Your partner for technical support

CERATIZIT is a high-tech engineering group in tooling and hard material technology.

Tooling the Future

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Cemented carbide

Cemented carbide is a powder metallurgical composite consisting of one or more hard material phases (e.g. tungsten carbide) and a binding material (e.g. cobalt). It is an extremely hard material, characterised by high wear resistance and thermal stability. It is used in various fields that require tools or components to be particularly wear-resistant.

Cemented carbide improves the quality of tools and components, gives them a longer service life and ensures a constant performance.

By varying the grain size of the tungsten carbide, binder content and alloy components, the performance characteristics of the cemented carbide, such as hardness, transverse rupture strength, fracture toughness or corrosion resistance can be optimised according to the application.
Cemented carbide – a composite material with valuable properties

Cemented carbides are composite materials consisting of a hard material and a comparatively soft binder metal, like cobalt (Co). The performance characteristics of carbide are determined by hardness, transverse rupture strength and fracture toughness. With regard to their application, important parameters for the optimisation of these characteristics are the cobalt content and the grain size of the metal binder phase. The tungsten carbide grains have an average size of less than 0.2μm up to several micrometres (μm). The cobalt fills the gaps between the carbide grains. When extremely high toughness is required, the cobalt content can amount to as much as 30%, whereas, for maximum wear resistance, the cobalt content is reduced and the grain size decreased to the nanocrystalline range of < 0.2μm.

CERATIZIT produces far more than 100 different cemented carbide grades particularly for wear parts and cutting tools, thus offering a customised solution for every application.
Carbide production

Carbide production at CERATIZIT started in 1929. Last but not least, thanks to long-standing experience CERATIZIT handles the entire process chain, from the raw material to the dispatching of the finished products to customers. The production process of powder-metallurgical products basically includes the four steps of powder preparation, shaping, sintering and finishing.

Tungsten carbide production

The APT (ammonium para-tungstate) is calcined into tungsten oxide under high temperature. Subsequently the oxide is reduced to tungsten metal in a hydrogen atmosphere. The metal powder is then mixed with carbon and carburised under inert atmosphere at high temperatures. The production parameters are decisive for the WC grain size in the sintered carbide.

Powder preparation

The tungsten carbide is intensely mixed with the binder metal cobalt, nickel or iron, various grain growth inhibitors and special alloys as well as materials, which promote compaction, by wet grinding so that a homogeneous suspension is created. Afterwards, the suspension is dried in a spray tower to produce a granulate with good flow characteristics. This granulate represents the basis for all forming processes.
Pressing – shaping – machining

The objective of the forming process is to obtain a near net shape sample. Pressing is normally carried out at room temperature with pressures reaching up to several tons per square centimetre.

There are several ways of pressing blanks:

During isostatic cold pressing the powder is filled into an elastic flexible hose and pressed into a compacted form through high liquid pressure. The powder blocks which are produced in this way can then be processed mechanically. All common machining methods like milling, cutting, drilling or turning may be used.

In uniaxial pressing the pressing tool consists of a die and an upper and a lower punch. The carbide powder is filled into the die and then compacted to create the "near-net-shape" green geometry, which is ejected from the pressing die.

Extrusion pressing is mainly used to produce rectangular bars or cylindrical rods, with or without axial hole(s). A plastifier is added to the powder. The resulting paste is pressed through an extrusion nozzle. Before sintering, the plastifier must be evaporated in special drying furnaces.

Metal Injection Moulding (MIM) is a process used to produce more complex forms which cannot be produced by direct pressing. The paste preparation is similar to the extrusion process.
Sintering

The sintering process converts the blank into a homogeneous and dense cemented carbide with a high level of hardness. The material is sintered at temperatures between 1,300 and 1,500°C (liquid phase sintering) and sometimes also at high pressure (up to 100 bar). The volume is reduced by up to 50% during this process.
In order to achieve the final requirements of surface finish, tolerances, etc., carbide parts can be subjected to a series of finishing processes such as grinding, spark erosion and coating.

As a pioneer in coating technology we set new standards through revolutionary coating developments even today. Our coating competence covers classic hard material coatings, functional custom coatings for specific customer applications as well as multi-layer coating. These coatings, which consist for example of titanium carbide, titanium nitride or aluminium oxide, maximise the cutting performance and service life of the CERATIZIT carbide products. The most important coating procedures are CVD (Chemical Vapour Deposition) and PVD (Physical Vapour Deposition).

Cemented carbide machining by spark erosion meets the highest technological standards. Wire erosion and cavity sinking by EDM guarantee high precision. Long-standing experience combined with carbide grades that are specially adapted for erosion guarantee optimum machining results.
Joining – erosion – quality check

In many cases it is not optimal to manufacture the entire component in cemented carbide. The use of cemented carbide is then limited to the area in which the special properties of cemented carbide are needed. Materials with appropriate wear resistance are used for the tool. They are easier to machine than cemented carbide. Numerous tried and tested technologies, such as brazing, gluing, clamping, connections with screws and shrinking are applied to combine cemented carbide with other materials.
Cemented carbide is a hard material with mechanical properties that can be adjusted within a very wide range, given its composition and microstructure. The hardness and toughness range of the CERATIZIT grades includes everything from wear-resistant tool steel to super-hard ceramic materials.

Criteria relevant for the choice of application

- Wear resistance, hardness
- Compressive strength
- Impact strength
- Transverse rupture strength
- Tribological properties
- Specific weight
- Magnetic properties
- Modulus of elasticity, rigidity
- Thermal properties
- Corrosion resistance, resistance to oxidation
- Toughness

The hard material provides the necessary

- hardness
- wear resistance

The metallic binder provides

- toughness

The classification of carbides according to grain size corresponds to the recommendations of the Powder Metallurgy Association. The standard ISO codes for carbides which were developed for fine to medium grain sizes no longer correspond to today’s state of the art. In order to choose the correct grades, only the application data are relevant.
Cemented carbide properties

Hardness

Cemented carbide grade (extreme example):
▲ Very high hardness: 2650 HV30
▲ Small grain size: < 0.5 µm
▲ Low Co content: 0.4%
▲ Corrosion resistance when adding Cr₃C₂

Transverse rupture strength

Cemented carbide grade (extreme example):
▲ T.R.S.: > 4000 MPa
▲ Small grain size: < 0.5 µm
▲ Low Co content ~ 8.5%
▲ High wear resistance: 1930 HV30

Toughness

Cemented carbide grade (extreme example):
▲ Sufficient fracture toughness: Co content 20%
▲ Good wear resistance: 1030 HV30
▲ Medium grain size coarse or extra-coarse

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The graphic illustrations below show that the mechanical properties of the carbide mainly depend on the binder content (Co) and the WC grain size. Hardness, i.e., wear resistance, increases inversely proportional to the fracture toughness. This means that the harder the material the more it reacts to notch tensions and impact stress (the 'impact resistance' parameter, which cannot be precisely defined, correlates with the fracture toughness of the material).

On the other hand, the transverse rupture strength does not directly depend on the hardness but rather on the WC grain size and the cobalt content. The adhesive wear (tendency to stick), however, decreases with the grain size and the cobalt content of the carbide used. The list of the mentioned interdependencies, which could be extended at will for other wear and failure mechanisms, show that it is only possible to choose the correct carbide grade following a systematic procedure and/or based on experience with similar applications.
Production site

Mamer (Luxembourg)

The CERATIZIT-Group has its headquarters in Mamer, Luxembourg. Today the plant in Mamer has more than 1,200 employees and concentrates on industrial wear protection, wood, metal and stone working as well as inserts and tools.

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Surface treatment

CERATIZIT is continuously working to provide the best solutions for toolmakers. From the raw material to the finished products, details matter. That is the reason why we are able to provide several surface finishes for our cemented carbide products.

Nevertheless we highly recommend a cobalt layer on every brazed product, and a nickel layer for welded parts. For any questions or special requests, please do not hesitate to contact our CSC (Customer Service Centre).

<table>
<thead>
<tr>
<th>Surface treatment designation</th>
<th>Process description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TSR1</td>
<td>Tumbling – polishing</td>
</tr>
<tr>
<td>TS42</td>
<td>Tumbling – sandblasting – cleaning in aqueous media</td>
</tr>
<tr>
<td>TS43</td>
<td>Sandblasting – tumbling – polishing – cleaning in aqueous media</td>
</tr>
<tr>
<td>TSN</td>
<td>Tumbling – nickel deposition</td>
</tr>
<tr>
<td>TSX = TS8* = TS90*</td>
<td>Tumbling – cobalt deposition</td>
</tr>
</tbody>
</table>

* We apply different designations to the same surface treatments because they relate to different product families.
Pre-tinning

If you are looking for a way to save time and reduce your production costs, CERATIZIT provides you with pre-tinned saw tips and strobe blanks. Most of our standard saw tip designs can be pre-tinned. Two different kinds of brazing material are available. Wherever you need tri-foil (silver/copper/silver), named ‘DA’, or silver braze known as ‘PT’, CERATIZIT can deliver material in all carbide grades.

For technical feasibility, please refer to the table below:

Saw tips

<table>
<thead>
<tr>
<th>Minimal dimensions</th>
<th>Maximal dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>Width</td>
</tr>
<tr>
<td>6,5</td>
<td>2,5</td>
</tr>
</tbody>
</table>

Strobe blanks

<table>
<thead>
<tr>
<th>Minimal dimensions</th>
<th>Maximal dimensions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Length</td>
<td>Width</td>
</tr>
<tr>
<td>20,0</td>
<td>2,0</td>
</tr>
</tbody>
</table>

CERATIZIT square strobe blanks are only available with the tri-foil brazing alloy ‘DA’.
Brazing

Brazing doesn’t have to be stressful! Over decades, the CERATIZIT R&D team has acquired a wealth of expertise in connection with the brazing process. Thanks to 3D simulation, cooperation with universities and various internal tests we are familiar with the root causes of most frequently found brazing failures.

Troubleshooting

The condition in the brazing gap has a major influence on the stresses within the carbide parts and a possible breakage. Thus, a too small brazing gap or even contact between steel and hardmetals could generate cracks. Regarding these facts the brazing material position is one of the main brazing issues. Total or partial absence of Cu layer in the top/bottom of the brazing gap is critical and leads to generation of high internal stresses.

With the use of a massive brazing filler metal a uniformly brazing gap thickness of approximately 0.1 to 0.2 mm is recommended. With the use of tri-metal brazing alloy (sandwich braze) the standard thickness of the Cu interlayer is 0.15 mm. Increasing this Cu layer thickness reduces stresses in the tungsten carbide and therefore the risk for breakage.

During the brazing process, temperature control is too often neglected. We strongly recommend the use of a pyrometer out of the direct light. Too high or not accurate temperature can generate porosity. Temperature should be adapted in function of the used brazing filler metal and fluxes.
Grinding

Cemented carbide is exclusively ground with diamond grinding wheels.

Diamond

Diamond types
- Synthetic
- Natural

Properties
- Hardness: 80 kN/mm²
- Density: 3520 kg/m³
- Thermal stability: up to approx. 700 °C
- Colour: transparent to green-yellowish
- Highly reactive regarding the formation of carbides

Application fields
- Machining of carbides, ceramic, cermets, PCD, PCBN (polycrystalline cubic boron nitride), glass, extremely hard steel

Application in grinding wheels
- In all types of bonds
- But mainly in synthetic resin and metal bonds

Thermal stability

![Graph showing the relationship between hardness and temperature]
**Diamond abrasive grit**

### Types of grit:
- ▲ Block-like
- ▲ Micro-crystalline
- ▲ Splintering
- ▲ Grit with coating

### Coated abrasive grit:
- ▲ Lightly or strongly covered
- ▲ Mostly with metal cover
  - abrasive grit with a metal cover achieves longer tool life and better thermal conductivity
  - abrasive grit without metal cover cuts better and is smoother

#### Grit size designation and grit size comparison for diamond grit (1)

<table>
<thead>
<tr>
<th>D…</th>
<th>% &gt;</th>
<th>FEPA grit sizes</th>
<th>Mesh (USA) (Japan) grits/ct</th>
<th>Medium grit size</th>
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<tr>
<td></td>
<td></td>
<td>µm</td>
<td>% between</td>
<td>µm</td>
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<td>8</td>
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<td>57</td>
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<td>54</td>
<td>15</td>
<td>65</td>
<td>80</td>
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<td>46</td>
<td>15</td>
<td>57</td>
<td>80</td>
<td>41</td>
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</tbody>
</table>

< 46; micron -> no screening

### Grit size designation and grit size comparison for diamond grit (2)

<table>
<thead>
<tr>
<th>Europe (metric)</th>
<th>Macro-grit size (screened)</th>
<th>USA (mesh)</th>
<th>Designation</th>
<th>Micro-grit size</th>
<th>US (mesh)</th>
</tr>
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<tr>
<td>D…</td>
<td>mesh size</td>
<td>[µm]</td>
<td>Designation</td>
<td>flour</td>
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<tr>
<td>1.180</td>
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<td>500/500</td>
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<td>1.001</td>
<td>1.000–850</td>
<td>18/20</td>
<td>MD25</td>
<td>16–34</td>
<td>600/800</td>
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<tr>
<td>851</td>
<td>850–710</td>
<td>20/25</td>
<td>MD16</td>
<td>10–22</td>
<td>800/1200</td>
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<tr>
<td>711</td>
<td>710–600</td>
<td>25/30</td>
<td>MD10</td>
<td>6–14</td>
<td>1.200/1.800</td>
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<tr>
<td>601</td>
<td>600–500</td>
<td>30/35</td>
<td>MD6,3</td>
<td>4–9</td>
<td>1.400/3.000</td>
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<tr>
<td>501</td>
<td>500–425</td>
<td>35/40</td>
<td>MD4,0</td>
<td>2,5–5,5</td>
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<td>426</td>
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<td>MD2,5</td>
<td>1,5–4</td>
<td>8.000/12.000</td>
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<td>356</td>
<td>355–300</td>
<td>45/50</td>
<td>MD1,6</td>
<td>1,0–2,5</td>
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<td>54</td>
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<td>270/325</td>
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<tr>
<td>46</td>
<td>45–38</td>
<td>325/400</td>
<td></td>
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</tbody>
</table>
Influence of grit size on ground surface and edge quality

Selection of diamond grit size is important when considering the final surface quality that needs to be achieved.

Coarser grit mesh sizes reduce the achievable surface quality and finer granularity will improve the surface.

Influence of grit size and concentration

<table>
<thead>
<tr>
<th>Grit Size</th>
<th>Concentration</th>
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<tbody>
<tr>
<td>USA [mesh]</td>
<td>C50</td>
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<tr>
<td>325/400 D46</td>
<td>2481</td>
</tr>
<tr>
<td>270/325 D54</td>
<td>1534</td>
</tr>
<tr>
<td>230/270 D64</td>
<td>921</td>
</tr>
<tr>
<td>200/230 D76</td>
<td>550</td>
</tr>
<tr>
<td>170/200 D91</td>
<td>320</td>
</tr>
<tr>
<td>140/170 D107</td>
<td>197</td>
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<tr>
<td>120/140 D126</td>
<td>120</td>
</tr>
<tr>
<td>100/120 D151</td>
<td>70</td>
</tr>
<tr>
<td>80/100 D181</td>
<td>40</td>
</tr>
<tr>
<td>60/80 D252</td>
<td>15</td>
</tr>
</tbody>
</table>

Types of bonds in grinding wheels

<table>
<thead>
<tr>
<th>Advantages and disadvantages</th>
<th>Metal</th>
<th>Ceramic</th>
<th>Resin</th>
<th>Galvanic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting performance</td>
<td>○○○○</td>
<td>○○○○</td>
<td>○○○○</td>
<td>○○○○</td>
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<tr>
<td>Deformation resistance</td>
<td>○○○○</td>
<td>○○</td>
<td>○○○○</td>
<td>○○○○</td>
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<tr>
<td>Thermal stability</td>
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<td>○○○○</td>
<td>○○</td>
<td>○○○○</td>
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<tr>
<td>Conductivity</td>
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<td>○○○○</td>
<td>○○○○</td>
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<td>Dressing characteristics</td>
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<td>○○○○</td>
<td>○○○○</td>
<td>○○○○</td>
</tr>
</tbody>
</table>

Metal (Cu, Co)
Ceramic
Galvanic
Resin

In addition the bond is characterised by filler materials and porosity

○○○○ optimal
○○ good suitability
○ not suitable
Wear mechanisms on grinding wheels

Grit wear
- Grit flattening ⇔ Grinding pressure ↑
- Grit splintering ⇔ Self-sharpening effect
- Grit chipping ⇔ Tool failure

Bond wear
- In materials with chip formation/cutting materials ⇒ Wear of the bond
- In chipless materials/work piece materials ⇒ Powdery abrasion of the work piece (very low wear of bond)

Influence of modifying grinding parameters

<table>
<thead>
<tr>
<th>Machine and operation parameters</th>
<th>Modifying parameters</th>
<th>Cemented carbide</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cutting speed (v_c) [m/s]</td>
<td>Grit size [µm]</td>
<td>Hardness [HV]</td>
</tr>
<tr>
<td>Metal removal rate (Q_w) [mm&lt;sup&gt;3&lt;/sup&gt;/s]</td>
<td>Concentration [grit amount/cm&lt;sup&gt;3&lt;/sup&gt;]</td>
<td></td>
</tr>
<tr>
<td>Coolant</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| Grinding force \(F\) | \(\uparrow\) | \(\uparrow\) | \(\uparrow\) | \(\uparrow\) |
| Wear rate \(G\) | \(\uparrow\) | \(\uparrow\) | \(\uparrow\) | \(\uparrow\) |
| Roughness \(R_a\) | \(\uparrow\) | \(\uparrow\) | \(\uparrow\) | \(\uparrow\) |
| Temperature \(\theta\) | \(\uparrow\) | \(\uparrow\) | \(\uparrow\) | \(\uparrow\) |

Influence of cutting conditions on grinding result

\[ \frac{Q'w}{\text{grit size}} \]

\[ v_c \cdot l_g \]

\[ l_g \]

\[ v_w \]

Internal pressure and tension
Surface quality
Cutting edge quality
Cooling lubricant for grinding

Applying a cooling lubricant when grinding is extremely important:

▲ It influences the removal of the heat generated during the grinding process and the evacuation of the chips produced

Therefore, the use of the coolant has to be adapted with regard to:

▲ The type of coolant (oil, emulsion)
▲ The viscosity of the coolant
▲ The flashpoint of the coolant
▲ Pressure, flow rate, speed and direction of the coolant jet

The coolant achieves an optimal effect only when it is correctly filtered:

▲ Without filtering the fine abrasive material can be recirculated and become re-attached to the grinding wheel
▲ The abrasive material from grinding refuse sticks to the work piece and to the grinding wheel
▲ Blocks the grinding wheel, generates excessive heat and destroys the bond of the grinding wheel and the carbide part which is to be ground
▲ Leads to early wear of the wheel
▲ Contaminated coolant decreases the service life and precision of the machine

Influence of cooling lubricant

Potential properties of cooling lubricants

<table>
<thead>
<tr>
<th></th>
<th>Grinding oil</th>
<th>Emulsion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lubricating effect</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Thermal conductivity</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Thermal capacity</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Viscosity</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Costs</td>
<td>✓</td>
<td>✓</td>
</tr>
</tbody>
</table>

Comparison of potential process influence of cooling lubricants

<table>
<thead>
<tr>
<th></th>
<th>Grinding oil</th>
<th>Emulsion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heat generation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Heat removal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tool wear</td>
<td></td>
<td></td>
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<tr>
<td>Cleaning effect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Costs</td>
<td></td>
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</tbody>
</table>

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Dressing of the grinding wheel

When dressing the grinding wheels the following has to be considered:

▲ Hardness and grit types of the dresser and grinding wheel sharpening stick
  - dressing stick must be approx. 1 to 2 grit sizes finer than the abrasive grit size of the grinding wheel
  - medium grit is good for resin-bonded grinding wheels
  - for metal bonds the same grit size or 1 x class coarser than the grinding wheel
  - ceramic bonds generally do not require wheel dressing

▲ Rotation speed of the grinding wheel during the dressing process
▲ Material of the dressing stick (SiC, Al2O3)
▲ Procedure
  - dressing and 'sharpening' of the grinding wheel,
  - sharpening of the rim
  - The surface of the grinding wheel is smooth and closed.
  - The grinding wheel surface is open with exposed abrasive diamond grit, prepared for an effective grinding impact.

▲ Verification method of the grinding wheel's sharpness after dressing

How to establish if grinding wheel is correctly dressed

Diamond grit loss

Exposed diamond grit (free cutting)
EDI – your direct line to reach us

If you order products frequently, electronic data interchange (EDI) offers you the possibility of accelerating the ordering process by means of direct, encoded communication between the ERP systems of both companies. This also minimises the administrative workload and excludes errors caused by manual input. As EDI is based on industrial standards, the outlay involved in a one-off set-up is quite manageable. In the long run, however, you will benefit by reducing the time and cost of ordering from us.

Your benefits:

▲ Order faster via your own ERP system
▲ Reduced administrative workload
▲ Avoid mistakes caused by manual processing
▲ 24/7 safe, encoded data interchange between you and us
▲ The electronic data can be further processed on your ERP system

Supported features:

▲ All common message formats, e.g. XML IDoc (native), EDIFACT, VDA and ANSI X.12
▲ All common transmission channels like HTTPS (native), OFTP/OFTP2, AS and X.400
▲ Various message types (orders, order confirmations, delivery schedules, shipment notifications, invoices etc.)
Design Guidelines

If you cannot find the specific product you need in our large standard range, we are happy to manufacture a customised product to your requirements. Simply specify the properties you require on the following enquiry templates and send it to your personal contact person at CERATIZIT to receive an offer in no time.
Circular saw tips (wood)

Design:

- [ ] Straight
- [ ] US
- [ ] Canadian
- [ ] 60000
- [ ] Hollow
- [ ] Your drawing

Dimensions:

<table>
<thead>
<tr>
<th>L</th>
<th>W</th>
<th>T</th>
<th>α</th>
<th>β</th>
<th>γ</th>
<th>R / C</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Surface treatment:

- [ ] TS90
- [ ] TSN
- [ ] TS43
- [ ] TS42
- [ ] TSR1

Pre-tinning:

- [ ] DA
- [ ] PT
- [ ] None

Grade:

- [ ] KCR02+
- [ ] KCR05+
- [ ] KCR06
- [ ] KCR10
- [ ] KCR18+
- [ ] KCR32
- [ ] GC32
- [ ] CTOPP10

Please indicate your application and we will suggest the best grade for your requirements.

Quantity:

Number of parts to be quoted: ____________________
Annual volume forecast: _____________________
Strobe blanks

Design:
- □ CT SB00
- □ CT SB02
- □ Your drawing

Dimensions:
- L = _______ 
- W = _______ 
- T = _______ 
- α = __________°

Surface treatment:
- □ TS8
- □ TS42

Pre-tinning:
- □ DA
- □ None

Grade:
- □ CTOPP10

Please indicate your application and we will suggest the best grade for your requirements.

Quantity:
- Number of parts to be quoted: _______
- Annual volume forecast: _______
Band saw tips

Design:
- [ ] Ball
- [ ] Cylinder
- [ ] Segment
- [ ] Your drawing

Dimensions:
- [ ] D = ______
- [ ] L = ______
- [ ] α = ______

Surface treatment:
- [ ] TSN
- [ ] TSX

Grade:
- [ ] KCR10
- [ ] KCR32
- [ ] CTS18D
- [ ] CTS22D
- [ ] CTU24L

Please indicate your application and we will suggest the best grade for your requirements.

Quantity:
Number of parts to be quoted: ______
Annual volume forecast: ______
Circular saw tips (metal)

Design:
- Block
- Straight
- Net shape
- Your drawing

Dimensions:
- L =
- W =
- T =
- α =
- β =
- γ =
- R / C =

Surface treatment:
- TS90
- TSN
- TS43
- TS42
- TSR1

Pre-tinning:
- DA
- PT
- None

Grade:
- S25T
- S40T
- SMX
- CTS18D
- CTS22D
- CTS24D
- KCR10
- CTF34T

Please indicate your application and we will suggest the best grade for your requirements.

Quantity:
- Number of parts to be quoted:
- Annual volume forecast:
Strips

Type:
- Rectangular
- With groove-lines
- Without groove-lines
- One bevel
- With groove-lines
- Without groove-lines
- Two bevel
- With groove-lines
- Without groove-lines
- Your drawing

Dimensions and tolerances:
- L = ±
- W = ± α =
- T = ± β =

Surface finishing:
- Ground
- Unground
- Surface treatment (sandblasting)
- Please specify:

Grade:
- CTOPP10
- KCR06
- KCR18+
- Please indicate your application and we will propose you the optimal grade.

Quantity:
- Number of parts to be quoted:
- Annual volume forecast:
Knives

**Style**
- [ ] Straight knives
- [ ] Scorer knives

**Dimensions:**

<table>
<thead>
<tr>
<th>Straight knives</th>
<th>L =</th>
<th>W =</th>
<th>T =</th>
<th>d =</th>
<th>C =</th>
<th>β =</th>
<th>γ =</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scorer knives</td>
<td>L =</td>
<td>W =</td>
<td>T =</td>
<td>d =</td>
<td>R =</td>
<td>β =</td>
<td></td>
</tr>
</tbody>
</table>

**Grade:**
- [ ] KCR08
- [ ] CTOPP10
- [ ] KCR02+
- [ ] KCR18+
- [ ] Please indicate your application and we will propose you the optimal grade.

**Additional requests:**
Please specify if you have any additional requests like polishing or special screw angle/diameter:

**Quantity:**
- Number of parts to be quoted: 
- Annual volume forecast: 

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Profiling blanks

Style
- No hole
- One hole
- Two holes
- No angle
- One angle
- Two angles
- Your drawing

Dimensions and tolerances:

L = [ ]
W = [ ]
T = [ ]
C = [ ]
d = [ ]
h = [ ]

Surface treatment:
- Ground
- Unground
- Microfinish

Grade:
- KCR08
- CTOPP10

Please indicate your application and we will propose you the optimal grade.

Quantity:
- Number of parts to be quoted: [ ]
- Annual volume forecast: [ ]
Rods

Type:
- Standard length
- Fix length
- Special geometry
  (Your drawing)

Dimensions and tolerances:
- \( \varnothing = \) 
- \( L = \) 
- Chamfer = 
- \( 2^{\text{nd}} \varnothing = \) (optional)
- \( 2^{\text{nd}} L = \) (optional)

Tolerance:
- \( \square \) h6
- \( \square \) h5
- \( \square \) h4

Surface finish:
- \( \square \) Ground
- \( \square \) Unground
- \( \square \) Microfinish

Grade:
- \( \square \) CTOPP10
- \( \square \) KCR06
- \( \square \) KCR05+

Please indicate your application and we will propose you the optimal grade.

Quantity:
- Number of parts to be quoted: 
- Annual volume forecast: 

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