

## **DEVELOPMENT PROCESS GENERATES GRADES FOR HEATED TIMES**

Technologies such as high speed machining, dry machining and the development of difficult-to-machine workpiece materials will continue to put the pressure on cutting tool manufacturers for development of new products that can perform at higher speeds, provide longer tool life and withstand rigorous operating conditions. Some of the issues caused by these demands include increased temperatures in the cutting zone, where much of the energy applied to the cutting process is converted into heat. And, although the heat generated during the machining process can help make the cutting action easier by reducing the force needed for chip formation, it can also flow into the cutting edge to negatively impact tool life by causing plastic deformation of the tool.

Every machinist is striving to achieve the optimal combination of productivity and tool life, which can become a complex task when cutting at high speeds in harder steels. For operators to take advantage of these machines' high speed capabilities, they must have chemically stable, heat-resistant cutting tools. We are going to concentrate on the role of the insert coatings. The insert plays a critical role in chip formation -- the first step to good chip control, productivity, tool life and reliability.

### **COATINGS CONTRIBUTION**

Coated carbide inserts have long dominated the majority of metal removal operations in job shops due to their wear resistance, chemical stability and high hardness. With the ability to remove large amounts of material across a range of applications while retaining a long tool-life, about 80% of inserts used in machining today are coated carbide grades. Coatings improve wear resistance, increase tool life, and can broaden the functionality of a particular grade as well as allowing for higher machining speeds.

The coating is important, but the coating must also be applied to the appropriate substrate for the insert to achieve the desired characteristic. This multilayer coating technology means that each layer has its own function, be it toughness, wear-resistance, lubricity, etc. So, although the substrate is protected by the coating until there is significant tool wear, its properties have a significant impact on the way the tool and the coating perform. Within this realm, there is a variety of substrate and coating compositions.

There are a numerous approaches to improving the performance of coated products. Fine adjustments to the chemistry in the coating furnaces, more careful structural control of the individual coating layer and even polishing the edges after coating. All are designed to improve quality, productivity or reduce cost.

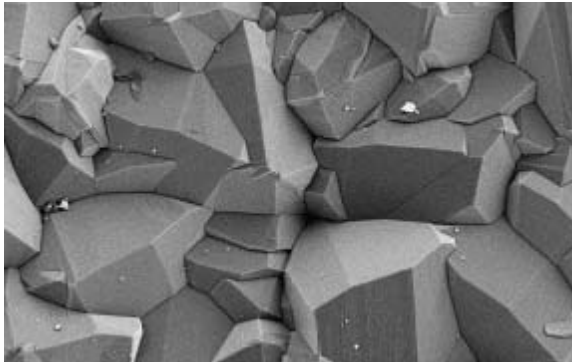
### **TODAY'S BEST TECHNOLOGY**

Advancements in coatings technology have typically been incremental. The rare revolutionary change did come about with Seco Tools' unique Duratomic® methodology, a unique chemical-vapor-deposition (CVD) applied coating. Through extensive research and development, Seco learned how to control the crystallographic texture of the aluminum oxide (Al<sub>2</sub>O<sub>3</sub>) substrate layer. By modifying the coating deposition techniques, the individual crystals that make up the coating are "tilted" to bring a more favorable crystallographic

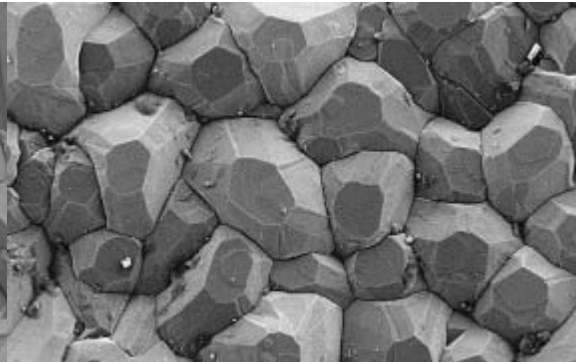
direction into the cut. To use an analogy, think about how diamonds can be cleaved relatively easily in certain crystallographic directions, producing the facets that reflect and refract light and make gems so attractive. However, in other crystallographic directions diamond is very resistant to any form of breakage.

Through this technique, Seco has learned how to control the alumina crystal growth. Essentially, this structural alteration creates a coating that offers improved mechanical and thermal properties in combination with better wear resistance and toughness -- beyond the capabilities of all previous  $\text{Al}_2\text{O}_3$  on the market.

CONVENTIONAL

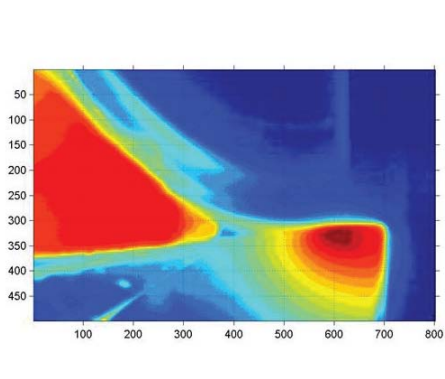


DURATOMIC

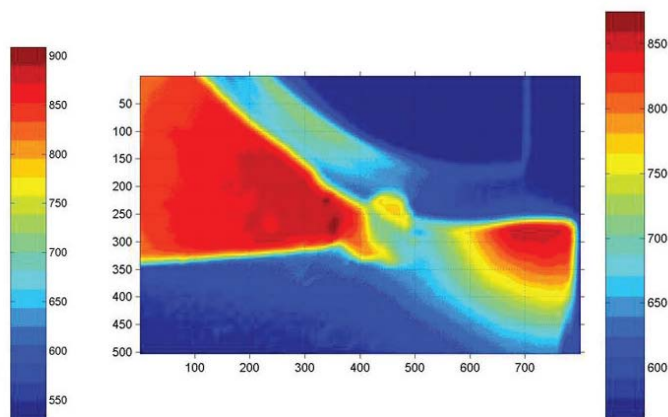


Where conventional aluminum-oxide coatings have a hardness of about 27.5 (GPa). Duratomic hardness is closer to 30.5 (GPa), nearly an 11% increase. This translates directly to an increase in abrasion resistance and, therefore, tool life. The coating also runs cooler – down a full 60°C or over 9%, in a typical application, enough to substantially reduce the tendency (for the insert) to crater.

CONVENTIONAL

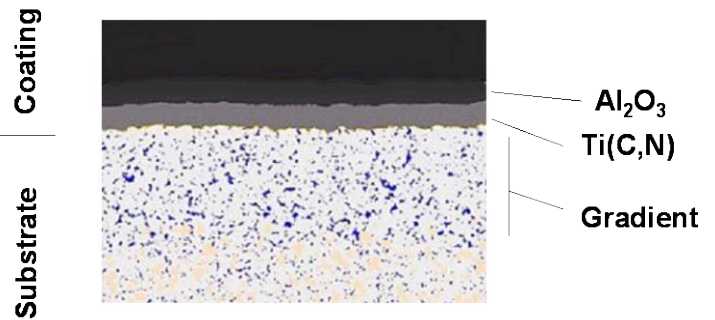


DURATOMIC



Compared with conventionally produced  $\text{Al}_2\text{O}_3$ , the Duratomic coatings shows less crater wear, less deformation of the cutting edge, and longer tool life. When compared with titanium carbonitride (TiCN) coatings produced by MTCVD, or conventional  $\text{Al}_2\text{O}_3$  coatings,

the Duratomic-developed grades consistently show increased flank wear resistance and improved toughness.



The optimized Duratomic coating structure is composed of two functional parts. The inner TiCN base layer is responsible for excellent adhesion and the basic cutting edge strength while the top layer of  $\text{Al}_2\text{O}_3$  acts as an effective thermal barrier to permit higher cutting speeds.

It is the combination of the substrates and coatings, and the fine-tuning within the Duratomic range that has allowed Seco to deliver insert grades that can run faster, longer and suited to a wide range of applications, making them first-choice grades for a variety of turning, milling and holemaking applications ... until now.

### **ROUGHING IT FAST AND HOT**

With its newest turning grade TP0500, Seco has built upon its existing foundation of Duratomic knowledge. But, rather than suited to a wide application range, TP0500 is designed to be the absolute champion of wear resistance in a specific area – high temperature, high speed steel machining where you need to apply the hardest, most wear-resistant grades in order to remove a lot of metal quickly. Although various grades can work in these applications, they would not typically be able to withstand the heat for as long as TP0500 without deformation and cratering. TP0500 allows users to stock one reliable grade for these applications, simplifying inventory and reducing tool change-over.

This is not a universal grade, but when applied to certain applications – such as those where there is a long time in-cut or in high-productivity, heavily competitive environments such as automotive – TP0500 can significantly improve machining data. It is a good choice for producing shafts, forged parts, hub units, flanges or bearings for the power generation segment. An excellent area to apply TP0500 would be in the machining of axle or drive shafts for construction and agricultural vehicles.

### **DOUBLE DUTY**

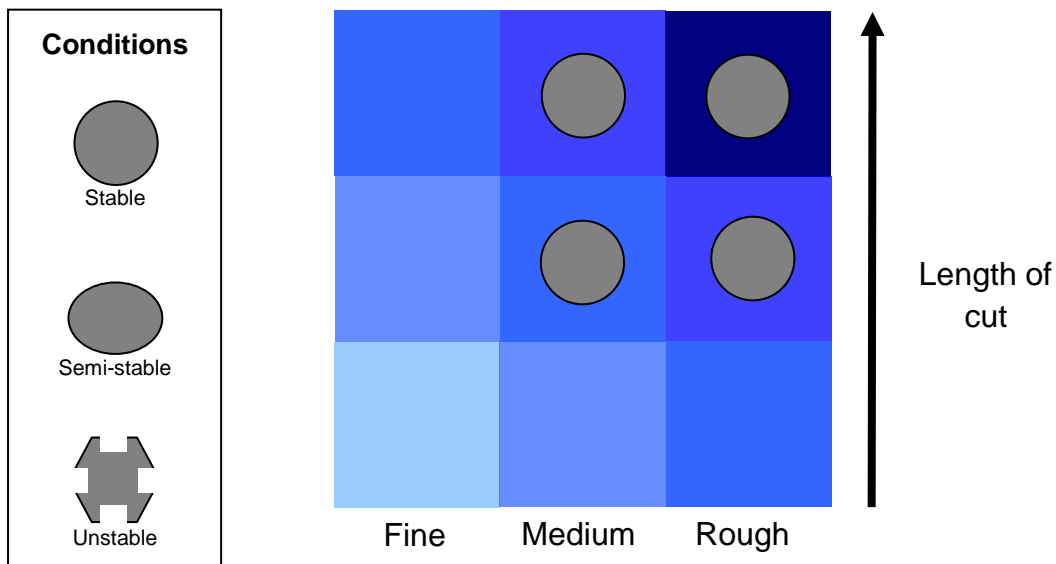
To achieve this level of performance, Seco built upon its existing knowledge derived from the Duratomic grade technology. However, in this instance, it reduced the grain size of the substrate for improved hardness while increasing the Duratomic coating thickness. This means users get the industry's most wear-resistant coating for steel applications sitting on top of a hard, deformation-resistant base layer.

This arrangement withstands tremendous amounts of heat. In fact, heat is a prerequisite to gaining adequate toughness and to reduce chipping tendencies in this grade. It is designed to work at medium high feeds and depths of cut where the bulk properties, not the edge properties, of the substrate are most important.

To determine if this is a grade you should consider, here are some basic pre-requisites:

- Large components (or long time in cut)
- Medium to roughing applications
- Dry machining and long cuts with coolant
- Hard and abrasive steels (up to 40 HRC)
- Ability to run high speeds at stable cutting conditions

### TP0500 Steel Application Areas



The fine tungsten carbide grain structure of the TP0500 substrate has yielded an additional benefit of making it a suitable grade for some applications in cast iron, especially in the ductile (nodular) iron area and where increased speed capability is needed. As compared to dedicated cast iron grades, TP0500 is actually coarser-grained, but this provides an increase in toughness that can handle intermittent operations in these cast iron applications.

In today's highly competitive machining arena, especially in the area of automotive production, the ability to reduce cost per component will be necessary for survival. Tool performance can significantly impact cost per part.

For your business, the newly engineered TP0500 within its application area can provide a solution for increased productivity gains.