




APPLICATION GUIDE: Coatings and Substrates

Coating / Substrate:	TiN Titanium Nitride	AlTiN Aluminum Titanium Nitride	AlTiN Nano Aluminum Titanium Nitride Nano	CBN Cubic Boron Nitride
Application / Benefits:	General purpose coating for machining ferrous materials. Less expensive than AlTiN coatings. Good low cost alternative to AlTiN in applications not generating extreme heat.	High performance coating in ferrous materials. Excellent high temperature resistance and hardness. Maintains high surface hardness at elevated temperatures improving tool life and allowing faster feed rates. Produces aluminum oxide layer at high temperature which reduces thermal conductivity transferring heat into the chip. Excellent in dry machining, machining titanium alloys, inconel, stainless alloys and cast iron.	Premium coating in ferrous materials. Latest generation AlTiN coating. Unique nanocomposite coating structure improves hardness, heat resistance, and toughness over traditional AlTiN coatings. Superior results, extended tool life and reduced cycle times over traditional AlTiN coatings in demanding applications.	Solid CBN tipped endmills designed for finishing hardened steels 52Rc to 68Rc. Use only in applications with light, consistent depth of cut. Run at high RPM and feed rates. Hardness of CBN is second only to diamond, and CBN can withstand high temperatures.
Materials:	Ferrous Materials / Exotic Metals			
	General Purpose Ferrous Materials	Alloy steels, stainless steels, tool steels, titanium, inconel, nickel and other aerospace materials	Hardened steels, hardened stainless, nickel based alloys, tool steels, titanium alloys, inconel and other aerospace materials	Finishing hardened steels 52Rc to 68Rc
Color:	Gold	Dark Gray / Black	Blue / Black	Black
Structure:	Mono-layer	Multi-layer	Nano Composite Multi-layer	Solid Cubic Boron Nitride
Hardness (GPa):	21.7	35.5	45.0	65.0
Coefficient of Friction:	0.5	0.6	0.5	0.2
Coating Thickness (microns):	2 - 5	2 - 5	1 - 4	Solid CBN Tip
Max. Working Temp:	1000° F	1400° F	2100° F	2500° F

PLEASE NOTE: Information and test results were compiled from multiple sources and testing methods. Data presented is intended to be a general application guideline for comparing various coatings / substrates.

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ZrN Zirconium Nitride	TiB ₂ Titanium Diboride	Amorphous Diamond	CVD Diamond	PCD Diamond Polycrystalline Diamond
<p>High hardness, lubricity and abrasion resistance. Improves performance over uncoated carbide in a wide variety of non-ferrous materials. Less expensive alternative to diamond.</p>	<p>Primary benefit over other non-ferrous coatings is extremely low affinity to aluminum. Prevents build-up on cutting edge, chip packing and extends tool life. Recommended in Aluminum Alloys and Magnesium Alloys. Not ideally suited for abrasive varieties of these alloys.</p>	<p>A PVD amorphous diamond coating which improves lubricity and wear resistance in non-ferrous materials. Performance similar to CVD Diamond, but significantly less expensive. Coating is thin relative to CVD diamond preventing edge rounding. Sharp edges improve results (performance and finish) over CVD in certain abrasive, non-ferrous materials (copper, brass, high silicon aluminum). Low temperature threshold makes diamond unsuitable for ferrous applications.</p> <div style="text-align: center; margin-top: 10px;">  </div> <p style="text-align: center;">Thin coating maintains sharper edge.</p>	<p>True Crystalline CVD diamond is grown directly into a carbide end mill. Dramatically improves hardness. Hardness improves abrasion resistance and extends tool life up to 50x and allows higher feed rates than uncoated carbide. Ideal for machining Graphite, Composites, Green Carbide, and Green Ceramics. Diamond layer approx 5 times thicker than Amorphous Diamond improving wear resistance. Low temperature threshold makes diamond unsuitable for ferrous applications.</p> <div style="text-align: center; margin-top: 10px;">  </div> <p style="text-align: center;">Thicker diamond layer for increased wear resistance.</p>	<p>PCD diamond is manufactured as a carbide backed flat wafer. The wafer is brazed to a carbide body to form an end mill. PCD has excellent hardness and abrasion resistance. Thickest diamond layer we offer. Sharply ground cutting edges and thick diamond layer combine the sharp edge benefits of Amorphous Diamond with the abrasion resistance of CVD Diamond. Low temperature threshold makes diamond unsuitable for ferrous applications.</p> <div style="text-align: center; margin-top: 10px;">  </div> <p style="text-align: center;">Thickest diamond layer ground to sharp edge.</p>
Non-Ferrous Materials				
<p>Abrasive non-ferrous alloys such as Brass, Bronze, Copper and Abrasive Aluminum Alloys</p>	<p>Aluminum Alloys, Magnesium Alloys</p>	<p>Abrasive Plastics, Graphite, Carbon Fiber Materials, Composites, Aluminum, Copper, Brass, Bronze, Carbon, Gold, Silver, Magnesium, Zinc</p>	<p>Graphite, Composites, Green Carbide, Green Ceramics</p>	<p>Abrasive Plastics, Graphite, Carbon Fiber Materials, Composites, Aluminum, Copper, Brass, Bronze, Carbon, Gold, Silver, Magnesium, Zinc, Green Carbide, Green Ceramics</p>
<p>Light Gold / Champagne</p>	<p>Light Gray / Silver</p>	<p>Charcoal / Gray</p>	<p>Gray</p>	<p>Gray / Black</p>
<p>Mono-layer</p>	<p>Mono-layer</p>	<p>Mono-layer</p>	<p>True Crystalline CVD Multi-Layer</p>	<p>Polycrystalline Diamond (Carbide Backed)</p>
<p>24.6</p>	<p>27.5</p>	<p>78 - 88</p>	<p>88 - 98</p>	<p>88 - 98</p>
<p>0.5</p>	<p>0.45</p>	<p>0.1</p>	<p>.05 - .3</p>	<p>.05 - .2</p>
<p>2 - 5</p>	<p>1 - 3</p>	<p>.5 - 2.5</p>	<p>8 - 10</p>	<p>.010" - .030" Solid PCD Layer</p>
<p>1100° F</p>	<p>1500° F</p>	<p>750° F</p>	<p>1100° F</p>	<p>1100° F</p>

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