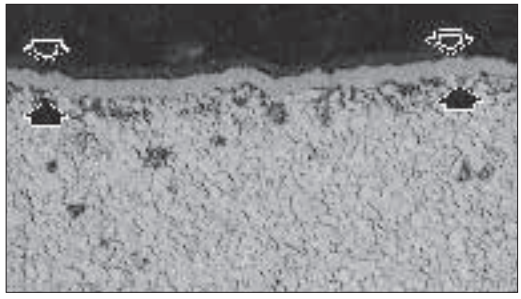
SINTERED CARBIDES

Sintered carbides are very hard materials made by the powder metallurgy process and may by reinforced with several types of MC-type carbides besides the usual tungsten carbide (WC). The binder phase is normally cobalt although minor use is made of nickel. Modern cutting tools are frequently coated with a variety of very hard phases, such as alumina, titanium carbide, titanium nitride and titanium carbonitride. Sectioning is normally performed with a precision saw, so surfaces are very good and rough abrasives are not usually required. Listed below are two alternate procedures for preparing sintered carbides using Apex DGD metal-bonded UltraPrep discs or the Apex Hercules H rigid grinding discs. A further option would be the use of the traditional metal-bonded diamond discs.

If a greater amount of material must be removed in the planar grinding step, use either the 30µm resin bonded or the 45µm metal-bonded UltraPrep disc for step one, in Table 34.

The final step in these two procedures, Tables 33 and 34, employs either MasterMet colloidal silica or MasterPrep alumina suspensions as they will produce the best definition of the structure,



Surface of a WC – 11.5% Co cutting tool enriched with 1.9% Ta and 0.4% Nb (form complex carbides, the dark regions in the matrix) and coated with alumina (arrows) for enhanced tool life (Murakami's reagent, 1000X).

Helpful Hints For Sintered Carbides

The ability to see the boundaries between the WC particles and cobalt binder in the as-polished condition depends on the surface of the polishing cloth used in the last step. To see no boundaries, which makes it easier to see graphite or eta phase, use a napless surface, such as TriDent, TexMet or UltraPol pads. To see the phase boundaries between WC particles and the cobalt binder, use a medium nap surface, such as MicroCloth, MasterTex pads.

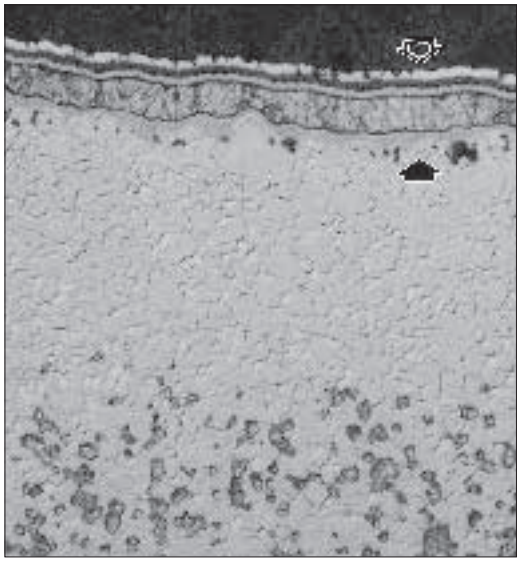
Table 33: 4-Step Method for Sintered Carbides

Sectioning	Precision Saw with 20LC blade recommended for hard tough materials				
Mounting	Castable, typically epoxy with added flat-edge filler				
Surface	**Abrasive / Size**	**Load - lbs [N] / Specimen**	**Base Speed [rpm]**	**Relative Rotation**	**Time [min:sec]**
UltraPrep Metal-Bonded Disc	45µm Diamond water cooled	6 [27]	300		Until Plane
TexMet P	9µm MetaDi Supreme Diamond*	6 [27]	150		4:00
VerduTex	3µm MetaDi Supreme Diamond*	6 [27]	150		3:00
ChemoMet	0.02 - 0.06µm MasterMet Colloidal Silica	6 [27]	150		2:00
= *Platen* = *Specimen Holder* **Plus MetaDi Fluid Extender as desired*					
Imaging & Analysis	Porosity Assessment, Particle Sizing, Coating Layer Thickness				
Hardness Testing	N/A				

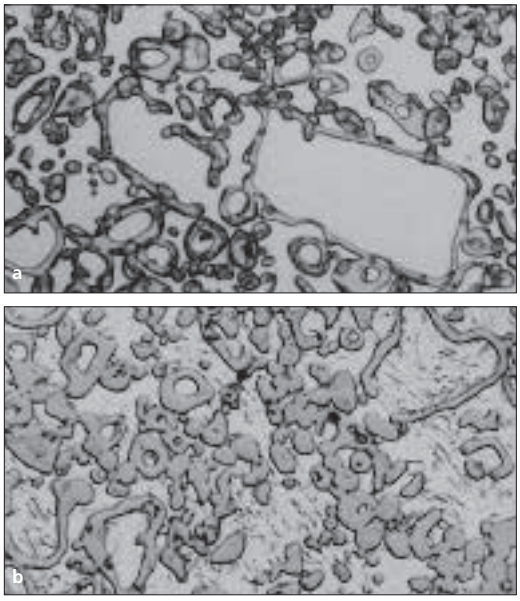
Sintered Carbides

Table 34: 4-Step Method for Sintered Carbides

Sectioning	Precision Saw with 20LC blade recommended for hard tough materials				
Mounting	Castable, typically epoxy with added flat-edge filler				
Surface	**Abrasive / Size**	**Load - lbs [N] / Specimen**	**Base Speed [rpm]**	**Relative Rotation**	**Time [min:sec]**
Apex Hercules H Rigid Grinding Disc	30µm MetaDi Supreme Diamond*	6 [27]	150-200		Until Plane
Apex Hercules S Rigid Grinding Disc	9µm MetaDi Supreme Diamond*	6 [27]	150		4:00
VerduTex	3µm MetaDi Supreme Diamond*	6 [27]	150		3:00
ChemoMet	0.02 - 0.06µm MasterMet Colloidal Silica	6 [27]	150		2:00
= Platen	*= Specimen Holder*	**Plus MetaDi Fluid Extender as desired*			
Imaging & Analysis	Porosity Assessment, Particle Sizing, Coating Layer Thickness				
Hardness Testing	Vickers				



Microstructure at the surface of a multilayered, CVD-coated WC - 8% Co cutting tool. The arrows point to the CVD layers of TiCN, TiN, TiC and alumina. The region below the coatings is made higher in Co to improve crack resistance and complex carbide forming elements (Ta, Ti and Nb) are added to the matrix (dark spots at bottom) for wear resistance (Murakami's reagent, 1000X).



Microstructure of cold isostatically pressed and age hardened Ferro-Titanit Nikro 128 (Fe - 13.5% Cr - 9% Co - 4% Ni - 30% TiC) cutting tool; a) etched with Murakami's reagent at room temperature to darken the TiC; and b) electrolytic etched with aqueous 1% chromium trioxide at 2 V DC, 30 seconds to reveal the martensitic matrix (1000X).

particularly if the surfaces have a complex series of coatings for improved wear resistance, as used in some coated carbide inserts. However, if such a coating is not present, the matrix grain structure can be observed quite clearly after the 3µm diamond step. For routine examination there is little need to go beyond the third step. It is also possible to use a 1µm diamond step, similar to step three, but for 2 minutes, as an alternative fourth step.