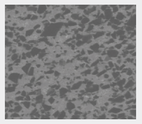
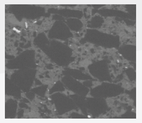
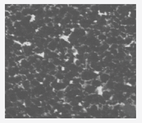
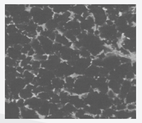
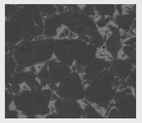
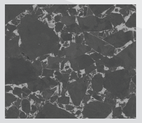
PCBN APPLICATION GUIDE

elementsix™ a De Beers Group Company

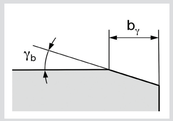
GRADES AND CHARACTERISTICS

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 continuous 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	
DCX650	For moderate to heavy 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 2 µm 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 majority of ferrous powder metals.	Approximately 90% CBN 4 µm 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	

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

CHAMFER / T-LAND:

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

HONED EDGE:

Hone size is more difficult to control than chamfers, but popular for HRSA's

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	DCX650	DBS900	DBW85	AMB90	AMK90	CUTTING SPEED, v_c (m/min) [8]		FEED, f (mm) [3, 5, 7]		DEPTH OF CUT, a_p (mm) [4, 5, 7]		CHAMFER ANGLE, γ_b	CHAMFER WIDTH, $b\gamma$ (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	150	500	150	500	15 -	0.1 -	10 -	0.8 -
	ADI - K10																	
	ADI - K20 - K30								200	400	200	400	200	400	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				

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 heavy 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 HRSA's it is preferable to use round inserts. It is also advisable to assess the use of un-chamfered, but honed, cutting edge geometries.