Will Rainbow Coating Lead to Manufacturing Gold?

Gear manufacturers have used coated cutting tools to obtain dramatic increases in productivity over the past decade. Titanium nitride (TiN), titanium aluminum nitride (TiAlN) and titanium carbonitride (TiCN) coatings have become the norm for gear cutting tools.

Space Age Concepts of Dayton, OH, claims to have the next generation of coatings for cutting tool applications, and according to company CEO Daryl Blessing, gear manufacturers who have tried it have had great success.

The Laser-Cut 964 Rainbow Coating is made up of 10 elements, which are applied in a single ultra-thin layer by the process of physical vapor deposition. The exact makeup of the coating is proprietary, but the end result is a Rockwell hardness in the 92–94 range, a coefficient of friction of .027 and coating thickness of 65 millionths of an inch.

Because of the number of elements involved and some special processing steps, the coating costs approximately 25% to 30% more than TiN. Also, the coating process takes about 10–12 hours, compared to about 3–4 hours for TiN.

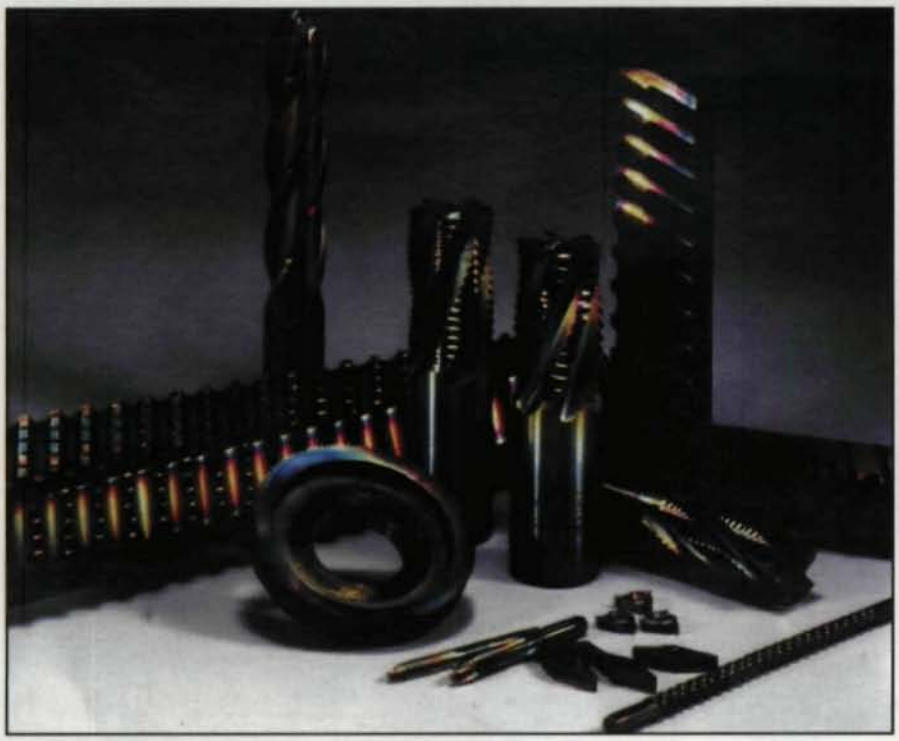
However, the combination of properties achieved allows both faster cutting and increased tool life, Blessing says.

The coating has been applied to all forms of gear cutting tools, including hobs, shaper cutters, broaches and bevel gear cutting blades. "Our gear manufacturing customers get as much as three to four times the tool life before the tool needs resharpening," Blessing says.

Also, because the coating is so thin, gear manufacturers can regrind their tools more times than with other types of coatings, Blessing says. "In some cases, they've seen as many as 10 to 11 regrinds per hob."

The coating can be applied to most cutting tool materials, including stainless steel, tool steel and carbide. Coated tools can be used to machine typical gear materials, such as 4140 steel, as well as a variety of more unusual or exotic materials such as aluminum, titanium or high nickel-content steels used in aerospace and other special applications. "You can basically machine any material that you'd like," Blessing says.

The combination of hardness and lubricity also makes the coating an ideal candidate for dry cutting, either with high speed steel or carbide hobs, Blessing says.



The Laser-Cut 964 Rainbow Coating from Space Age Concepts.

Welcome to* Revolutions, *the column that brings you the latest, most up-to-date and easy-to-read information about the people and technology of the gear industry.* Revolutions *welcomes your submissions. Please send them to* Gear Technology, *P.O. Box 1426, Elk Grove Village, IL 60009, fax (847) 437-6618 or e-mail* people@geartechnology.com. *If you'd like more information about any of the articles that appear, please circle the appropriate number on the Reader Service Card.

The same combination of properties gives Laser-Cut 964 promise as a coating for wear parts. In fact, at least one major automotive manufacturer is using the coating to increase life and improve performance of internal engine parts, Blessing says.

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Carbide Insert Hobbing

Very large gears, those with 3/4 DP for example, present certain problems for gear manufacturers. Such gears could have a tooth height of 3" or more and be 40 feet in diameter. According to Ron Schomann of LMT-Fette, the surface speed of a conventional high-speed steel hob has to be reduced to almost nothing on such a large tooth profile. "If the gear or pinion to be machined has a hardness of approximately 300 HB, the machinability chart for conventional hobbing calls for a surface speed of no more than 10 m/min (33 feet). The corresponding spindle revolution on a 14" diameter hob would then be as low as 8 rpm. With a feed rate of 1–1.5 mm (.040"–.060") and a gear face width of 1 meter (40"), it is easy to imagine that the machining time becomes astronomically long. We are not talking in terms of hours. It takes many days to complete a gear or pinion of these dimensions."

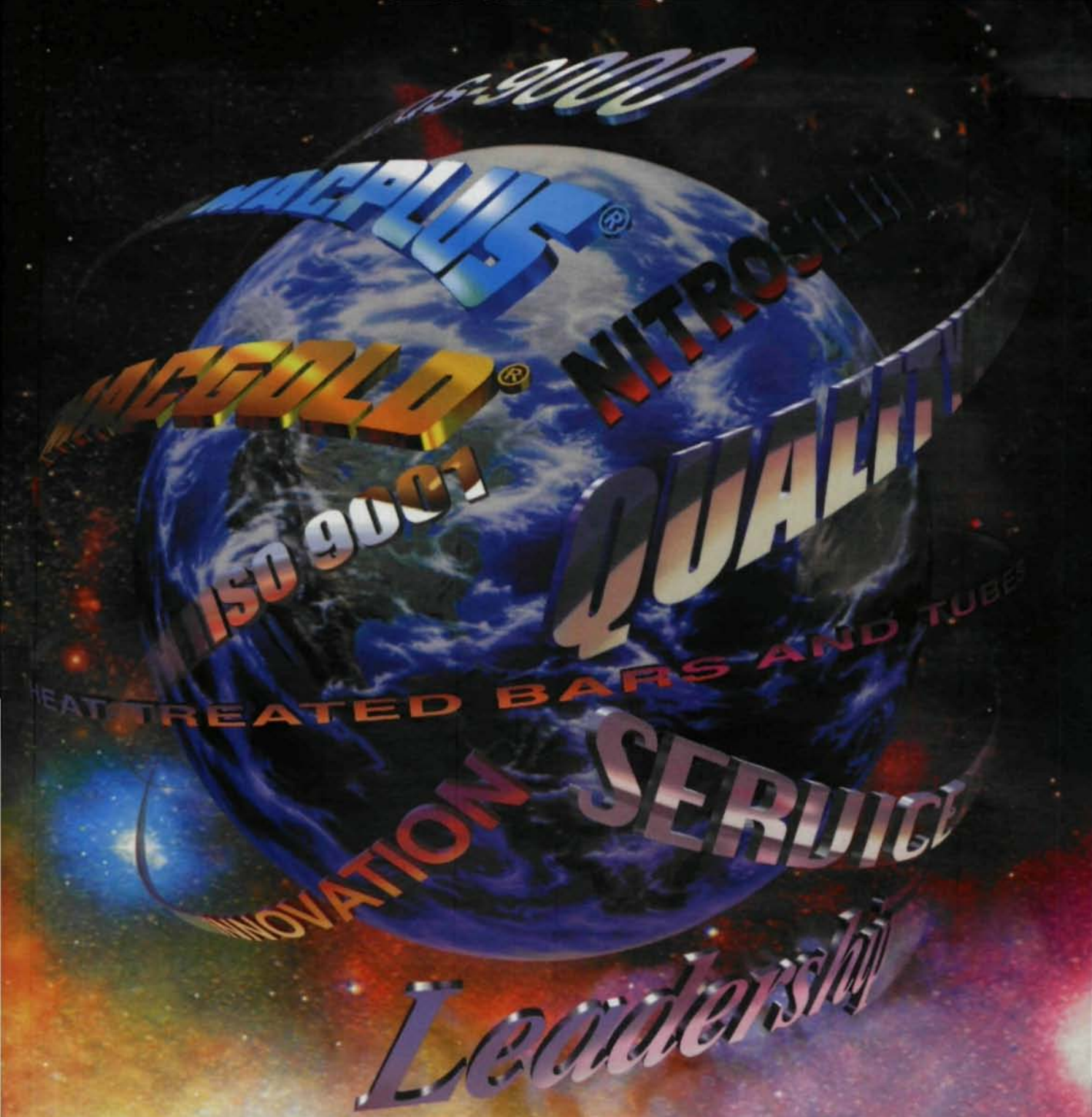
In order to speed up hobbing operations of large gears and pinions, engineers at Wilhelm Fette GmbH, Hamburg, Germany, have developed a unique hob design that uses indexable carbide inserts. The cutter body has a precise helical path on which the tooth segments are accurately placed. To ensure maximum accuracy for the tool, these segments must be precisely machined and placed. For maximum rigidity, the insert seats are arranged tangentially. On hobs for DP 5–2.5 (module 5–10), one long insert covers the entire tooth profile. For DP 2.4 (module 11) and larger, a number of inserts in staggered locations are used to cover the profile. According to Schomann, the design concept, called ICI, is a combination of the known advantages of the hobbing process with the performance of carbide and the economy of indexable inserts.

"Changing and regrinding large conventional hobs is very time consuming and expensive," said Schomann. "Large hobs don't allow the same amount of shift steps as smaller hobs because the pitch is so big, so the wear factor becomes more noticeable. With the ICI hob, the inserts that show the most wear can be rotated or exchanged while the hob stays in the machine." Other advantages to the system, Schomann mentions, include the ability to utilize the four cutting edges on each insert before having to replace it; the option of using different kinds of inserts for different operations, such as roughing, semi-finishing or skive hobbing. This last can be important in the manufacture of large gears and pinions because these components can show considerable distortion or "unwind" after heat treating operations.

"When using an ICI hob for skiving," said Schomann, "the grinding operation that usually follows has a much shorter cycle time because all of the distortion has already been removed." The ease with which these hobs can be repaired, which is often impossible with conventional carbide hobs, is also an advantage. "Hob segments can be exchanged," said Schomann, "which saves the tool from being discarded." The chief benefit of the system, however, is speed.

Tests were carried out by one of LMT-Fette's customers comparing the ICI hob with a conventional high-speed steel hob. The material was steel with a hardness of 330–375 HBn, the OD of the gear was 35", face width was 7" and the DP was 2.8. Three gears were cut with each hob and the results were dramatic. With the HSS hob, the total floor to floor time was 349 minutes. The ICI hob showed no insert wear after the three gears were cut and its total floor to floor time was 79 minutes. According to

An indexable carbide insert hob being loaded for shipment.



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Schomann, after the above tests were carried out, the tool was equipped with carbide inserts for skiving a hardened gear of similar size. "The 60 Rc gear was machined with 248 SFM and .160" feed rate per table revolution," said Schomann. "There was no detectable wear on the TiN-coated carbide inserts after machining eight gears, each with 61 teeth and a face width of 5.5 inches.

The initial cost of ICI hobs is high, but according to Schomann, these tools become economical when you take into account maintenance problems such as tooth chipping, cracking or breakage; excessive flank wear; accidents and downtime due to sharpening. "When all of these factors are considered," said Schomann, "the use of a hob with indexable carbide inserts becomes an economical investment."

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Machine Tool Technology Training Survey

The Tooling and Manufacturing Association (TMA), a local not-for-profit trade association serving 1,600 plastics and metalworking companies and suppliers in the Chicago area, asked its member companies to rank several educational areas for potential entry-level employees. The goal of the survey was to aid school boards and local advisory councils in their decision-making processes as related to manufacturing technology programs. The educational areas designated were academics, manual machining, CNC training and CAD training. The respondents were asked to rank each educational area in order of preference with 1 being the most important and 5 being the least important attribute. TMA received 162 survey responses from member companies and six written responses.

Study Procedure. The study examines the Chicago precision metalworking industry as a group, as well as by individual area. This includes precision machining, moldmaking, diemaking and machine building. The study also examines influencing factors such as company size, manual, and CNC machine use.

Results and Opinions. Chicago area metalworking companies rank manual machining as the most preferred education area, followed by manual machining/CNC training, academics, CNC training and CAD training.

The survey concluded that the best prepared students for the precision metalworking industry should have a combination of manual machining, CNC machining, and CAD training. Students should enroll in math classes stressing algebra, geometry and trigonometry. Science classes such as physics and chemistry are also important.

For a copy of the complete survey, contact the TMA Education Department at (847) 825-1120, ext. 322 or e-mail Dan Kiraly at *dkiraly@tmanet.com*.

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