# Diamond- and CBN-Tools

In the past decades diamond tools for working hard materials and CBN tools for working steel have contributed to a rapid development in the metal cutting production technology.

WENDT supports and assists its industrial partners in coping with the constantly growing requirements of economical production and product quality. Our knowhow is dedicated to the service of our customers.

WENDT provides high quality CBN and diamond grinding tools in all bonding systems and for every single application.

The efficient machining of difficult-to-grind materials, such as HSS, tungsten carbide, ceramics, PCD and PCBN, Cermets and hard coatings requires high-performance tools.

WENDT diamond grinding tools in resin and sintered metal bonds set the standards for the machining of hard materials.

WENDT diamond grinding tools in vitrified bond enables the economical machining of extremely hard materials.

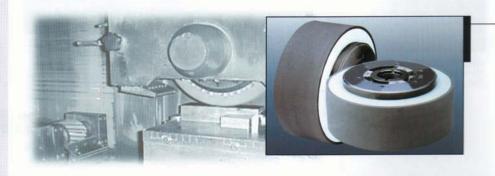
WENDT CBN grinding tools in vitrified bond are indispensable for large-batch productions of precision components.

WENDT CBN grinding tools in galvanic bond for high-speed grinding have opened new dimensions in the performance evaluation of the grinding process.

WENDT precision tools for gear grinding set the highest standards.













# Diamond Grinding Wheels in Resin Bond enable the grinding of complex small workpieces accurately to form and size

- long service life and reduced frequency of corrections
- High cutting edge quality and freedom from chipping
- high material removal rates
- good cutting action
- high surface quality

# Diamond Grinding Tools in Vitrified Bond (VIT DIA) open new fields of application especially for the machining of PCD and PCBN

- easy conditioning
- reduction of grinding times
- high stock removal rates
- good form stability

# CBN Grinding Wheels in Vitrified Bond (VIT CBN) stand out with their excellent grinding and profiling properties and are chiefly used for production grinding of hardened steel materials

- easy conditioning
- reduction in grinding time
- high material removal rates
- good form stability

CBN Grinding Wheels in Galvanic Bond are for production grinding of all kinds of steel and cast iron materials with high material removal rates and are used: e.g. in the car industry for grinding camshafts and crankshafts

- extremely high process reliability
- reduction of machining times
- extremely good cutting capacities
- no conditioning necessary
- reduced down-times

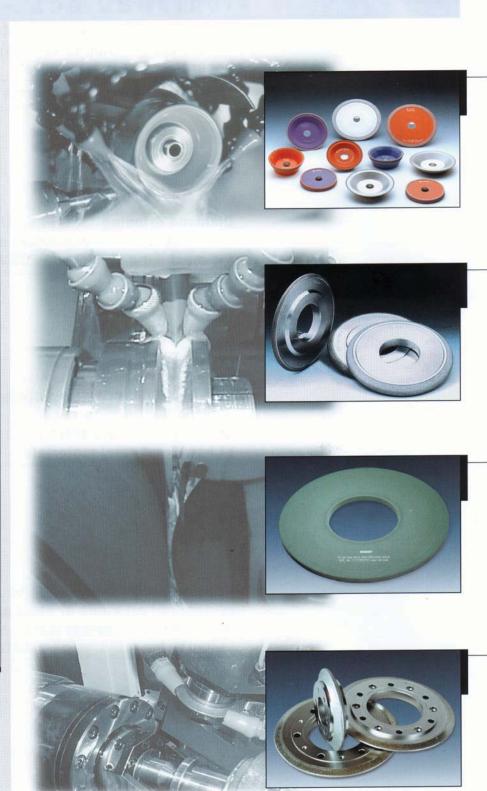
# Bonds

Grinding tools with diamond or CBN abrasive grits usually consist of a basic body on which the abrasive layer, i.e. the grits and bond, is applied in different ways. The bond can be resin, sintered metal, ceramic or galvanic bond.

The bond is of equal importance as the abrasive grit for the performance of the grinding tool. In consideration of the operating conditions applied both have to be match to each other in such a way that the abrasive grits are held in the bond as long as they still have or generate cutting edges. When the grits are worn and become unusable as an abrasive, they have to be released from the bond. A grinding wheel adapted in this way gives durability with the highest performance, low wear and reduced grinding forces.

If the worn grit remains in the bond too long, the grinding wheel loses its cutting ability after a short time. If, on the other hand, the bond wears faster than the abrasive grits or it does not hold them long enough, the abrasive grits cannot be fully utilised and the service life of the grinding wheel is reduced.

In particular cases it may be necessary to adapt the grinding wheel to optimise it to the specific application parameters.





#### **Resin Bond**

The resin bond has proved a success in almost all fields of grinding hard materials and steel. High cutting capability with low grinding forces in dry and wet grinding characterise this type of bond and allow a great scope for adaptation. The basis of this bond system are, for the most part, phenolic or polyimide resins. In particular cases special resins are also used. The extreme flexibility of the bonds properties is achieved by adding a mixture of suitable additives.

#### Sintered Metal Bond

Grinding tools in sintered metal bonds often consist of bronze and iron compounds to which suitable additions are admixed. They are used in applications requiring particularly high wear resistance and profile stability. Due to the generally high active forces the material removal capacity is lower than that achieved with resin bonds. The exception is the special sintered metal bonds, which are used, for an example, for profile crush forming. These bonds have a particularly good cutting ability and distinguish themselves by a high material removal capacity.

#### **Vitrified Bond**

Ceramic bonds are composed of mineral raw materials. Ceramic bonds are used in the production of abrasive layers with a defined porosity of approx. 2% to 40%. This allows for an extremely wide spectrum of applications. The tools in ceramic bond stand out for their particularly good dressing and profiling ability, low wheel wear together with low grinding forces and high qualities of the workpiece surface.

#### **Galvanic Bond**

The galvanic bond constitutes a special type of metal bond. As bonding material mainly nickel is used, in special cases also cobalt, which is deposited electrolytically over a layer of grits on a metallic tool body in a galvanic bath. The advantage of electrolytically bonded grinding wheels is their extremely high cutting ability and grinding performance. Galvanic tools are used for pre-grinding complex profiles with high material removal rates and for finish-grinding with high accuracy, e.g. in the gear grinding industry.

# Characteristics of Diamond and CBN Grits

In the industry abrasive and dressing grits of diamond and CBN (Cubic Boron Nitride) are used. Both natural and synthetically produced diamond is used whilst CBN is always synthesised product. Besides the cubical crystal structure and its resulting cutting edge formation, the chemical and physical properties (Table 1) are decisive factors in the grinding applicability of the diamond and CBN grits. Diamond is considerably harder than CBN as is shown the comparison of the different hard materials in Diagram 1. The much higher temperature resistance of CBN shown in Diagram 2. This is based on the lower oxidation properties of CBN compared with that of diamond. Besides the grit size the influence of the grit quality which is manifold and needs a detailed analysis of the requirements. WENDT provides corresponding information to make the selection easier.

Generally valid correlation between the tool quality, grinding behaviour and the grit quality can only be given to a very limited extent and in most cases only in relation to special cases of application. In general, however, the following applies: A friable grit type improves the cutting ability of the grinding wheel while it usually results in a deterioration of the achievable surface quality. Whereas a blocky grit type improves the service life of the grinding wheel and, in many cases, the achievable surface quality, however, it deteriorates the cutting ability. Often the grits are coated in copper or nickel to improve the bonds ability to hold the grits, the heat transfer and the chemical and mechanical properties.

		DIA	CBN
Density	g/cm <sup>3</sup>	3,52	3,48
Hardness (Knoop)	kN/mm <sup>2</sup>	80	47
Hardness (Mohs)		10	9-10
Temperatureresistance (air)	°C	up to 700	up to 1400
Chemical formula		С	BN

Table 1

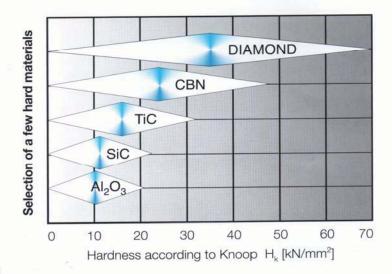


Diagram 1

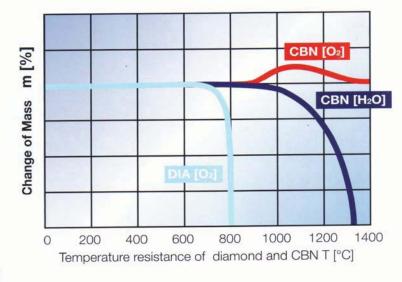


Diagram 2



### Grit Sizes

Among the variables applied in tool grinding the grit size of the abrasive material has a large influence on the grinding process and final result.

By reducing the grit size the number of active cutting edges increases and the roughness of the produced surface improves independently of the workpiece speed. The grit size therefore has a decisive influence on the cutting ability and service life of the grinding tool. Apart from a few exceptions it can be said in general that both the cutting ability and the service life improve with increasing grit sizes. Consequently the largest grit size possible should always be chosen.

The classification and designation of grit sizes is made according to ISO standard 6108-1979, FEPA or DIN 348. This standard contains two designation systems:

- The metrical designation system preferred in Europe based on the mesh width of the screens.
- The designation system used in the USA according to the number of screen apertures per square inch of the corresponding screens (mesh).

Table 1 gives an overview of the designations of typical diamond and CBN abrasive grits in a narrow (1) and wide (2) distribution range. Both classification systems are shown in a comparison chart.

In the case of extremely fine grits, the mirco-grit sizes, the classification is made according to FEPA standard or WENDT designation (Table 2).

Eur	ope (met	ric) U	SA (mesi	1)	
for Di	nation A : D BN: B or VIT-CBN)	Screen Mesh Width in µm	Designation for DIA : D for CBN: B (or M for VIT-CBN)		
(1)	(2)		(1)	(2)	
1181	1182	1180 - 1000	16/18	16/20	
1001	1102	1000 - 850	18/20	10/20	
851	852	850 - 710	20 / 25	20/30	
711	852	710 - 600	25 / 30	20/30	
601	000	600 - 500	30 / 35	20/40	
501	602	500 - 425	35 / 40	30/40	
426	407	425 - 355	40 / 45	40/50	
356	427	355 - 300	45 / 50	40/50	
301	-	300 - 250	50 / 60		
251	050	250 - 212	60 / 70	60/80	
213	252	212 - 180	70 / 80	00/80	
181	-	180 - 150	80 / 100	-	

150 -

125 -

106 -

90 -

75 -

63

53

45 -

125

106

90

75

63

53

45

38

100 / 120

120 / 140

140 / 170

170 / 200

200 / 230

230 / 270

270 / 325

325 / 400

Table 1

151

126

107

91

76

64

54

46

Screen Grit Sizes

Designation for DIA: MD for CBN: MB		WENDT Designation Ø Size in µm	FEPA Standard Ø Size in µm	USA Designation (mesh)	
MD/MB	40	30 - 40	27 - 53	500/600	
MD/MB	40A	30 - 60			
MD/MB	40B	36 - 54			
MD/MB	25	20 - 30	16 - 34	600/800	
MD/MB	25A	15 - 25			
MD/MB	25B	15 - 30			
MD/MB	25C	20 - 40			
MD/MB	16	10 - 20	10 - 22	800/1200	
MD/MB	16A	8 - 16			
MD/MB	10	6 - 12	6 - 14	1200/1800	
MD	6,3	4 - 8	4 - 9	1400/3000	
MD	4,0	3 - 6	2,5 - 5,5	3000/8000	
MD	2,5	2 - 4	1,5 - 4	8000/12000	
MD	1,6	1 - 3	1,0 - 2,5	12000/13000	
MD	1,0	0 - 2	0,5 - 1,5	13000/14000	

Table 2



# Concentrations

The concentration defines the gravity fraction of the abrasive grit per volume of abrasive layer. Internationally valid concentration standards do not exist. In Germany the following definition is generally accepted and standardised under DIN 69800, Part 2. According to this standard the following applies to diamond and **CBN** grits: Concentration  $100 = 4.4 \text{ ct/cm}^3$  abrasive layer. As one carat (ct) = 0.2 g, the concentration 100 means 0.88 g grinding grit per cm3 abrasive layer. This applies to diamond and CBN grinding tools alike since the specific weight of both grit types is almost identical. In the scope of a standardisation, diamond and CBN abrasive grits are chiefly processed in the concentrations shown in Table 1. Some manufacturers use volume-related specifications for the concentration. These values are calculated according to the following formula:

V = weight (g)
specific weight (g / cm³)

This means, for example, that instead of the concentration 100 the designations V24 or V240 are used. In general the following applies: Increasing concentrations reduce the roughness of the ground tools, i.e. the surface quality and edge chipping are improved. The grinding energy increases, and the achievable material removal rate reduces, i.e. the cutting ability of the grinding wheel deteriorates.

III(ATAMAKAN)	NDT - C	UIIGE	IIIIai	10115				
25	38	50	75	100	125	150	175	200
	/ -	m <sup>3</sup>	ENGIN	HHH	muna		MILLIA	
Car	at / c							

Vol	ume-	Relate	d Cor	centi	ration	s in F	er Ce	nt	
V6	V9	V12	V18	V24	V30	V36	V42	V 48	

Vol	ume-F	Relate	d Con	centr	ation	s in P	er Mi	1
V60	V90	V120	V180	V240	V300	V360	V420	V480
Table	1							



Concentration 50



Concentration 75



Concentration 100

