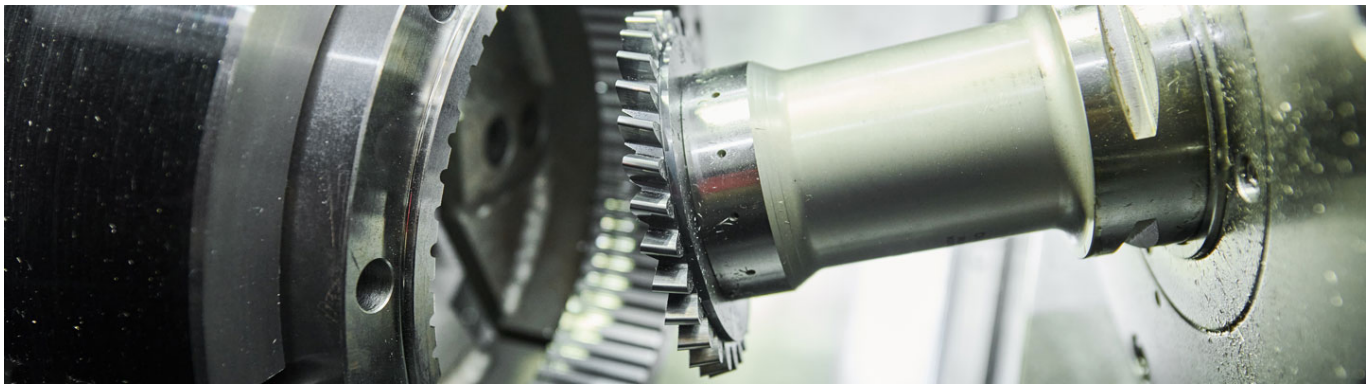


Machining

3 Cutting Tool Advances in Electric Vehicle Manufacturing

Kip Hanson | Apr 12, 2022

As automakers retool for the shift to electric vehicles, cutting tool manufacturers follow suit with advanced designs and high-performance materials.

The market for electric vehicles (EVs) has grown dramatically over the past decade and ***will probably keep expanding***, thanks in part to government incentives and global climate-protection pacts. To meet this demand, cutting tool providers are developing new designs, geometries, substrates and coatings that will benefit not only EV producers and their tier suppliers but also the general machining market.

Leading cutting tool manufacturers give a glimpse of what's here, what's coming down the pike and how all of it will benefit machine shops, even those that don't service the EV market.

Lighter Weight

One tool from ***Kennametal*** represents a harmonious marriage of EV manufacturing, 3D printing and the ***automotive industry's desire to increase productivity with multipurpose cutting tools***. The RIQ Reamer tool is used to cut three diameters at once in the bore containing the rotating stator in aluminum electric motor housings. Constructed of a carbon fiber tube between a pair of 3D-printed cutter bodies, each containing a series of polycrystalline diamond (PCD) inserts, the tool weighs just 16 pounds, despite the fact that it's about 10 inches wide by 16 inches long.

Addressing Disruption

There is a high degree of disruption in the automotive industry right now, and electric vehicle (EV) components are significantly different than those used in internal combustion engine vehicles, says Brent Marsh, business development manager in the automotive segment for the Americas at ***Sandvik Coromant***.

"Motor housings and battery racks are now coming into play, and every manufacturer has a different concept," he says. "Some use one central motor to drive all wheels, some have separate front and back motors, and others have a motor on every wheel. There will be a significant amount of tooling and retooling as these concepts evolve over the coming years. Also, additive manufacturing for both prototypes and production components is coming on strong."

Marsh explains that advances in diamond-like carbon (DLC) coatings are constantly improving. Laser cutting and edge preparation in polycrystalline diamond (PCD) tools are becoming the norm, as these are needed to efficiently machine the various types of aluminum alloys used in castings, forgings and extruded components. Also, regarding the steel gears, shafts and bearings common to electric vehicles and internal combustion engine vehicles, advances in carbide grades have been and will continue to improve.

"In addition, gear manufacturing will bring about an increase in power skiving tools and machinery, as this method provides more flexibility in retooling versus older, more expensive dedicated processes like internal broaching," Marsh says. "Power skiving cutters in solid and indexable carbide designs are available for gear manufacturing and are perfect for the many EV powertrain components coming online."

For facilities that might soon be producing these and other EV components, Marsh has several suggestions:

- Focus on flexible machining concepts, and be ready to adapt to shortened product life cycles.

- Think about machines that are faster in terms of feeds and speeds to handle the aluminum components.

- If you make gears, take a hard look at power skiving, and consult with experts before buying machines.

- Stay lean and focus on reducing waste.

Read more: How to Reduce Production Costs in the Automotive Industry

Christoph Kurth, Kennametal's manager for global end-market strategy in transportation, explains how the company used 3D printing to develop this innovative cutting tool that reduces cycle time up to 50

percent. “Quite simply, it would have been impossible to produce a tool of this diameter with six insert pockets without additive manufacturing,” he says. “It’s a great example of what we can do with our in-house 3D-printing capabilities, which we leverage whenever we can benefit the customer.”

> **“Multipurpose cutting tools are common in the automotive industry, as they dramatically reduce cycle time. This is just as important with electric vehicles as those using internal combustion engines.”**
> Kyle Matsumoto
> OSG

In this case, Kennametal used 3D printing to produce a tool light enough for automatic tool changers to carry, thus eliminating the need to invest in new equipment. It also made possible the creation of internal passages to channel emulsion-type cutting fluids and ***minimum quantity lubrication, or MQL***, a greener and more cost-effective alternative that is increasingly popular with automakers.

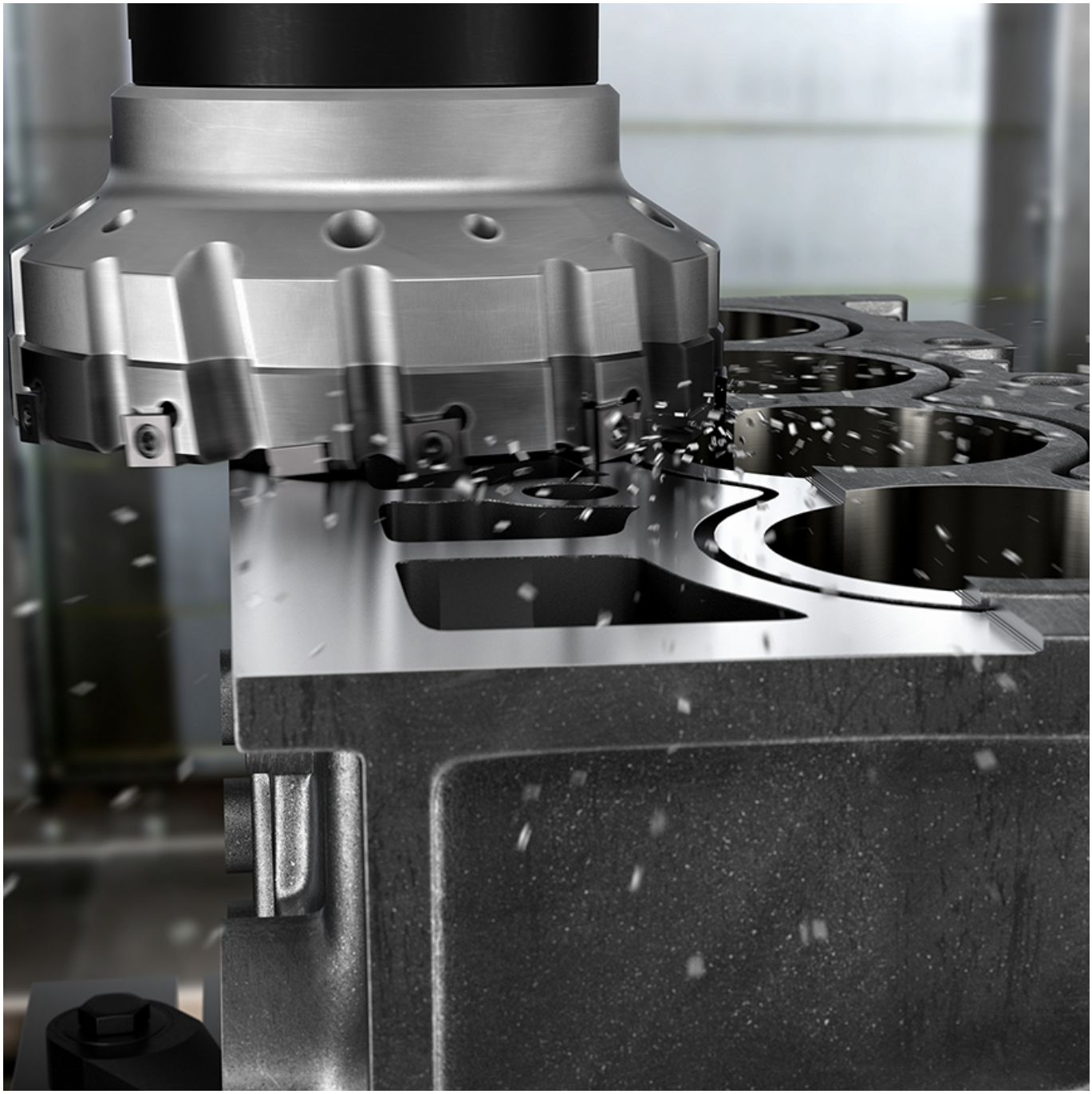
Kurth adds that special tools such as this are nothing new in the automotive market, although the RIQ Reamer has clearly raised the bar on what’s possible. Nor is the use of PCD inserts and round tools anything new, as these are the most productive and cost-effective means to machine large quantities of aluminum, especially the abrasive, high-silicon alloys common in automobiles of all kinds.

Cutting More Freely

Mike Hafke sees much the same thing. The vice president of sales and marketing at ***Guhring*** says there are far fewer parts in an electric vehicle compared with an internal combustion engine vehicle and automakers, therefore, require fewer cutting tools. The tools they do need, however, are sometimes large and bulky but must cut efficiently. Hafke, like Kennametal’s Kurth, suggests that 3D-printed cutter bodies are becoming fairly common, and that PCD inserts continue to play an important role.

“The automotive OEMs [original equipment manufacturers] and their tier suppliers obviously own a lot of machine tools geared toward traditional components, and rather than replacing all that equipment, they’re very intent on repurposing it,” Hafke says. “Unfortunately, many of these are lighter duty machines, so we find it’s necessary to lightweight the tooling by 3D printing the cutter body or using carbon fiber. Not having enough power can also be an issue, so PCD is practically a must, but the geometries must often be modified to further reduce cutting forces. Whatever we can do to get the weight out of the tools and make them cut freely.”

Read more: Automotive Industry Trends: 3 Things to Watch for in Electric Car Manufacturing



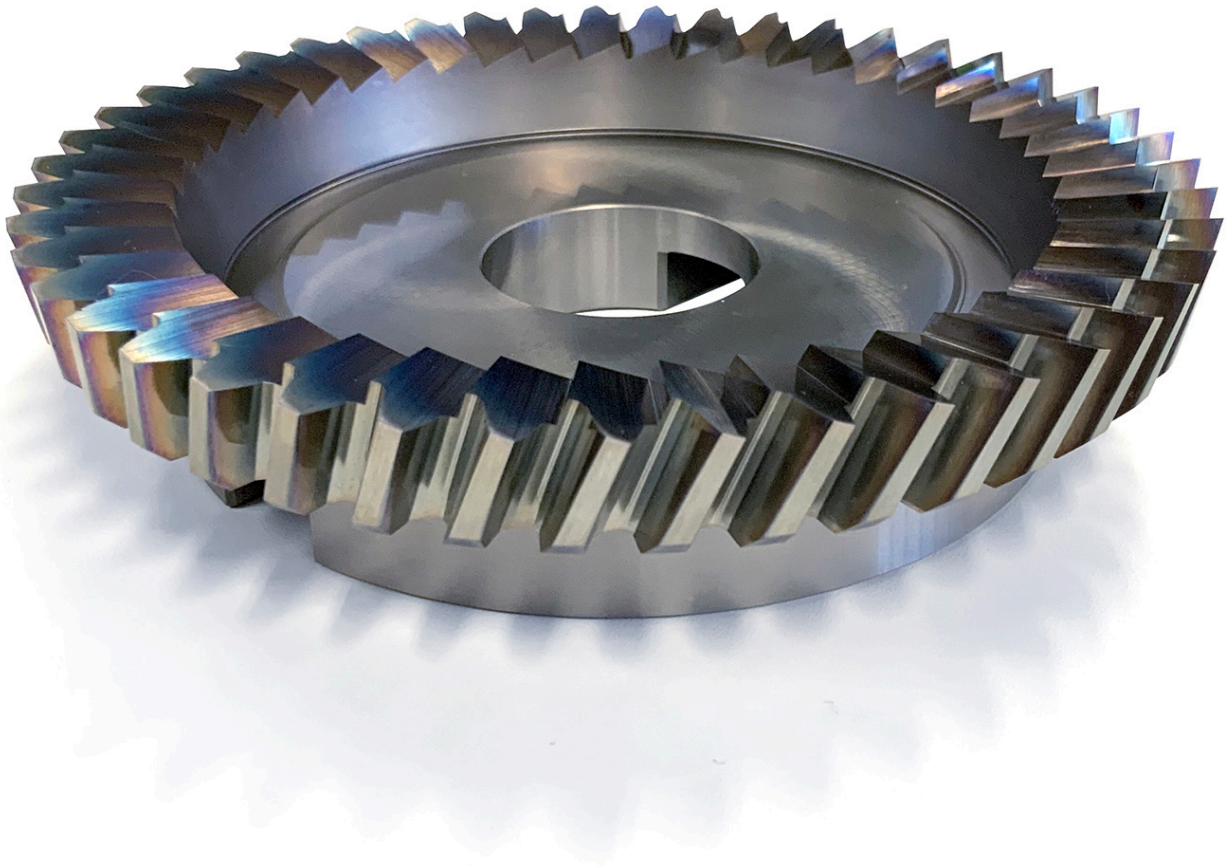
The M5 series of cutters are good examples of milling tools designed to increase productivity and provide high-quality, burr-free surfaces in aluminum components. (Image courtesy of Sandvik Coromant)

In one example, Guhring was asked for help with an 11-millimeter-wide slotting application that had a substantial overhang on a machining center with an HSK 63 spindle, resulting in chatter and tool deflection. The solution was to reduce the cutting forces as much as possible by using positive rake PCD inserts split into two 6-millimeter-long segments and then eliminate any remaining vibration by installing an oil-encased damping element inside the tool shank.

The battery housing is another common EV component. Hafke explains that although the pockets holding the hundreds of individual cells need little machining, each has mounting points or holes for wiring that must be drilled and sometimes tapped. Right-angle attachments are required here, but the extremely long overhangs and slender tool design make it challenging to meet positional and diametrical tolerances. Once again, Guhring made special modifications to meet that challenge. “Situations like these are fairly common in the EV environment,” Hafke says.

Faster Production

OSG is also heavy in the EV market, notes product manager Kyle Matsumoto, who claims that battery housing holes can be drilled and tapped in a single operation using one of the company's AT-2 R-SPEC thread mills. "Multipurpose cutting tools are common in the automotive industry, as they dramatically reduce cycle time," he says. "This is just as important with electric vehicles as those using internal combustion engines."



When used on CNC multitasking lathes, the skiving process provides greater flexibility than older dedicated machinery. (Image courtesy of OSG)

Matsumoto lists several additional tools popular with EV automakers: the TRA-HO 3-flute drill and a pair of cutting end mills: the AE-VTS and AE-TL-N. All have diamond-like carbon (DLC) coatings, and all are designed for nonferrous materials. "We're also seeing increased use of carbon fiber composites, fiberglass and metal hybrid materials," he says. "Each of these requires solutions not unlike those developed for the aerospace industry over the past decade or so."

OSG applications engineering manager Jeff Stephens adds to the discussion, stating that the gear manufacturing process is also changing, although this is due more to new machine technology than the growth of electric vehicles. "Companies like DMG Mori and Mazak have introduced skiving and hobbing capabilities to their multitasking lathes, which is opening up opportunities for some of the tier suppliers who might not have dedicated gear-making equipment," he says. "We support these customers as well with special cutters that bring a lot of flexibility to their operations."

Which of the above EV cutting tool advances does your facility need the most? Let us know in the comments below.