Diamond Innovations

Compax* Diamond Tool Blanks for Machining

Nonferrous and Nonmetallic Materials

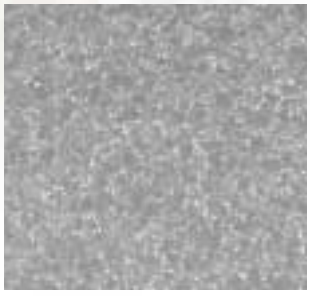
Compax* Diamond Tool Blanks for Machining Nonferrous and Nonmetallic Materials

Diamond Innovations, a leader in superhard cutting materials, manufactures a complete line of high quality sintered diamond Compax tool blanks. Polycrystalline diamond (PCD) is used for machining a wide variety of nonferrous and nonmetallic materials. Different blank shapes, sizes and grades, tailor-made to achieve maximum productivity in their respective application fields, are provided to toolmakers for fabrication into finished cutting tools.

Compax polycrystalline tool blanks consist of the highest quality micron sized particles of Man-Made* industrial diamond, sintered and integrally bonded to a cemented tungsten carbide substrate using a high temperature high pressure process.

Courtesy: Walter Kieninger GmbH, Germany

Compax Diamond Tool Blanks Product Range Tailor-Made for Maximum Productivity



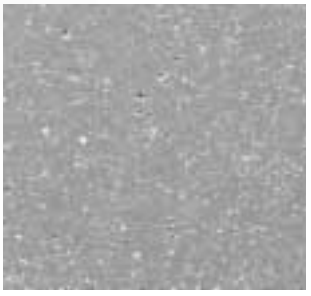
Grade 1600 Microstructure

- Average particle size 4 µm
- 90 Vol % diamond
- Unpolished or polished abrasive layer
- Electrically conductive

Fine surface finishes for

- Aluminum
- Copper
- Precious Metals
- Wood Composites
- Plastics

- Excellent edge quality and retention
- High abrasion resistance
- Moderate impact strength
- Excellent surface finish
- Easiest Compacts material to grind



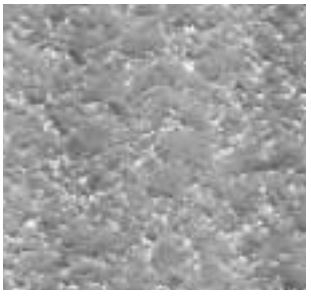
Grade 1300 Microstructure

- Average particle size 5 µm
- 92 Vol % diamond
- Unpolished and polished abrasive layer
- Electrically conductive

Highly abrasion resistant for machining of

- < 14% Si/Al Alloys
- Copper Alloys
- Graphite and Graphite Composites
- Wood Composites
- Green Ceramics and Carbides

- Good edge quality
- Excellent abrasion resistance
- Moderate impact strength
- Good surface finish



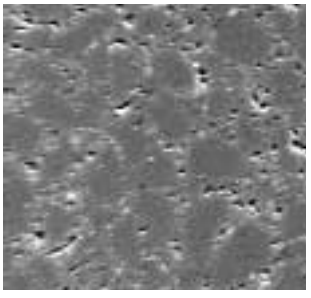
Grade 1500 Microstructure

- Average particle size 25 µm
- 94 Vol % diamond
- Unpolished and polished
- Electrically conductive

High strength for interrupted and roughing cuts of

- > 14% Si/Al Alloys
- Metal Matrix Composites
- Bi-Metals (aluminum/cast iron)
- Sintered Ceramics and Carbides
- Other highly abrasive materials

- Exceptionally long tool life
- Extremely high abrasion resistance
- High impact strength
- Fair to good surface finish, depending on application



Grade 1800 Microstructure

- Bimodal particle size 25 µm / 4 µm
- 95 Vol % diamond
- Unpolished and polished
- Electrically conductive

Bimodal grain structure for severe applications

- MMC (Duralcan**)
- >14% Si/Al Alloys
- Fiberglass
- Fiberboard
- Wood Laminates

- Exceptionally high abrasion resistance
- Outstanding impact strength
- Very good surface finishes
- Record tool life

All the Benefits of Diamond and Much More

Compax diamond laminated blank design combines the high hardness, abrasion resistance, low coefficient of friction and strength of single crystal diamond with the impact strength of tungsten carbide. The tungsten carbide substrate of the blank provides mechanical support to the diamond abrasive layer, increases its impact strength and also allows ease of braze attachment in finished tool fabrication.

Polycrystalline Compax diamond cutting blanks are most widely applied in machining nonferrous and nonmetallic materials. They have become a global industry standard for enhanced part quality and significant cost reductions in the overall production cycle.

- Higher material removal rates improved cycle times, providing more parts per shift
- Significantly faster cutting speeds and feed rates compared to conventional cutting tools
- Highly improved workpiece quality, excellent dimensional control, consistent surface finishes, reduced scrap
- Longer tool life resulting in increased machine up-time, providing greater production capacity without investing in new equipment

Machining Parameter Guidelines

Material Machined	Operation	Compax Grade	Speed m/min	Feed Rate mm/rev	DOC mm
Aluminum Alloy					
4 - 8% Si	Turning	1300/1500/1800	900 - 3500	0.1 - 0.4	0.1 - 4.0
	Milling		1000 - 5000	0.1 - 0.3 mm/insert	0.1 - 3.0
9 - 14% Si	Turning	1300/1500/1800	600 - 2400	0.1 - 0.4	0.1 - 4.0
	Milling		700 - 3000	0.1 - 0.3 mm/insert	0.1 - 3.0
>13% Si	Turning	1300/1500/1800	300 - 700	0.1 - 0.4	0.1 - 4.0
	Milling		400 - 900	0.1 - 0.3 mm/insert	0.1 - 3.0
Metal Matrix Composites					
A1/10 - 20% SiC	Turning/Milling	1500/1800	300 - 600	0.1 - 0.4	0.2 - 1.5
Copper Alloys					
Copper, Zinc, Brass	Turning/Milling	1600/1300	400 - 1260	0.03 - 0.3	0.05 - 2.0
	Turning/Milling	1800	400 - 1200	0.05 - 0.3	0.05 - 2.0
Tungsten Carbide <16% Co[1)]					
Unsintered ("green")	Turning	1300/1500	30 - 100	0.1 - 0.4	0.2 - 1.0
	Turning	1800	100 - 200	0.1 - 0.4	0.1 - 1.0
Sintered	Turning	1300/1500	20 - 40	0.1 - 0.25	0.1 - 0.5
	Turning	1800	20 - 40	0.1 - 0.25	0.1 - 1.0
Ceramics					
Unsintered ("green")	Turning	1300/1500	70 - 100	0.1 - 0.4	0.2 - 1.0
	Turning	1800	70 - 200	0.1 - 0.4	0.1 - 1.0
Sintered	Turning	1300/1500	50 - 80	0.1 - 0.25	0.1 - 0.5
Manufactured Wood	Routing	1600/1300	1000 - 3650	0.1 - 0.4	0.1 - 4.0
	Sawing	1300/1500	1500 - 4000	0.5 - 6.0	1.0 - 200
	Routing/Sawing	1800	1000 - 4000	0.1 - 0.4	0.1 - 3.0
Plastics / Composites					
Carbon / Graphite	Turning/Milling	1600/1300	300 - 2000	0.05 - 0.3	0.1 - 3.0
Fiberglas / Plastics	Turning/Milling	1600/1300	200 - 1000	0.05 - 0.5	0.1 - 3.0
Fiberglas / Graphite	Turning/Milling	1800	300 - 1000	0.1 - 0.4	0.1 - 3.0

1) It is recommended to use Diamond Innovations BZN* 6000 Compacts for machining sintered tungsten carbide with >16 % cobalt binder.

Material Application Case Histories – Compax Tool Blanks at Work

O.D. Turning of Alumium Pistons

Compax 1500

Conditions

Work material	390 Al (GD-Al Si 17)
Tool	CPG-424 (CCMW 12 03 16) Compax 1500 Tool Blanks
Turning conditions	machining speed: 730 m/min feed rate: 0.2 mm/rev depth of cut: 0.25 mm
Coolant	emulsion
Cutting mode	continuous
Result	8000 pistons per cutting edge

Grooving of Aluminum Pistons

Compax 1300

Conditions

Work material	390 Al (GD-Al Si 17)
Tool	Three grooving tool sets Compax 1300 Tool Blanks
Grooving conditions	machining speed: 370 m/min feed rate: 0.45 mm/rev
Coolant	emulsion
Result	10000 pistons per tool setup

Surface Milling of Aluminum Cylinder Head Face

Compax 1500

Conditions

Work material	GK-Al Si9Cu3
Tool	Milling head 250 mm Ø, 18 inserts tipped with Compax 1500 Tool Blanks
Milling conditions	machining speed: 3500 m/min feed rate: 0.15 mm/rev per tooth spindle speed: 4460 rev/min depth of cut: 0.5 mm
Coolant	emulsion
Result	40000 heads per tool setup

Slot Milling/ Edge Conturing Glass Fiber Reinforced Plastic Composite

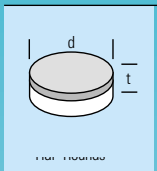
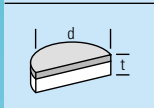
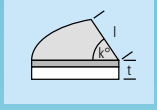
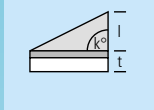
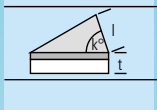
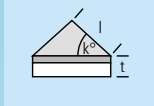
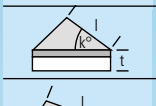
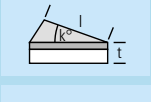
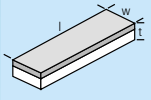
Compax 1300

Conditions

Work material	Glass fibre reinforced plastic composite, 40 Vol % fibre filled
Tool	6.0 and 8.0 mm, 2 cutting edges Compax 1300 Tool Blanks
Machining conditions	speed: 850 m/min, 1130 m/min feed rate: 0.065 mm/rev, 0.05 mm/rev spindle speed: 45000 rev/min
Result	Compax 1300 Tool Blanks: 800 parts per cutting edge Tungsten Carbide: 60 - 80 parts per cutting edge

Compax Diamond Tool Blanks – Availability

✓ = Standard S = Special

Shape		Dimensions (mm)			Grade			
		Angle (k°) / Shape	Diameter (d)	Thickness (t)	1500	1300	1600	1800
	**Rounds** 360°	360R	8.1	3.2	S	✓	S	S
		360R	58.0	1.6 - 2.0/3.2	✓	✓	✓	✓
		360R	58.0	1.6[1] 0.3 mm PCD Layer[1]	n/a	✓	n/a	n/a
	**Half Rounds** 180°	180P	8.1	1.6	S	✓	✓	S
		180P	9.5	1.6	S	✓	✓	S
		180P	13.2	1.6	✓	✓	✓	S
	**Partial Rounds** 90°	90P	3.9	1.6	S	✓	S	S
		90P	6.5	1.6	✓	✓	✓	S
	Triangles	**Angle (k°)/Shape**	**Leg Length (l)**	**Thickness (t)**				
	90°	90T	4.0	1.6	✓	✓	S	S
		90T	5.0	1.6	✓	✓	✓	S
		90T	6.5	1.6	✓	✓	S	S
		90T	7.5	1.6	✓	✓	S	S
	80°	80T	5.0	1.6	✓	✓	S	S
	60°	60T	4.0	1.6	S	✓	S	S
		60T	5.0	1.6	✓	✓	S	S
		60T	7.0	1.6	✓	✓	S	S
	55°	55T	5.0	1.6	✓	S	✓	S
	35°	35T	7.0	1.6	✓	✓	S	S
	Rectangles	**Length (l)/Shape**	**Width (w)**	**Thickness (t)**				
	L	6.0L	3.0	1.6	S	S	S	S
		6.0L	4.3	1.6	S	S	S	S
		6.5L	5.5	1.6	S	S	✓	S
		8.0L	5.0	1.6	S	S	S	S
		9.0L	9.0	1.6	S	S	S	S
		10.0L	3.0	1.6	S	S	✓	S
		11.5L	2.5	3.2	✓	S	S	S
		13.0L	3.0	1.6	✓	✓	S	S

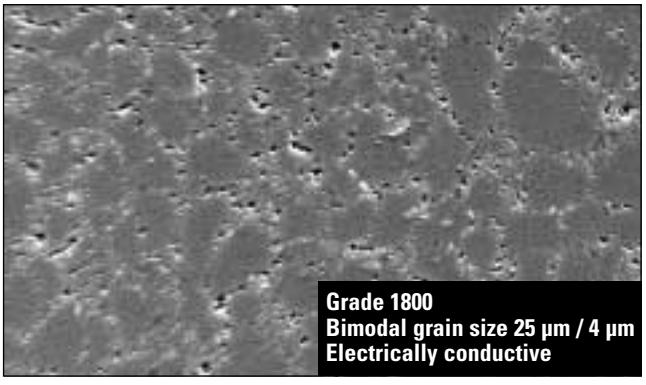
All dimensions in mm. Dimensional tolerances: ±0.15 mm for length (l) and width (w), ±0.1 mm for diameter (d), ±0.05 mm for overall thickness (t). Nominal diamond abrasive layer thickness is 0.5 mm. Blanks available with polished diamond surface, denoted by "P" following grade. When ordering please specify dimensions and grade.

Example: 360R58.0/1.6-13 or 90T5.0/1.6-13P (13 = 1300, 15 = 1500, 16 = 1600, 18 = 1800) [1] 360R58.0/1.6 = 13P 0.3 mm PCD Layer

Additional shapes and sizes available upon request.

Compax* 1800 Diamond Tool Blanks
Bimodal Diamond Grain Structure for Severe Applications

Diamond Innovations introduces a new bimodal diamond grain layer. Compax* 1800 is a highly abrasive resistant grade of polycrystalline diamond integrally bonded to a tungsten carbide substrate. The extremely dense PCD structure of Compax 1800 consists of polycrystalline Man Made* Diamond with a specially engineered bimodal grain distribution. This new innovative cutting tool blank design is engineered to achieve maximum abrasion resistance for applications in nonferrous and nonmetallic materials. Field test results with Compax 1800 show performance improvements up to 2X over competitive PCD materials.

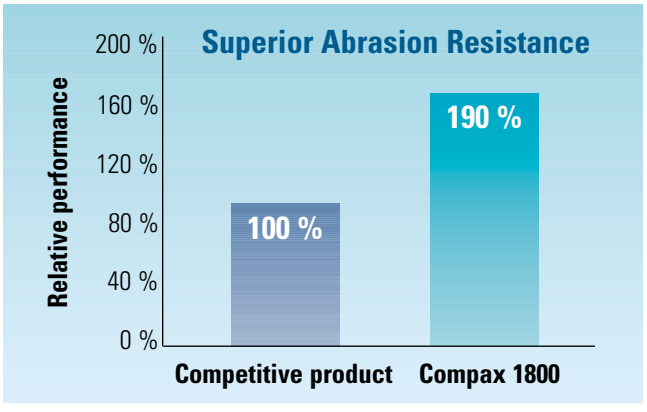


The Most Abrasive Resistant Product of the Compax* Product Family

Applications	Relative Performance vs. Competitive PCD in Highly Abrasive Materials
• Turning of MMC (Duralcan**)	175%
• Milling of Medium Si/Al	150%
• Wheel Dressing Tool	130%
• Machining of Fiberglass	200%
• Sawing of High Density Fiberboard	120%
• Edge Finishing of Al_2O_3 Laminated Flooring	130%

- Exceptionally high abrasion resistance
- Outstanding impact strength
- Very good surface finishes
- Record tool life

** Trademark of DuPont



Compax 1800 achieves significant tool life improvement over competitive products

Physical Properties of Compax Diamond Tool Blanks

Property		Compax Diamond Grade 1600	1300	1500	1800	Effect of increasing particle size
Compressive Strength	(GPa)	7.5	7.5	7.5	7.5	constant
Elastic Modulus	(GPa)	850	950	1100	1150	increases
Transverse Rupture Strength	(GPa)	1.7	1.4	0.85	0.90	decreases
Thermal Conductivity	(W/mk^0)	500	525	600	600	increases
Electrical Resistivity	(ohm-mx 10^{-2})	1.5	2.0	4.0	4.5	increases
Density	(g/cc)	4.1	4.0	3.9	4.0	decreases
Knoop Hardness - 3 kg load	(kg/mm^2)	4000	4000	4000	4000	constant

Abrasion resistance and impact resistance increase with diamond grain size.

Tool Preparation and Usage Guidelines

- Use a sharp edge whenever possible for most applications.
- For severely interrupted and roughing cuts use honed edge of ~0.025 mm to avoid edge chippage.
- A neutral or slightly positive rake angle (5 - 8°) with up to 10 - 13° clearance angle is recommended for most applications.
- Do not use high rake (15 - 20°) and clearance angles (20 - 25°) as recommended for tungsten carbide cutters. This tends to cause tool edge chippage on roughing and interrupted cuts in metalworking.
- 10 - 15° positive rake angles minimize burring for soft copper alloy and plastic materials.
- Use neutral or 3 - 5° negative rake angle for machining sintered tungsten carbide and ceramic materials.
- Rigid machining system with sufficient speeds and horsepower is paramount.
- Generally no coolant is required except for improving chip removal from the cutting zone, if desired.

Diamond Innovations' quality systems are registered under ISO 9002.

Diamond Innovations
6325 Huntley Road, Worthington, OH 43085, USA
Phone: (1) 614 438 2000, Fax: (1) 614 438 2888
Toll free: 1 800 443 1955

www.AbrasivesNet.com

DI 1309 E