 135 to 175 feet per minute.

## Select the right tool for the job.

Marshall explains that carbide-grade milling tools with physical vapor deposition (PVD) coating are the most effective choices when milling titanium because they handle coolant more effectively than other coatings do. It also works best when the tool is sharp. He recommends using a positive geometry and a strong insert. Hoefler also suggests that new-generation, high-speed steel or titanium aluminum nitride (TiALN)-coated carbide could be good choices for some applications.

## Metal removal rates can be accelerated.

When milling titanium, Hoefler recommends using a tool with a ***fine pitch*** or a corncob tool. The geometry of these tools improves their metal removal rate. Plunge roughing, a machining technique that involves taking a rough pass to deliver faster results, can also speed up the process. However, after taking a quick first pass at removing material, machinists should clean up the imperfect surfaces that roughing typically creates.

## Tool innovation allows for light cuts and high speeds.

Some tools are optimal for taking light cuts and high feed rates. Marshall recommends Kennametal's 7792 milling cutter from the Stellram product line. It does not take a high axial depth of cut and promises to remove the highest volume of metal in the shortest time.

## There's a trick to removing large batches.

When removing large amounts of titanium at once, Marshall thinks Kennametal's 5230 end mill is a good option. A long-edge rougher, otherwise known as a Chevron, has 60 to 70 inserts and removes stock aggressively.

Coolant levels need your attention.

A wide variety of water-soluble coolants can control the temperature during titanium milling, but the delivery and amount used are also important. Marshall says a recommended coolant concentration level should be 9 to 12 percent. The coolants provide lubricity, which makes machining much easier.

*How are you using titanium in your shop?*