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 know-how 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, Ceramets 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

For more detailed information on the product line see page 22 and 23
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 matched 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 cubic 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.
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 6106-1979, FEPA or DIN 346. This standard contains two designation systems:
- The metric 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 micro-grit sizes, the classification is made according to FEPA standard or WENDT designation (Table 2).
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 ct/cm² abrasive layer. As one carat (ct) = 0.2 g, the concentration 100 means 0.88 g grinding grit per cm² 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:

\[ V = \frac{\text{weight (g)}}{\text{specific weight (g / cm}^3)\text{}} \]

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.

### Concentrations

**WENDT-Concentrations**

<table>
<thead>
<tr>
<th>25</th>
<th>38</th>
<th>50</th>
<th>75</th>
<th>100</th>
<th>125</th>
<th>150</th>
<th>175</th>
<th>200</th>
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**Carat / cm²**

<table>
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<tr>
<th>1,1</th>
<th>1,65</th>
<th>2,2</th>
<th>3,3</th>
<th>4,4</th>
<th>5,5</th>
<th>6,6</th>
<th>7,7</th>
<th>8,8</th>
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**Volume-Related Concentrations in Per Cent**

<table>
<thead>
<tr>
<th>V6</th>
<th>V9</th>
<th>V12</th>
<th>V18</th>
<th>V24</th>
<th>V30</th>
<th>V36</th>
<th>V42</th>
<th>V48</th>
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</thead>
</table>

**Volume-Related Concentrations in Per Mil**

<table>
<thead>
<tr>
<th>V60</th>
<th>V90</th>
<th>V120</th>
<th>V160</th>
<th>V240</th>
<th>V300</th>
<th>V360</th>
<th>V420</th>
<th>V480</th>
</tr>
</thead>
</table>

Table 1

Concentration 50

Concentration 75

Concentration 100