

ON THE CUTTING EDGE

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The year 2006 was an unusual one for Niagara Cutter. For the first time in recent history, actual sales exceeded the planned manufacturing forecast, leaving the company scrambling to keep up with deliveries. In fact, sales have increased dramatically in the past two years, with significant growth in carbide products. As most business experts would say, "this is a wonderful problem to have." But it is still a problem. In typical Niagara Cutter fashion, we met the challenge head-on with significant investments in new equipment, software, staff and procedures designed to position us for even greater growth in the years to come.

"We have always sought continuous improvement," says company President Sherwood Bollier. "Niagara Cutter's key focus is to provide high performance cutting tools. We want to provide the top quality products at a competitive market price and we want to improve the technology of our products to provide better solutions for our customers."

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The latest improvement process actually began in 2004, with the implementation of new production scheduling software at the Athol, Massachusetts, plant. The software worked so well at that plant that in 2005 we decided to begin implementation in the Reynoldsville, Pennsylvania, plant as well. Due to the size of the Pennsylvania plant and the higher volume of tools manufactured there, this implementation was more complicated and much of 2006 was spent completing training and working out any difficulties in the system.

"Since 1988, we have been in a continuous improvement mode," says David Reiter, plant manager at the Reynoldsville facility. "We needed this new software package to go to the next level." The software is designed to streamline production scheduling and capacity planning so that the plant is always producing the correct tools to meet our distributors' changing requirements.

"The software also forced us to add consistency to the steps of each engineering

continued >



Dedicated New Applications Development Niagara Introduces the MAP® System

New application/product development is the lifeblood of every company, and Niagara Cutter uses a disciplined approach for analyzing new milling applications, and helping you convert these potential opportunities into successful applications. We have developed a highly engineered systems approach called MAP® (Machining Application Process). This systems approach includes: selecting the best combination of engineering

design, substrate material, and appropriate coating technology, along with optimized operating parameters and finally end user training to address the unique requirements of specific machining operations.

The application development work is carried out not only in the machining testing laboratory in Reynoldsville, PA but also in actual field trials at customer sites. Yair Bruhis, Bill Sebring, Dennis Noland, and Kevin

Harriger are heavily involved in these activities. A good example of a recent MAP® development project was the successful development of an efficient tool and optimized operating parameters for machining Ti-5553 (Ti-5Al-5V-5Mo-3Cr) forgings, the alloy selected by Boeing for a number of components for the new 787 to be launched later this year.

Machining studies on Ti-5553 work-piece material, conducted both in

Meeting the Challenge of High Performance Milling in Aerospace Materials

Substantial growth predicted in the aerospace industry over the next 20 years has focused attention on the difficulties inherent in machining many new high performance materials. Materials such as aluminum, composites, Inconel, stainless steel and titanium, as well as new high performance alloys, provide greater strength at lighter weights for more fuel efficient airplanes but can impose challenges to machining efficiency.



For example, Boeing's new 787 Dreamliner mid-size, twin-engine jet will use 20 percent less fuel than today's mid-size planes. To achieve this goal, new lightweight, high strength-to-weight ratio materials will be incorporated

into both the airframe and the interior components. Approximately 50 percent of the primary structure will be made from composite materials. Another 15 percent will be made from titanium. Titanium and composites resist corrosion, require less maintenance than aluminum and help the plane consume less fuel. In addition, titanium is often preferred over aluminum because it is more compatible with composites and avoids corrosion problems that occur in aluminum because of galvanic reactions with the carbon fibers in the composite structure. Titanium also offers light weight, great stiffness and strength, and superior heat and fatigue resistance.

Despite its advantages, titanium can create challenges for fabricators. Titanium is generally machined at slow speeds and low feed rates with less than 30 percent radial and low axial depths-of-cut to avoid the risk of heat build-up. As a result, the cost to machine titanium can be 10 times greater than conventional machining of aluminum. A new grade of titanium, Ti-5553 (Ti-5Al-5V-5Mo-3Cr) is now often preferred for key component parts over Ti-6Al-4V because it exhibits excellent hardenability characteristics with superior strength, combined with high fracture toughness and excellent high cycle fatigue behavior properties.



Unfortunately, it appears to be even more difficult to machine than traditional titanium compounds. Here are a few of the challenges in machining Ti-5553:

- Titanium is a very poor heat conductor. With steel-based components, more than 75 percent of the heat generated by the cutting process is transferred to the evacuated chip. With titanium-based products, only 25 percent is transferred to the chip. This creates a greater heat concentration on the cutting tool edge, leading to rapid tool failure or slower cutting speeds and diminished productivity.
- A low modulus of elasticity creates a "springiness" that allows titanium parts to move under the force of the cutting edge, then spring back.

Reynoldsville and in the field, confirmed that this material is more difficult to machine than the traditional Ti-6Al-4V that it is replacing. Testing has indicated that the rough milling operations be done with a high speed M42 cobalt or PM cobalt fine pitch roughing end mill with TiCN or TiAlN coating, operating in the range of 40-60 SFPM at a feed rate of 3-5 IPM. For semi-finish milling a 4 flute solid carbide end mill with TiAlN coating, operating at 70-100 SFPM and 5-7 IPM is recommended and for finish milling, a 6-8 flute solid carbide end mill with

TiAlN coating operating at 400 SFPM and 5-7 IPM.

As a result of this development project, an article was prepared and published in the spring issue of *Aerospace Manufacturing and Design*. Reprints of this article are available by contacting National Sales Manager Joe Sarkees in Amherst, NY at 716.689.8400, or at www.niagaracutter.com (pdf download).

For further information on MAP® and to discuss new potential applications contact Bill Sebring or Dennis Noland in Reynoldsville, PA at 814.653.8211.



- Forged parts tend to be work hardened, presenting very hard, non-homogeneous surfaces, resulting in high cutting pressures and excessive heat generation.
- High chemical reactivity can lead to an undesirable diffusion reaction at the tool-workpiece interface that leads to premature tool wear.

Niagara Cutter is currently working with a number of aerospace companies to develop optimum tool and operating parameters to machine Ti-5553. Extensive testing is being done in the Reynoldsville machining laboratory to explore the role of tool geometries, edge preparation techniques, and the use of coatings to act as a heat barrier in solving these machining challenges. This research is not limited to titanium. Improved stainless steel materials, such as Custom 465 and Project 70+15C5-5Ni, and carbon-reinforced polymer fiber are also literally under the microscope at Niagara Cutter to determine the optimal substrates, tool geometries and coatings needed to create superior solutions to specific machining applications.

The research process begins with machining studies and lab tests. This is followed with on-site testing by Niagara Cutter application engineers

at customer facilities and ultimately with intensive, application specific training to transfer our knowledge to our customers. Few tooling manufacturers offer the depth of research and the commitment to this task that Niagara Cutter has already shown. As with all our customers, we are firmly committed to working with the aerospace industry to make the task of creating lighter, better aircrafts a little bit easier.

Aerospace Materials

Non-Ferrous:

6061-T6
7075-T6
Magnesium (military)

Alloy Steels:

4340
Aeromet 100

Stainless Steels:

416
15-5 PH
17-4 PH

Titanium:

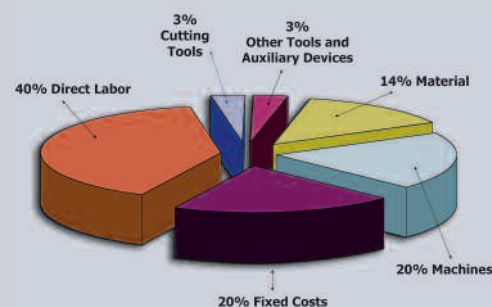
Ti-6Al-4V
Ti-10V-2Fe-3Al
Ti-5Al-5V-5Mo-3Cr (new)

Nickel Base Alloys (high temp):

Inconel-718
Waspaloy
Hastelloy-X

Composites:

Carbon/Carbon Polymer Matrix



Productivity Is What Counts: The True Cost of Tooling

Pressure is always on to reduce the cost of all manufacturing operations. But careful analysis over the years has shown that the cost of tooling compared to the other major costs associated with machining operations is a relatively minor factor.

As the well-known pie chart indicates, only 2-3% of the total machining production cost is attributed to the actual cutting tool, while the major costs are associated with direct labor and cost of machines.

A strong case can be made that the relatively small amount spent on tooling, greatly impacts the efficiency of the 60% spent on labor and equipment. It follows then, that the investment in quality Niagara Cutter tools will maximize the effectiveness of the machines and labor force.

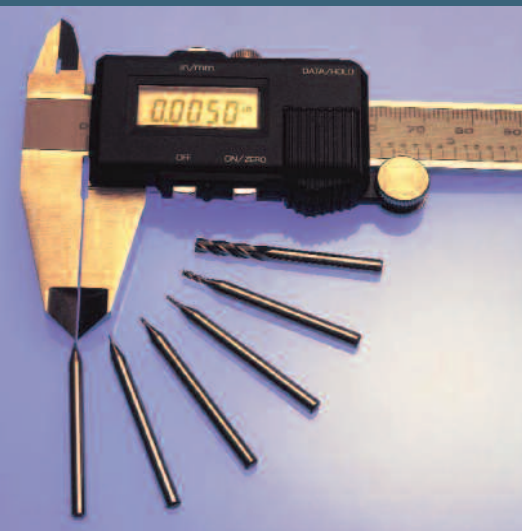
When you choose a Niagara Cutter product with a Microshield™ coating, you achieve optimal tool life and performance.

MicroTools Provide Precision Machining for Miniature and Sub-Miniature Applications

Niagara Cutter introduced its MicroTool line in May 2006. These very small diameter precision carbide cutting tools are designed for use in the electronics and medical machining industries and allow intricate shapes to be created in products such as printed circuit boards and dental or surgical tools. Available in two-flute and four-flute configurations, the MicroTool line includes square and ball-style end mills with diameters ranging from 0.005 in. to 0.120 in.



In addition to the standard uncoated carbide tools, MicroTools are also available with TiAlN coating. This coating has been specially customized to provide a proprietary coating on these remarkably small tools, enhancing tool life and performance.



New Stabilizer™ Increases Productivity In High-Speed Milling

Niagara Cutter's patented Stabilizer™ end mill reduces chatter and increases productivity in high speed milling. Stabilizer typically runs two to four times faster than conventional end mills.

Harmonics, commonly referred to as "chatter," are self-excited vibrations created between an end mill and the work piece. This phenomenon often occurs during high speed milling or when large axial and radial depths-of-cut create the need for high torque or high horsepower. Because of the stress this vibration creates in both the tool and the work piece, chatter typically forces a reduction in speed, feeds and depths-of-cut.



This pre-coating treatment eliminates the "break-in" period common with end mills of the past. This break-in period is typically unstable and unpredictable. Stabilizer creates a stable milling environment from the time of its installation, eliminating the need for reduced feeds and speeds at the beginning of the milling process.

By minimizing chatter through Stabilizer's patented design, we have created a product that allows aggressive speed, feeds and depths-of-cut, even when milling the high temperature resistant alloys common in the aerospace industry. Stabilizer also increases tool life, improves work piece surface finish, reduces axial and radial loads on the machine to improve spindle life, and delivers the predictability and repeatability required in today's marketplace.

Stabilizer is available in three styles: the Stabilizer GP series for carbon and alloy steels and the Stabilizer HT series for stainless, titanium and high temperature alloys. The Stabilizer Plus product includes the new AlCrN coating as standard. This coating has proven to be superior in high heat applications.

If your customer needs to increase throughput, reduce cycle time and machine downtime, and improve surface finish on high-speed milled parts, Stabilizer is the answer!

US06991409B2

(12) **United States Patent** (09) Patent No.: **US 6,991,409 B2**
Noland (45) Date of Patent: **Jan. 31, 2006**

(54) **ROTARY CUTTING TOOL** 6,152,657 A 11/2000 Pickett et al.
6,164,878 A 12/2000 Cookson 407/50
(75) Inventor: **Donald L. Noland**, Hickory, PA (US) 6,802,288 B2 5/2002 Cook
2003/002181 A1 7/2002 Serna

(73) Assignee: **Niagara Cutter**, Amherst, NY (US) FOREIGN PATENT DOCUMENTS
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(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 365 days.

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(52) **U.S. Cl.** 407/60, 407/59, 407/60, 407/61, 407/65, 407/66, 407/67, 407/68, 407/69, 407/70, 407/71, 407/72, 407/73, 407/74, 407/75, 407/76, 407/77, 407/78, 407/79, 407/80, 407/81, 407/82, 407/83, 407/84, 407/85, 407/86, 407/87, 407/88, 407/89, 407/90, 407/91, 407/92, 407/93, 407/94, 407/95, 407/96, 407/97, 407/98, 407/99, 408/1, 408/2, 408/3, 408/4, 408/5, 408/6, 408/7, 408/8, 408/9, 408/10, 408/11, 408/12, 408/13, 408/14, 408/15, 408/16, 408/17, 408/18, 408/19, 408/20, 408/21, 408/22, 408/23, 408/24, 408/25, 408/26, 408/27, 408/28, 408/29, 408/30, 408/31, 408/32, 408/33, 408/34, 408/35, 408/36, 408/37, 408/38, 408/39, 408/40, 408/41, 408/42, 408/43, 408/44, 408/45, 408/46, 408/47, 408/48, 408/49, 408/50, 408/51, 408/52, 408/53, 408/54, 408/55, 408/56, 408/57, 408/58, 408/59, 408/60, 408/61, 408/62, 408/63, 408/64, 408/65, 408/66, 408/67, 408/68, 408/69, 408/70, 408/71, 408/72, 408/73, 408/74, 408/75, 408/76, 408/77, 408/78, 408/79, 408/80, 408/81, 408/82, 408/83, 408/84, 408/85, 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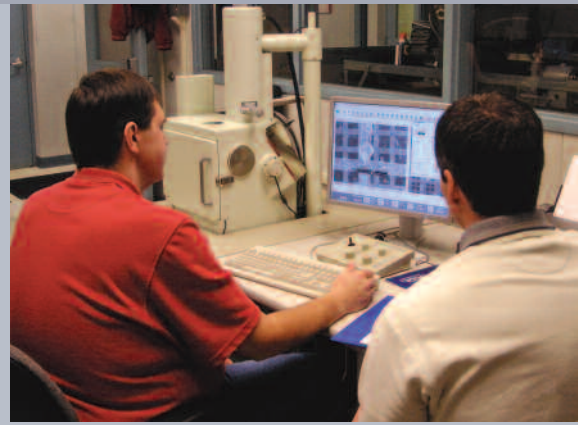
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This microscope offers a 300,000X magnifying power and will take our internal testing capabilities to a new level. This microscope will allow us to inspect tools before and after

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