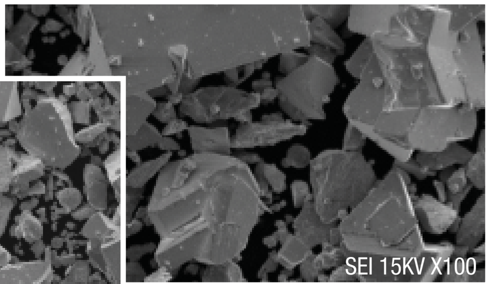
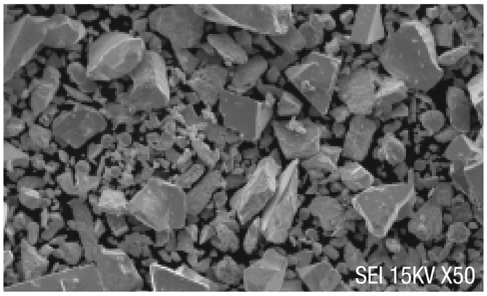
Macrocrystalline Tungsten Carbide

1. Fully carburized, dense, high-purity crystals of tungsten carbide produced by the Kennametal unique, proprietary, high-temperature “alumino thermit” reaction.
2. Predominately free of detrimental uncombined carbon.
3. Non-agglomerated monocarbide, available in grain sizes from 40 US mesh (420 micron) to 1.5 micron.
4. Well-defined internal microstructure:
   – Grown from single crystals.
   – Highly uniform and reproducible.
   – Angular crystals have triangular habit.
5. Absence of variable substructure:
   – No under-carburized W_2C phase.
6. Formed at 4500 °F (2480 °C) and slowly cooled:
   – Lower microdefects.
   – Higher microhardness.
7. Comparatively low specific surface area.
8. Lower grain growth during sintering.
9. High degree of wettability.
10. High pack density offers the most carbide per unit volume.
11. Vickers microhardness VHN (25g) approximately 2200 kg/mm^2.
12. Superior properties in mining grades, wear parts, hardfacing rods, and infiltrated diamond tools.
13. Ideal starting material for infiltrated, hot-pressed, or sintered diamond tools.
14. Blends into homogeneous mixtures with cobalt, bronze, iron, nickel, and other common diamond tool matrices.
15. Typical analysis ranges:
   – Total carbon: 6.08%–6.24%
   – Free carbon: 0.05% maximum
   – Iron: 0.30% maximum

Superior wettability and thermal stability.





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The Kennametal macrocrystalline thermit process provides a highly effective method for the production of tungsten carbide crystals directly from ore concentrates. Unique properties of macrocrystalline WC are being exploited in many special applications, including diamond tool matrix powders. WC crystals grown to 500 microns in an iron menstruum, with a stoichiometric 6.13% carbon, yield a stable carbide ideal for infiltration and wear applications.

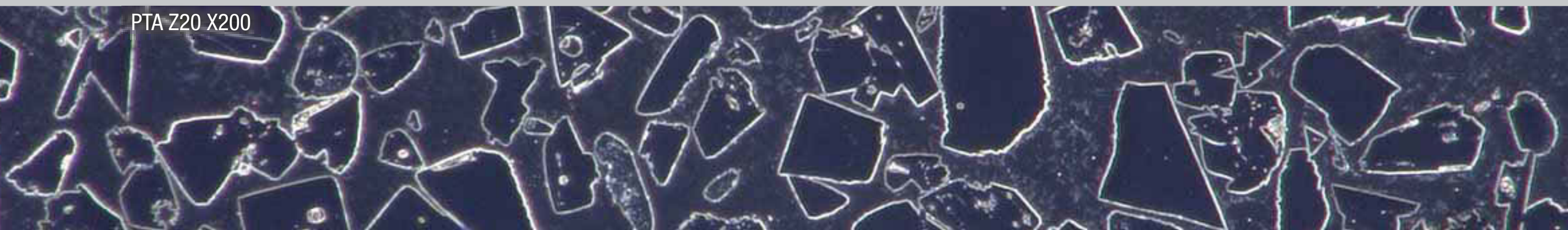
Both macrocrystalline and conventional WC have the same hexagonal crystal habit. The most striking difference between the two is the size and shape of the grains. Macrocrystalline WC has a sharp, angular shape, even after the particles have been subjected to comminution processes, such as ball milling. Both in its initial form and after size reduction by milling, macrocrystalline WC has a comparatively low specific surface area.

Another feature of thermit grown WC crystals is the absence of under-carburized phases, such as $Fe_3W_3C_2$ and W_2C. Macrocrystalline WC crystals are uniformly 6.13% carbon. Compared to conventional carbides, macrocrystalline WC has less than a tenth the oxygen and nitrogen. As a result of the menstruum process, degassed WC has very low levels of micropores. Macrocrystalline WC also has a high degree of wettability, making it ideal for the infiltration process.

Macrocrystalline WC is thermodynamically more stable than case carbide WC/W_2C. In diamond tool matrices, binder metals such as nickel, cobalt, and iron dissolve and react with cast carbide to form eta phase M_3W_3C. Under the same conditions, macrocrystalline WC is much more resistant to eta phase formation.

Metal bonded diamond products use matrix powders to hold the diamonds in place. In mining, matrix powders are used for surface set and impregnated diamond coring bits, surface set oil well bits, and other well tools. Large tools are infiltrated, typically with copper alloys, such as manganese bronze. Either hot pressing or infiltration is used for smaller tools. Hot-pressed powders, which can contain self-bonding copper alloys along with hard metals such as macrocrystalline WC, are simultaneously pressed while heating to temperatures near the binder liquids. Diamond matrix powders are also employed in construction tools. Such applications include coring bits, saw blades, and other tools that are utilized on concrete, asphalt, rock, and glass. These tools are typically hot pressed or cold pressed and sintered.

Thermal Spray Z20 X200



PTA Z20 X200

Diamond tool performance reports have consistently confirmed laboratory test results, which show that tools containing macrocrystalline WC outlast those with conventional WC. A broad range of grain sizes is a very significant advantage in achieving the properties required for many types of diamond tools and the great variety of tool applications. As well, conventional carbides are polycrystalline and such particles degrade under stress. Fine tungsten carbide produces a hard matrix, but coarse grains are required for abrasion resistance. With macrocrystalline WC, a toolmaker can match the grain size to his tool conditions: fine-grain WC for fast cutting, coarse-grain WC for long tool life, or a blend to optimize both properties.

Oil exploration bits are subjected to extreme conditions. The Kennametal oil bit matrices, which contain a controlled ratio of fine to coarse macrocrystalline WC, maximize bit life while maintaining cutting speed. Our same grain size matching technique can be applied to mining bits, core drills, and saw segments.

Unique characteristics of macrocrystalline tungsten carbide make it ideal for most diamond tool applications.

Macrocrystalline tungsten carbide is available in many sizes, from 40 US mesh (420 micron) to 1.2–1.7 micron.

Typical Sizes Included

grade name	order number	US mesh
SCNC048	**1584620**	60 x 100
SCNC069	**1307136**	80 x 200
SCNC076	**1584630**	100 x 140
SCNC081	**1569934**	100 x 325
SCNC093	**1569935**	140 x 200
SCNC104	**1584638**	200 x 325
SCNC121	**1584647**	-325

NOTE: Special sizes may be available. Please contact a Kennametal Representative for details.

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