

L A S E R

F O C U S

BY JERRY SOVERINSKY PHOTOS BY STEVEN KARL METZER

*Reliance Tool partners with Seco Tools to perfect the difficult task of machining ceramic bearings.*

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**It's the first day of spring and the shop room at Reliance Tool & Manufacturing Co. is buzzing with activity. The impressive industrial facility in Elgin, USA, 60 kilometres west of Chicago, is a seemingly endless array of advanced stamping and assembly machines, grinders, borers and presses.**

Skilled tradesmen oversee the synchronized operations, while a chorus of percussive sounds fills the air. Jeff Staes, Reliance Supervisor of Technical Support, and Michael Shea, Technical Specialist for Seco, are standing alongside Reliance's Integrex 200-IV ST Multi-Tasking laser cutting machine, explaining how the machine,

when used with Seco's tip inserts, is perfecting the way ceramic is machined. There's talk of quicker turn times, grind sizes and grain particles, when suddenly the talk turns to Osama Bin Laden.

"When Navy Seal Team 6 went in to find Bin Laden, one of its helicopters went down," Shea says. "While those helicopters are armoured and built to withstand blasts, disrupting oil flow is a different story. If the oil supply to the bearing is cut off, without that lubrication, the helicopters will seize up in 30 seconds, maybe a few minutes at the most."

Replacing those steel or titanium bearings with ceramic bearings prolongs their ability to operate without lubrication.

"In lab tests working without lubrication, ceramic bearings have lasted 40 hours,"



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Staes says. “They’re far more durable and can withstand much higher temperatures. Plus, they’re a lot lighter.”

The story underscores Reliance’s efforts to achieve the Holy Grail of machining: finding a way to cost effectively machine an entire ceramic bearing assembly with other ceramic parts. It’s been a 14-year journey, one initiated by Reliance’s owner, Paul Knowlton.

“We are primarily into mould making and stamping dies, and fourteen years ago, he handed me a piece of ceramic and said, ‘See if you can cut this stuff,’” says Staes. And at that time, applying laser technology to machine ceramic was a whole different concept.”

**THE INTEGRIX HAND** turns ceramic without grinding it, which can be a far more efficient process — when it works. “Machining is a much easier way to make a bearing, but the only way to effectively cut down the size of ceramic to get it into bearing form is to grind it. And making a ceramic bearing by grinding takes days,” Shea says.

The first few years of Reliance’s research

produced minimal progress, and it was clear that it needed a customized solution to help it make headway.

“We were not getting results that we wanted because of the tooling — mainly the cutting inserts,” Staes says. “The laser softened the ceramic and got it into a chemical state where we could cut it, but carbide couldn’t stand up to it because it was too hot. This is where Seco came in and worked to develop a better tip insert, with a cutting edge that could help us get a longer tool life.”

Seco’s solution: the PCD 30M grade.

“At first, we thought CBN would be the way to go because ceramic is incredibly difficult to machine,” Shea says. “We found some decent results with CBN, but we also began thinking about the PCD grades.”

Shea says PCD was initially considered impractical because of its typical use for non-ferrous materials, like aluminium, copper and brass. “It usually doesn’t react well with harder materials like ceramic. But we saw decent success with it, which surprised us,” says Shea.

Meanwhile, back in Sweden, Seco was working on applying new technologies to its PCD inserts, which typically included just one grain size of diamond particle. “We



## About Reliance

For more than 60 years, Reliance Tool has been a leading designer and manufacturer of dies, die components, rubber and plastic mold components and precision metal stamping components for automotive, construction and farm equipment companies. From its headquarters 30 minutes west of Chicago in Elgin, Illinois, it operates one of the most comprehensive job shop tool rooms in the United States.



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## Case data

- **Component:** Bearings
- **Material:** silicon nitride ceramic
- **Operation description:** replace grinding operation with laser assisted machining
- **Machining objective:** make it possible to machine ceramic
- **Machine tool:** VNGA 332 grade PCD 30M
- **Machining data:** cycle time reduced from 5 hours (grinding) to 15 minutes

*“We’ve achieved material removal rates that far surpass grinding.”*

Jeff Staes, Reliance Supervisor of Technical Support

created PCD-30M, which mixes two grain particles — two microns and 30 microns,” Shea says. “The result was both toughness and wear-resistance. Usually, you have only one or the other and this gave us the best of both worlds.”

**SECO FINALIZED THE TIP** about two years ago, and since then, Reliance’s ability to machine ceramic “has improved probably 30-percent to 40-percent” over what it could achieve with anybody else’s product, Staes says. “And we’ve achieved material removal rates that far surpass grinding,” reducing the machining time by as much as 70 percent.

While the progress is impressive, Reliance’s research and development is far from complete. “We’re still refining this process and looking for ways to cut ceramic better; this project isn’t done by any means,” Shea says. “Now that we found a material that will actually cut the ceramic, we’re looking to see if there are ways to enhance tool life and enhance production.”

“I think we’re probably at a seven or eight (on a scale of 1 to 10) in terms of perfecting the process,” Staes says. “The whole thing hinges on the cutting material. This will never be as efficient as machining metal parts because of the nature of ceramic.



## Building a Better Tip Insert

Seco’s PCD 30M multi-micro-grain insert is integral to Reliance’s ceramic machining system. The insert incorporates two distinct grain sizes — 30-microns and 2 microns — inside its tip, which collectively impart superior durability and strength that exceeds other PCD grades — CBN or carbide insert.