Machining

Five Questions: Challenges in Machining Titanium

Interview With Brian Hamil, Vice President of Product Development at KYOCERA SGS Precision Tools | Mar 22, 2019

Is Titanium used in the automotive market?

It is, although I see it used more in the aftermarket, racing or high-performance segment of the automotive industry along with motorcycles versus typical automotive production. I see it in areas of high-output engines such as valve train components, i.e. valves, valve springs, valve spring retainers, rocker arms, wrist pins and connecting rods. Titanium is also used for other racing applications where high strength and light weight is desired.

What are the advantages in using titanium in high-performance applications?

Anytime you can reduce weight without sacrificing strength, you are gaining performance. Performance can be improving MPG, increasing payload capacity or decreasing lap or run times in racing. There are reports showing for every 100 lbs. in weight reduction you can improve MPG by 1-2%. In high-performance engine applications, the less rotating mass you have, the less parasitic loss you have in order to generate horsepower to race with.

Is there a reason it's not used more in general automotive production?

High costs and sourcing challenges are the key deterrents. Titanium compared to steel alloys can be 20 times more expensive per pound than steel. Combine this with machining challenges and the cost per component can get high. For example, I looked at a racing parts catalog and a set of 8, 4130 steel alloy connecting rods was shown at $250.00 where a similar set of titanium connecting rods was shown at $6000.00.

What are the "machining challenges" you mentioned?

The high density and modules of elasticity are the features that make titanium desirable but these are also the things that make it challenging to machine. Titanium can be machined efficiently if correct cutting parameters and cutting tool geometries are used. In general, you would machine titanium at 40% of what you would machine steels. Overly aggressive machining in steel has little consequences except to wear out your tooling faster. If you get too aggressive when machining titanium, you can develop an oxide surface layer that can lead to part failure. We know that it takes heat and pressure to generate a chip; when the heat gets excessive it can generate this oxide. Great care in the machining process with coolant placement and cutting tool geometry are contributing factors in how much heat is generated. Higher positive rake angles and higher helix angles, like the ones in our Z-Carb series of tools, help to reduce the pressure it takes to generate a chip, therefore reducing the heat. It's challenging to maintain sharp cutting edges that reduce the generated heat with proper cutting-edge strength in order to be as productive as possible.

Do you see any opportunities for an increase in titanium usage?

Yes, the titanium industry looks for new opportunities in the automotive market, including exhaust, body panels, and suspension components. The cutting tool manufacturers continue to advance the tooling used to improve the productivity and reliability of machining titanium.