GIVING TOOLMAKERS A COMPETITIVE EDGE

With PCD, PCBN, CVD Diamond & Single Crystal Diamond

elementsix™
a De Beers Group Company

A PARTNER FOR SUCCESS

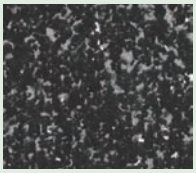
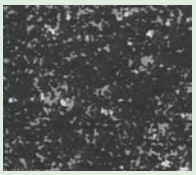
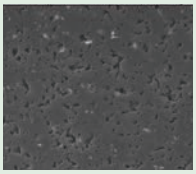
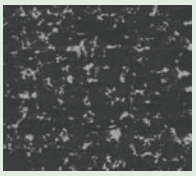
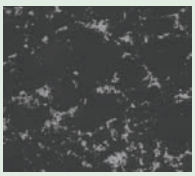
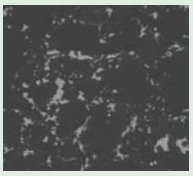
At Element Six, we work with our customers to develop cutting-edge products and materials. We have a proven commitment and capacity to innovate, and continue to deliver ground-breaking opportunities.

The unique Element Six state-of-the-art Global Innovation Centre (GIC) near Oxford (UK), further enhances our position as the world leader in synthetic diamond and supermaterials research, to find new ways to turn the extreme properties of supermaterials into products with revolutionary performance.

We welcome our customers to collaborate with us to develop next generation solutions at the GIC. Not only can we deliver unprecedented levels of product performance for customers, but we can bring these proven innovations to market within given timescales.

PCD GRADES AND CHARACTERISTICS

PCD GRADES AND CHARACTERISTICS

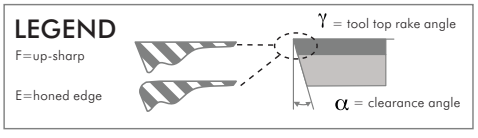
GRADE	APPLICATIONS	CHARACTERISTICS	MICROSTRUCTURE
CMX850	Ideal for milling and rough cutting of aluminium alloys where extreme chip resistance is required, also for machining titanium and composites.	Sub-micron grain size. CMX850's ultra-fine grain structure is suitable for applications where mirror finishes are required due to its extreme edge sharpness/retention.	
CTX002	Ideal for profile routers and thread cutting tools, can also be used in wear part applications.	2μm average grain size with increased cobalt for ease of processing. CTX002 is ideal for complex tools where excessive processing is required.	
CTB004	Ideal for cutting of aluminium alloys where high surface finish is required alongside higher wear resistance.	4μm average grain size. CTB004's 4-micron fine grain structure offers the addition to delivering the optimum balance between tool performance and resistance to abrasions and chips.	
CTB010	The ideal grade where roughing and finishing are performed with a single tool. Highly recommended for low to medium content aluminium alloys.	10μm average grain size. CTB010 is the workhorse PCD grade ideal for many applications where a good balance of toughness and wear resistance is required.	
CTH025	Successful in machining of high silicon aluminium alloys, metal matrix composites (MMC), tungsten carbides and ceramics.	Average grain size of 25μm. CTH025 offers the optimum wear resistance for abrasive machining conditions.	
CTM302	Application areas include MMC, high silicon aluminium alloys, high strength cast irons and bi-metal applications. Excellent abrasion resistance and good thermal stability.	A multi-modal PCD with a combination of 2μm to 30μm grain sizes which gives CTM302 excellent wear resistance, edge strength and edge quality.	

PCD AND CVD APPLICATION GUIDE

SELECTING PRODUCTS & GRADES FOR YOUR APPLICATIONS

		PCD / CVD GRADE SELECTION								CUTTING CONDITIONS AND EDGE DESIGN			
		CMX850	CTX002	CTB004	CTB010	CTH025	CTM302	CDM	CDE	CUTTING SPEED (M/MIN) 10 100 200 500 1000 5000	FEED, F (MM) FZ (MM/ INSERT)	DEPTH OF CUT A_P (MM)	TYPICAL EDGE GEOMETRIES
NON FERROUS METALS HYPOEUTECTIC (SI< 12%) AND EUTECTIC (SI =12%) SILICON ALLOYS	N01										0.1 - 0.4	0.1 - 4.0	F α = 7-20° γ = 0°/+6°
	N10												
	N20										0.1 - 0.3	0.1 - 3.0	
	N30												
HYPEREUTECTIC (SI > 12%) ALUMINIUM CASTING ALLOYS METAL MATRIX COMPOSITES (MMC)	N01										0.1 - 0.5	0.1 - 4.0	F/E α = 7-11° γ =0°/+6°
	N10												
	N20										0.1 - 0.3	0.1 - 3.0	
	N30												
CERAMIC MACHINING (GREEN)	UNSINTERED										0.1 - 0.4	0.2 - 1.0	F/E α = 0-7° γ =0°/-6°
CERAMIC MACHINING (SINTERED)	SINTERED										0.1 - 0.25	0.1 - 0.5	
COPPER AND ITS ALLOYS MAGNESIUM AND ITS ALLOYS	N01										0.03 - 0.3	0.05 - 2.0	F α = 7-11° γ =0°/+6°
	N30												
BIMETALS	N20										0.08 - 0.2	0.25 - 1.0	F/E α = 7-11° γ =0°/+6°
GREY & HIGH STRENGTH IRONS	K01										0.08 - 0.2	0.25 - 1.0	F α = 7-11° γ =0°/+6°
	K40												
COMPOSITE PLASTICS	01										0.1 - 0.2	0.2 - 3.0	F/E α = 7-11° γ =0°/+6°
	20												
TITANIUM	S01										0.1 - 0.2	0.2 - 0.5	F/E α = 7-11° γ =0°/+6°
	S30												

Work material characteristics and to a lesser extent, cutting parameters, determine the demands placed on the cutting tool and hence, the optimum balance of tool material properties. Knowledge of the application, including workpiece composition, facilitates selection of the optimum grade and selection of the correct tool geometry. Often, work material composition and machining parameters (vc, f, a_p) go hand in hand. It is possible, therefore, only to provide a typical range of values for each parameter.



PCD PRODUCT RANGE

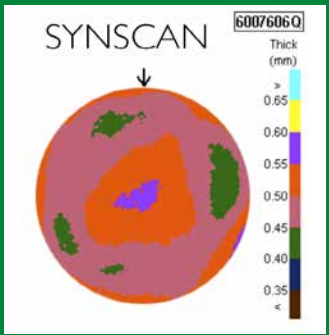
70 MM METALWORKING DISC PRODUCT RANGE

USABLE PCD POOL	GRADE	STANDARD PCD LAYER	OVERALL HEIGHT (+/- 0.05MM)								PCD LAYER THICKNESS (MM)
			0.8	1	1.2	1.4	1.6	2.0	3.18	8.0	
70mm	CMX850	0.3mm		✓	✓		✓				0.20 to 0.45
		0.5mm		✓			✓	✓			0.35 to 0.65
		1.0mm							✓		0.83 to 1.17
	CTX 002	0.5mm		✓			✓		✓		0.40 to 0.60
	CTB004	0.3mm					✓				0.20 to 0.45
		0.5mm					✓				0.35 to 0.65
	CTB010	0.3mm	✓	✓	✓	✓	✓		✓		0.20 to 0.45
		0.5mm		✓	✓		✓	✓	✓		0.40 to 0.60
		0.7mm					✓		✓	✓	0.53 to 0.88
		1.0mm							✓		0.83 to 1.17
	CTH025	0.5mm					✓	✓	✓		0.40 to 0.60
	CTM302	0.5mm					✓	✓			0.40 to 0.60
		0.7mm							✓		0.53 to 0.88
		1.5mm							✓	✓	1.35 to 1.88
	PSX 850 (wafer)	0.8mm	✓								0.6 to 1.0

Tighter overall height tolerance +/- 0.025mm available for selected CMX & CTB discs

PCD LAYER PROFILE

Element Six supplies a unique ultrasonic scan depicting the PCD layer profile. The PCD scan indicates a 'North Point', which matches a 'North Point' laser marked on the disc, allowing users to optimise the cutting areas.



CHOOSING THE RIGHT PCD GRADES

PCD GRADES FOR WIDER USAGE

Improvements in synthesis techniques coupled with new product development capability has resulted in CMX850 and CTM302 having the properties to meet all of the challenges in tool performance. CTM302 provides the ultimate abrasion resistance while CMX850 provides the optimum balance of processability and performance. CTB004 can deliver the optimum balance between tool performance and resistance to abrasions and chips.

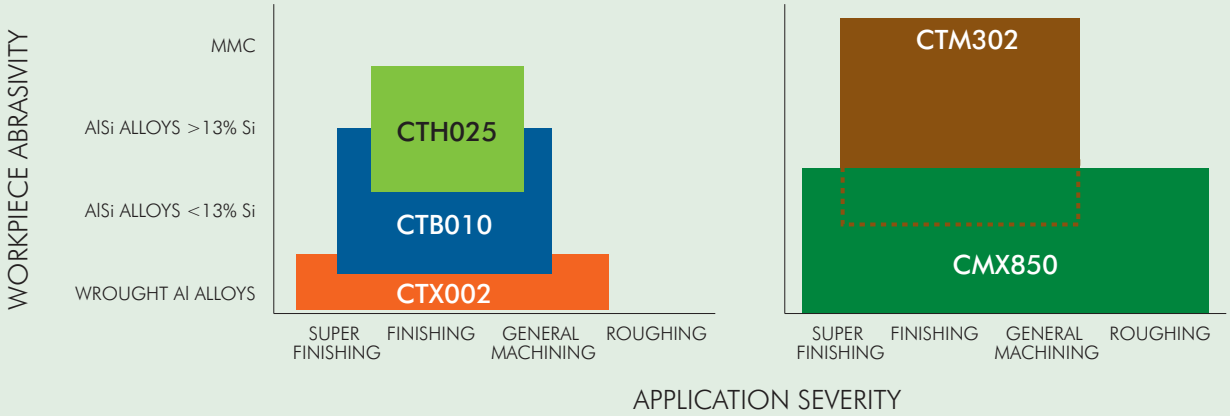
THE 4 MAIN FACTORS FOR CONSIDERATION WHEN SELECTING PCD GRADES:

– Chip resistance
– Abrasion resistance

} Behaviour in Application

– Electro-discharge characteristics
– Grindability characteristics

} Processing Characteristics



MATERIALS AND MACHINING

Element Six PCD grades provide the ideal balance between behaviour in application and processing characteristics to meet the requirements of the cutting or grinding operation.

		BEHAVIOUR IN APPLICATION		PROCESSING CHARACTERISTICS	
Grade	Grain Size	Chip Resistance	Abrasion Resistance	Electro-discharge Machining	Grindability
CMX850	0.85-1µm				
CTX002	2µm				
CTB004	4µm				
CTB010	10µm				
CTH025	25µm				
CTM302	2-30µm				

AERO-DIANAMICS™ - PCD ROUND TOOL BLANKS

GRADES AND CHARACTERISTICS

GRADE	APPLICATIONS	GRAIN SIZES	CHARACTERISTICS		
A3MH HELIX	Milling	Fine	– Helical geometry results in lower tool forces and better chip evacuation – High thermal conductivity and low coefficient of friction results in less heat build-up and adhesion – Sharp PCD edges cut fibres cleanly		
A2DS CHEVRON	Drilling	Coarse	– Tool life extended by 10 times compared to carbide drills – Half round disc formats available – EDM segments available and cut to order		
A3DP PLANAR	Drilling	Fine	– Almost infinite flexibility in drill point geometry – Tool life more than 10 times longer than tungsten carbide drills – Large rake angles possible for lower tool forces		

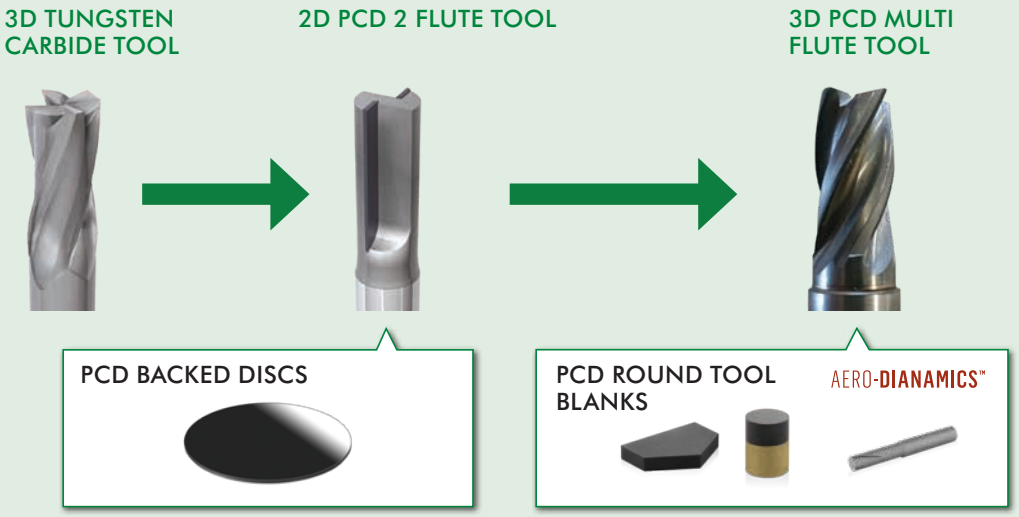
SETTING TOOL DESIGN FREE

Our Aero-Dianamics™ range of round tool blanks provides tool designers with the ability to create entirely new PCD tool geometries which break through existing barriers in PCD tool design with:

– freedom of design in flute profiles
– multiple flutes
– limitless flute angles and orientations

AERO-DIANAMICS™ - TRANSFORMING COMPOSITE TOOLING

These next generation composite tooling solutions entirely replace the need for coated tungsten carbide tools for fabricating composite components.



REVOLUTIONARY AD-M3 BLANKS FOR MILLING TOOLS

Our Aero-Dianamics™ milling range enables significant improvements in productivity over coated tungsten carbide tools:

– 3-12 x faster machining speeds
– Lower cutting forces
– Improved tool evacuation

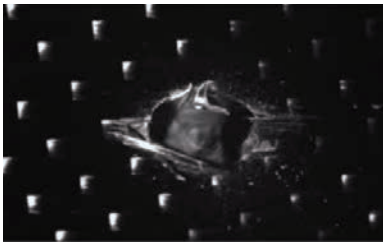
UNIQUE AD-D3 BLANKS FOR COMPLEX DRILL GEOMETRIES

Our Aero-Dianamics™ drilling range enables significant improvements in productivity over coated tungsten carbide tools:

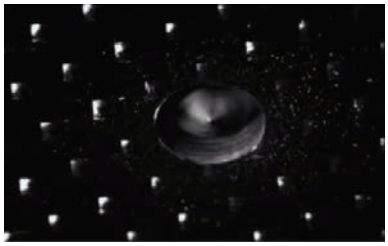
– Significantly increased wear resistance over coated carbide drills
– 10 x longer tool life in drilling CFRP
– 2 x speed of drilling CFRP/ Al
– Consistent performance over tool life
– Superior work piece finish

ACHIEVING A SUPERIOR EDGE QUALITY AND IMPROVED PRODUCTIVITY

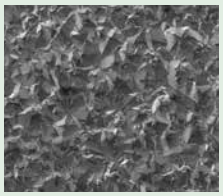
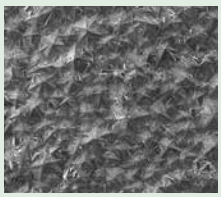
TUNGSTEN CARBIDE:
Hole surface quality on CFRP test piece



AD-M3 PLANAR:
Drills faster and provides a consistently clean finish



CVD DIAMOND GRADES AND CHARACTERISTICS

GRADE	APPLICATIONS	CHARACTERISTICS	MICROSTRUCTURE
CDE PL	Wide-ranging laser cut shape and size for precision machining of MMC, CFRP and woodworking materials.	An electrically conducting grade of CVD for cutting tool applications, that allows customers to use EDM machining or EDG grinding within their tooling processing.	
CDM PL	Wide-ranging laser cut shape and size for precision machining of MMC and CFRP materials.	A general purpose mechanical grade for cutting tools.	

BENEFITS OF ELEMENT SIX CVD DIAMOND: CVDITE

- Higher wear resistance than medium PCD grades
- Excellent thermal stability and thermal conductivity
- Binder-free so is extremely chemically inert
- Extreme abrasion resistance
- Ideal for applications where higher temperature operating conditions are seen
- High purity

		BEHAVIOUR IN APPLICATION		PROCESSING CHARACTERISTICS	
Grade	Grain Size	Chip Resistance	Abrasion Resistance	Electro-discharge Machinability	Grindability
CDE	60-80µm				
CDM	60-80µm			N/A	
CTB010	10µm				

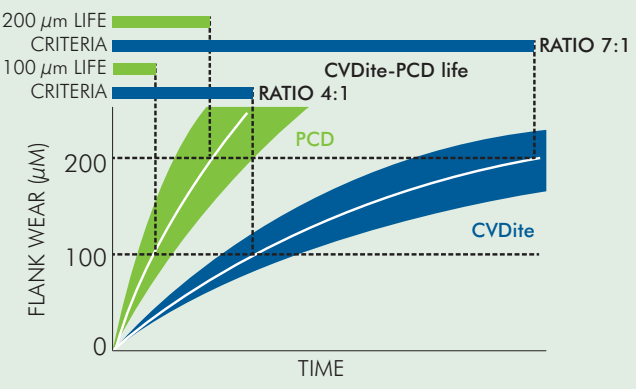
CHOOSING THE RIGHT CVDITE GRADE

Element Six's CVDite is generally recommended for the machining of non-ferrous materials where high abrasion resistance is required. CVDite has high thermal stability and more wear resistance than PCD.

Due to its high abrasion resistance and low coefficient of sliding friction, the CVDite range is also ideal for uses in lubricated and dry wear part applications.

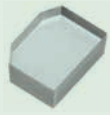
CVDITE-PCD LIFE

ABRASION RESISTANCE DEPENDING ON APPLICATION



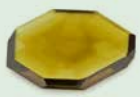
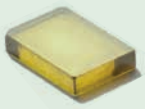
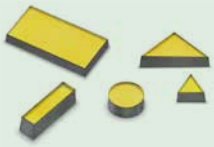
SINGLE CRYSTAL DIAMOND GRADES AND CHARACTERISTICS

SINGLE CRYSTAL MCC

APPLICATIONS	CHARACTERISTICS	
MCC is available in 2pt and 4pt orientations. Ultra precision machining acrylics, copper, germanium. Generates very high surface finishes.	Produced under ultra-high purity conditions, which gives it its colourless appearance. It offers a combination of extreme wear resistance, excellent chip resistance and high thermal conductivity combined with low thermal expansion.	

MONODITE

APPLICATIONS	CHARACTERISTICS
Primary applications for Monodite are engineered cutting tools and wear parts for super finishing, burnishing, wire guides and ultra-precision machining.	Manufactured using a proprietary high pressure, high-temperature synthesis process and is pale yellow in colour. The result is a single crystal synthetic diamond that is highly consistent and has predictable properties and behaviours, offering an unparalleled choice of synthetic diamond required for cutting tool applications.

PRODUCT RANGE	KEY PRODUCT FEATURES	PRIMARY APPLICATION	
MSP	Individually priced large edge length plates	Long edge length requirements (e.g. profile tools)	
MLP	Long edge length polished near rectangular logs	Long edge length requirements (e.g. controlled waviness tools)	
MT L (RECTANGULAR) **MT T** (TRIANGULAR) **MT R** (ROUND)	Highly engineered polished plates, laser cut to specific dimensions	Engineered cutting tools and wear parts for superfinishing, burnishing and wire guides. Convenient cut shapes	
MXP	Near square plates having guaranteed inscribed square	Superfinishing and precision machining (e.g. precious metals and MMC materials)	
MWS PT4	Near round plates having guaranteed inscribed circle		
MWS PT2	Engineered polished plates benefitting from 2 point orientation		

BENEFITS OF ELEMENT SIX SINGLE CRYSTAL

- Highly consistent, predictable properties and behaviour
- Unrivalled surface finish and component accuracy performance unattainable with conventional polycrystalline tool materials
- Surface roughness values are of the order of nanometres and form accuracies are commonly sub-micron
- Facilitates the manufacture of cutting tools with edge roughness and sharpness values in the order of 10 nm and form accuracies in the micrometre range

PCBN STANDARD PRODUCT RANGE AVAILABLE

OTHER SIZES AND FORMATS AVAILABLE ON REQUEST

PCBN WC BACKED DISC PRODUCT RANGE

GRADE	OUTSIDE DISC DIAMETER (MM)	PCBN USABLE AREA (MM)	PCBN LAYER (MM)	OVERALL THICKNESS (+/- 0.05MM)			
				1.6	2.38	3.18	4.76
DCN450	75	70	0.7-1.0	✓	✓	✓	✓
DCC500	75	70	0.7-1.0	✓	✓	✓	✓
DCX650	75	70	0.7-1.0	✓	✓	✓	✓
DBW85	75	70	0.7-1.0	✓	✓	✓	✓
DBS900	75	70	0.7-1.0	✓	✓	✓	✓

PCBN SOLID LOW CONTENT PRODUCT RANGE

GRADE	CONDUCTIVE / NON-CONDUCTIVE	OVERALL THICKNESS (+/- 0.05MM)							OUTSIDE DISC DIAMETER (MM)	PCBN USABLE AREA (MM)
		1.0	1.6	2.38	3.18	4.76	6.35	7.94		
DSN450	CONDUCTIVE	✓	✓	✓	✓	✓	✓	✓	95	90
DSC500	CONDUCTIVE	✓	✓	✓	✓	✓	✓	✓	95	90
DHA650	CONDUCTIVE	✓	✓	✓	✓	✓			ONLY SUPPLIED AS CUT PRODUCT	

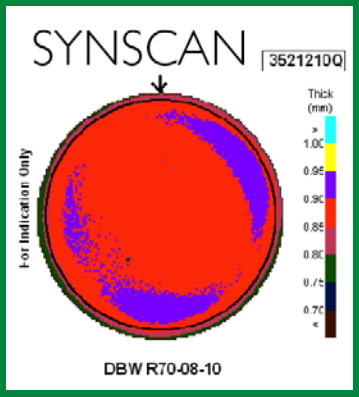
PCBN SOLID HIGH CONTENT PRODUCT RANGE

GRADE	CONDUCTIVE / NON-CONDUCTIVE	OVERALL THICKNESS (+ / - 0.13MM)			OUTSIDE DISC DIAMETER (MM)	PCBN USABLE AREA (MM)
		3.18	4.76	6.35		
AMB90	NON-CONDUCTIVE	✓	✓	✓	99	97
AMK90	NON-CONDUCTIVE	✓	✓		99	97
ZAA	NON-CONDUCTIVE	✓	✓		99	97

PCBN SYNSCAN

Element Six supplies a unique ultrasonic scan depicting the PCBN layer profile.

The PCBN scan indicates a 'North Point', which matches a 'North Point' laser marked on the disc, allowing users to optimise the cutting areas.



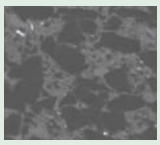
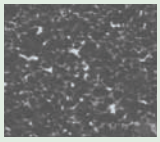
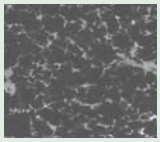
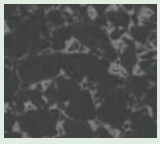
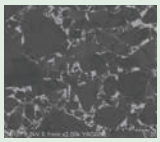
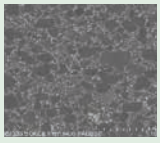
OUR UNIQUE SCALABLE SEGMENTATION SERVICE

Our fast, high quality and cost effective segmentation service is supported by the largest Laser Cutting and Electrical Discharge Machinery (EDM) capacity of all abrasive manufacturers. We provide both standard and complex bespoke geometries at any volume required.

Our unique segmentation expertise.

Our large scale EDM and laser cutting technology.

PCBN GRADES AND CHARACTERISTICS

GRADE	APPLICATIONS	CHARACTERISTICS	MICROSTRUCTURE
DCN450 (WC-BACKED) **DSN450 (SOLID)**	For moderately interrupted hard turning and finish hard milling as well as high speed continuous turning. Its resistance to crater wear is among the highest in the market. With one of the finest structures of all commercial grades, DCN450 provides for sub-μm surface roughness.	Approximately 45% CBN Sub-μm CBN grain size TiCN binder	
DCC500 (WC-BACKED) **DSC500 (SOLID)**	For continuously and lightly interrupted cutting of the majority of automotive steels. Excellent abrasion resistance makes it the ideal choice for cold work tool steels and certain valve seat alloys. Also recommended for finishing abrasive high strength cast irons.	Approximately 50% CBN 1.5μm average grain size Principally TiC binder	
DHA650	For moderately to heavily interrupted hard turning and finish hard milling in both dry and wet conditions. Suitable for both conventional and elevated machining speeds.	Approximately 65% CBN Binder phase includes TiC/ TiN	
DCX650	For moderately to heavily interrupted turning of all common hardened steels. Provides an excellent balance of toughness, and crater and flank wear resistance. Also used for plunge machining of valve seat rings.	Approximately 65% CBN Average 3μm proprietary multi-modal grain size TiN binder	
DBW85	For applications such as grey iron fine boring and valve seat machining, due to excellent strength and abrasion resistance. Ideal for heavily interrupted cutting of all hard and abrasive work piece materials including powder metallurgy components. Proven performance also in hard fine milling applications.	Approximately 85% CBN 2μm average grain size AlWCoB binder for extreme chip resistance	
DBS900	Ideal for applications where longer tool life is required. Excels in interrupted machining of grey and hard cast irons, hardened steel milling and in the machining of the majority of valve seat ring alloys. Excellent first choice grade for the majority of ferrous powder metals.	Approximately 90% CBN 4μm average grain size Novel binder system to provide the ultimate abrasion and chip resistance	
AMB90	For turning and milling of grey and hard cast iron and heavy turning of hardened steels; including components such as brake discs, pump bodies and impellers and large rolls.	Approximately 90% CBN Binder phase includes aluminium nitrides and borides	
AMK90	For similar application areas as AMB90, but providing higher wear resistance. Exhibits particularly high performance in abrasive work materials such as high chrome cast irons. Usable edges on both faces of insert.	Approximately 90% CBN Binder phase includes aluminium nitrides and borides	
ZAA	A value orientated grade for turning of grey cast iron, including components such as brake discs and pump bodies.	Approximately 90% CBN Binder phase includes aluminium nitrides and borides	

PCBN APPLICATION GUIDE

SELECTING PRODUCTS AND GRADES FOR YOUR APPLICATIONS

Due to the very large number of unique applications, it is possible only to make general recommendations.

Significant improvements in tool performance should be possible through further optimisation.

ISO513's colour-coded classification of cutting tool applications has been used here to indicate the intended application area for cutting tool materials.

Deeper colour bars indicate preferred grades.

Lighter colour bars indicate other grades which may be preferable in specific circumstances.

		GRADED RECOMMENDATIONS									CUTTING CONDITIONS						EDGE GEOMETRY GUIDE			
		DCN450 / DSN450	DCC500 / DSC500	DHA650	DCX650	DBS900	DBW85	AMB90	AMK90	ZAA	CUTTING SPEED, v_C (m/min)[8, 18]		FEED, f (mm)[3, 5, 7]		DEPTH OF CUT, a_P (mm)[4, 5, 7]		CHAMFER ANGLE, γ_b	CHAMFER WIDTH, b_γ (mm)	EDGE RADIUS, r_β (µm)	NOSE RADIUS, r_ε (mm)[6]
											MIN	MAX	MIN	MAX	MIN	MAX	Recommended Ranges			
HARDENED STEELS	H01										130	210	-	0.5	-	0.5	15 - 25	0.1 - 0.2	5 - 10	0.4 - 1.6
	H10										100	170	-	0.5	-	0.5	20 - 35	0.1 - 0.2	5 - 15	0.4 - 1.6
	H20										100	160	-	0.5	-	0.3	25 - 35	0.1 - 0.2	10 - 30	0.4 - 3.2
	H30 HARD MILLING										100	190	-	0.5	-	0.3	25 - 35	0.1 - 0.2	10 - 30	0.4 - 3.2
CAST IRONS[1, 2]	GREY IRON - K01										600	2500	0.1	1	0.1	2	15 - 25	0.2 - 1.0	- 20	- 3.2
	GREY IRON - K10[12]																			
	GREY IRON - K20[12]												0.2	2	0.5	5				
	GREY IRON - K30																			
	ADI[9] - K01										150	500	0.15	0.5	0.15	0.5	15 -	0.1 -	10 -	0.8 -
	ADI - K10																			
	ADI - K20 - K30										200	400	0.2	0.4	0.2	0.4	25	0.3	20	1.6
	NODULAR IRON AND CGI[10, 11]										150	350	0.1	1	0.2	2	As for ADI			
	WHITE AND CHROME IRONS - K10										50	80	0.1	0.5	0.2	2	20 - 30	0.2 - 1.0	20 - 30	1.6 - > 9.0
	WHITE AND CHROME IRONS - K20-K30										50	100	0.2	2	1	3				
FERROUS POWDER METALS (EXCL. VSR[13])	< 300 HV										-	350	0.1	0.5	-	1.0	0 - 20	-0.2	-15	-1.6
	< 750 HV										-	250	0.1	0.3	-	1.0	15 - 35	-0.2	-30	-1.6
VALVE SEAT RINGS:	< 350 HV: PLUNGING										50	150	0.02	0.05	NA	NA	10 - 30	0.1 - 0.2	0 - 20	NA - 1.6
	< 350 HV: TURNING										50	180	0.05	0.2	0.1	0.5				
	> 350 HV: PLUNGING										50	150	0.02	0.05	NA	NA	15 - 25	0.1 - 0.2	10 - 30	NA - 1.6
	> 350 HV: TURNING										50	180	0.05	0.2	0.1	0.5				
SUPER-ALLOYS:	NI-BASE: S10[14, 15]										150	400	-	0.3	-	0.5	0 - 20	0 - 0.3	20 - 40	1.6 - 3.2
	NI-BASE: S20 - S30										100	150				1.0				
	CO-BASE: S10										50	200				0.5	0 - 20	0 - 0.3		
	CO-BASE: S20 - S30										50	100				1.0				

ISO1832 prescribes several edge conditions, three of which are most commonly applied to PCBN indexable inserts.

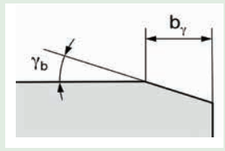
Indexable inserts made in accordance with ISO16462 are obliged to indicate the edge condition, expressed as a letter symbol (e.g. S, T, E). Five digits indicate the T-land dimensions. Hone dimensions are not indicated in ISO designations.

Example: CNGA120408 S 015 30

– Edge shape (S, T, E, etc.)

– Chamfer width, b_γ, in 1/100th mm

– Chamfer angle, γ_b in degrees



CHAMFER AND HONE:

Stronger than T-land - First choice for HPT

Feed must be greater than hone size

HONED EDGE:

Hone size is more difficult to control than chamfers, but popular for HRSAs

CHAMFER / T-LAND:

The larger the T-land width and angle, the higher the forces

1. For cast iron and roll machining, solid grades AMB90 and AMK90 are more economical, while DBW85 and DBS900 provide for a superior finish and greater edge strength; e.g. for positive inserts or a heavily interrupted cut.
2. Performance for grey irons can vary depending on casting quality and degree of ageing.
3. The feed is selected with nose radius according to surface roughness requirements.
4. The depth of cut is typically determined by stock removal allowance (oversize) prior to hardening of the component.
5. While there is no strict minimum feed or depth of cut, excessively low values (e.g., < 0.02 mm) may result in adverse machining vibrations.
6. While a larger nose radius provides a stronger edge, excessively large values may result in adverse machining vibrations.
7. For braze-tipped tools, the segment area (in mm^2) should be > $100*f*a_p$ so as to securely bear the cutting load.
8. Indicated cutting speeds for hard steels are primarily for case hardened steels. For higher alloy steels, it may be necessary to reduce the cutting speed to achieve the required tool life.
9. ADI: Austempered Ductile Iron.
10. CGI: Compacted Graphite Iron (also known as vermicular iron).
11. Compacted graphite cast irons are also successfully machined with PCD - we recommend CTM302. The cutting speed for PCD should be 200 +/- 50 m/min.
12. Milling of grey cast irons is typically done within the upper portion of the speed range indicated.
13. VSR: Valve Seat Rings.
14. Super-alloys - also known as heat resistant superalloys (HRSA) - consist of a very large range of compositions and properties, resulting in very different machining characteristics.
15. For HRSAs it is preferable to use round inserts. It is also advisable to assess the use of un-chamfered, but honed, cutting edge geometries.
16. PureCut™ grades are designed to operate at higher speeds than Element Six's other grades. Please contact Element Six technical support for further details.

SUPPORTING THE SWITCH TO HIGHER PERFORMING SOLID PCBN

Element Six's low content solid PCBN grades DSN450 and DSC500 offer significant advantages over their WC-backed (tungsten carbide backed) PCBN equivalents. Their uniform and self-supporting structures significantly increase tool life and provide unique opportunities for innovation in tool design giving toolmakers a technical and commercial edge.

PureCut™ grade DHA650 is only offered in solid PCBN format and shares the same benefits as DSN450 and DSC500.

SOLID DSN450 ← WC-BACKED DCN450
SOLID DSC500 ← WC-BACKED DCC500

DISCOVERING COMPETITIVE ADVANTAGE WITH SOLID PCBN

With an identical structure, it has never been easier to make the switch from WC-backed PCBN.

The benefits of our low content solid PCBN grades, DSN450 and DSC500, include:

– Highly adaptable and fully conductive

– Discs can be cut using EDM wire machines and configured into many shapes and geometries, offering greater flexibility in design to differentiate product lines

– Can be brazed directly onto tool substrates through advances in active brazing capabilities, reducing production costs

– Free of bimetal stress, reducing instances of chipping and cracking during brazing

– Can be supplied at any thickness between 1.0mm - 10.0mm

PROVEN PERFORMANCE

In our application tests under laboratory conditions in continuous turning of hardened steel 60 HR, our solid PCBN significantly extended mean tool life by:

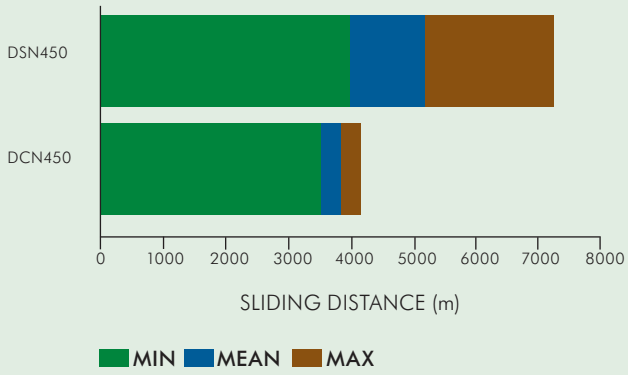
– up to 40% with DSN450

– up to 35% with DSC500

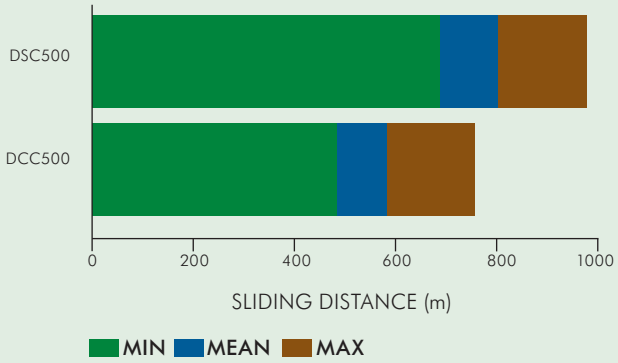
Extended tool life means better performance and reduced costs for end users.

SLIDING DISTANCE RESULTS IN CONTINUOUS MACHINING OF HARDENED STEEL 60 HRC (SAE8620)

SOLID PCBN (DSN450) VS. WC-BACKED PCBN (DCN450)



SOLID PCBN (DSC500) VS. WC-BACKED PCBN (DCC500)



TEST CONDITIONS

CUTTING SPEED: 200m/min
FEED RATE: 0.1mm/rev
DEPTH OF CUT: 0.15mm
FAILURE MODE: Edge chipping

REDUCE DOWNTIME & IMPROVE PRODUCTIVITY BY CONVERTING TO INTEGRAL INSERTS

With increasing pressure from competitors and end users, tool manufacturers are always looking for ways to simplify the manufacturing process, raise productivity and reduce costs. By switching from brazed inserts to centre-lock full face inserts, these aspirations can become a reality.

HIGH PERFORMANCE COMPONENTS

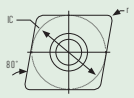
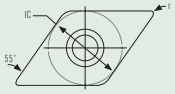
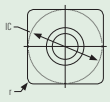
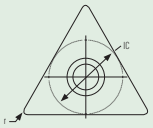
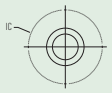
Centre-lock full face PCBN inserts provide for easily manufactured multi-cornered tools with a number of benefits:

- A more robust cutting component than a conventional brazed tool
- Greater reliability in interrupted cutting applications
- Elimination of the braze joint allowing higher temperature coatings to be applied
- Reduced insert failure risks and improved production continuity
- Longer cutting edges which enable productivity improvements in application; either through the use of larger depths of cut or plunge-type machining operations
- High and low CBN content configurations

THE BENEFITS OF USING CENTRE-LOCK FULL-FACE INSERTS

- Eliminate pocketing and brazing procedures
- Improved precision by eliminating brazing inaccuracies
- Reduce the amount of handling
- Cut the overall production cost per usable corner
- Apply higher temperature coatings
- Shorten the production pipeline by eliminating the need for:
  - carbide preparation
  - segment cleaning
  - brazing
  - after-brazing cleaning

STANDARD PCBN RANGE AVAILABLE
(OTHER SIZES AND FORMATS AVAILABLE ON REQUEST)

INSERT SHAPE	INSERT STYLE	CLEARANCE	TOLERANCE CLASS[1]	HOLE STYLE	FINISHED IC[2]	INSERT THICKNESS	CORNER RADIUS
	C	N	M	W	06 - 6.35	02 - 2.38	02
	80				09 - 9.52	T3 - 3.97	02
	D	N	M	W	07 - 6.35	02 - 2.38	02
	55				11 - 9.52	T3 - 3.97	02
	S	N	M	W	06 - 6.35	02 - 2.38	02
	90				09 - 9.52	T3 - 3.97	02
	T	N	M	W	09 - 5.56	02 - 2.38	02
	60				11 - 6.35	02 - 2.38	02
	R	N	M	W	06 - 6.35	03 - 3.18	00
	360				07 - 7.94	03 - 3.18	00
	W	N	M	W	06 - 9.52	03 - 3.18	02
	80						

IC - Inscribed Circle
1) Tolerance on overall thickness +/-0.05 and IC tolerance +/- 0.10mm.
2) Grinding allowances apply, IC diameters shown will be produced with a 0.3mm grinding allowance.
3) All measurements are mm.

PCBN GRADE AVAILABILITY

Centre-lock full face PCBN inserts are available in all WC backed PCBN grades.

END USER BENEFITS

Machine operators and engineering managers also value the benefits of integral inserts over brazed inserts; the ability to switch from corner to corner means that maintaining production continuity is simply a matter of adjusting the insert. The longer cutting edges of an integral insert also enable plunge machining which can achieve valuable gains in productivity and reductions in both downtime and costs.

ELEMENT SIX

Element Six, part of the De Beers Group of Companies, designs, develops and produces synthetic diamond and other supermaterials, and operates worldwide with manufacturing facilities in China, Germany, Ireland, South Africa, the UK and US.

Element Six supermaterial solutions are used in applications such as cutting, grinding, drilling, shearing and polishing, while the extreme properties of synthetic diamond beyond hardness are opening up new applications in a wide array of industries such as optics, power transmission, water treatment, semiconductors and sensors.

If you would like to know more about Element Six please visit our website **www.e6.com** or contact us using the details given below.

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