

## Technical Information

### Microtome / Profile Guide

D-Profile knives are the "standard" used in plastic sectioning microtomes today. Keep in mind that plastic sectioning microtomes typically are motorized and use specimen retraction to prevent the blockface from brushing the knife edge on the return stroke. Two types of D-Profile knives are popular today: the parallel-sided D-Profile for the Leica (or Reichert) Polycut microtomes and the wedge-shaped D-Profile for all types of rotary microtomes. These knives are NEVER interchangeable because the cutting angles differ dramatically.

K-Profile knives are used in the now-obsolete Jung Model K microtome. These microtomes were available in both motorized and "hand-cranked" versions and can be obtained occasionally from the used-equipment marketplace. DDK provides K-profile knives for those users still involved with this rugged workhorse of a microtome.

Cryostat knives are available with D or C profiles for use in cutting frozen undecalcified bone and other dense connective tissue. We are finding that the C-Profile knives work best for the hard, undecalcified specimen while the D-Profile are preferred for other dense connective tissue. These knives vary from the typical tungsten carbide knife in two ways: they are made from a tungsten carbide insert epoxied to a tool steel base and the tool steel base extends beyond the ends of the 16cm of tungsten carbide. A special aluminum-filled epoxy is used to allow the flow of heat (or cold) between the tool steel and the tungsten carbide. The tool steel extensions allow the entire 16 cm edge to be used and can be packed in dry ice to further lower the knife temperature during cryostat sectioning.

DDK has made a host of non-standard knives of tungsten carbide for a wide variety of applications and we would be happy to make one for you. It is easiest to work from an example; send us a blade and we will duplicate it in tungsten carbide. We have also worked extensively from mechanical drawings, back-of-the-envelope sketches, and mental pictures drawn with words. If you have an application that you think will benefit from the unique properties of tungsten carbide, let us know.

### Importance of Angles to Application

The angles placed on each side of the microtome knife are crucial to the performance and longevity of the edge.

**Clearance Angle** - The angle between the surface being cut and the back of the knife is the clearance angle. If this angle is too small, chatter occurs. Vibration set up by rubbing of the sample on the back of the knife can, in severe cases, be heard. In minor cases, chatter leaves telltale "washboard" marks in the sections, marks parallel to the edge of the knife in a regular occurring pattern.

DDK always prepares the block-side of the knife at the same angle. If this angle gets too large or your resharpening service is careless about its control, you must always search for the best clearance angle setting on your microtome. Hopefully it will occur within your range of adjustment.

**Total Angle** - The included angle of your knife is important in controlling compression of your sections and durability of the edge. For softer embedments (GMA and soft tissue), lower included angles can be used minimizing compression without sacrificing durability. For harder embedments (MMA and undecalcified bone), midrange included angles are recommended to prolong the edge life without

sacrificing section quality. For the hardest samples (horse bone, for example), high included angle knives may be necessary.

DDK can help recommend the proper angle for your application. Should your application change, DDK can change the included angle of your knife for the same price as a regular sharpening.

### **Misc. FAQ's**

#### **1. My knife broke into two pieces!**

Epoxy joints are typically subject to cracking with shear, an impact that is sideways on the joint. Subjecting your knife to cold temperatures only makes the joint more brittle. This type of failure is common when a knife is dropped, not unusual during shipment.

DDK repairs epoxy joints by carefully scraping away any remaining epoxy residue and cleaning the two surfaces thoroughly. Our own formulation of epoxy is then applied to both surfaces. The surfaces are joined with a sliding motion carefully eliminating any bubbles or voids and checking the angular alignment of the two parts. The knife is then placed on a hotplate (warmplate) for a two-hour thermal cure. Excess epoxy is removed with a bit of sandpaper and then sharpening of the edge is carried out. There is no extra charge for an epoxy repair.

#### **2. Why use DDK's sharpening service vs. laboratory sharpener?**

Several laboratory microtome knife sharpening instruments with adapters to handle tungsten carbide knives have been available for some time. Operating these instruments involves having the necessary accessories, disposable supplies and training in their proper use. Only recently has the confusion surrounding the details of their proper use subsided making it possible to sharpen your own tungsten carbide knives.

There are two reasons why you should take advantage of DDK's reconditioning service, periodically if not every time:

We will restore the cutting angles to the original specification. This is especially important if you have been using a laboratory sharpener or a less expert sharpening service. Minor misalignment of the knife adapter, even smaller than you can detect with the alignment tools provided, leads to drifting of the knife's cutting angles. If you do not optimize the clearance angle setting of your microtome each time you add or change knives, chatter and/or compression problems will result. DDK knives are sharpened with the same block side angle each time and checked with laser measuring devices to insure accuracy within  $0.1^\circ$ . Drop your knives into the microtome with confidence that the clearance angle has not changed. You'll get better sections faster.

We will remove the larger nicks which cannot be removed with a laboratory sharpener. Laboratory sharpeners remove material rather slowly, turning more than a touch-up into a big job. There are more productive uses for your time than tending your sharpener or searching your touched-up knife edge for area you can use. 100% of the edge is good with a DDK sharpening.

Extra services are provided as-needed with every DDK resharpening. Epoxy joints which have been broken will be repaired, cutting angle changes are done at your request and corrosion of the tool steel base will be brushed out to restore the original appearance of your knife ... even the container is repaired and cleaned. All these steps are done within 48 hours to minimize the time you are without your knife. DDK offers quick turnaround so you are without your knife for a minimal time and accurate service for confidence that your knife will do the job.

### 3. I inherited all these knives. Now what?

If you have found yourself with a new bone project after years away, you probably don't remember what state your knife collection is in. Delaware Diamond Knives free tungsten carbide knife evaluation service comes in handy at times like these.

Send us your knives, it doesn't matter who made them originally, and we will inspect the edges, measure the angles, and give them a cosmetic cleaning. From this you will learn what applications each knife can be used for, which knives will be usable right away and which will need some work before being put to use. This service can be had within 48 hours of the time we receive your knives.

### 4. How thin a section can I get with my tungsten carbide knife?

Because of the nature of tungsten carbide, there is a minimum section thickness that can be obtained. Tungsten carbide is a compacted material: fine grains of carbide are fused together with a binder at high temperatures and pressures. At every junction between two grains, the edge must be discontinuous. The size of these discontinuities dictates the depth of knife marks placed in the sections. The thinness of the sections then dictates how visible these knife marks are. Too thin, and the section will actually part at the mark.

Through experience, we have found that the minimum section thickness that can be expected with our tungsten carbide knives cutting methylmethacrylate is about 2 microns. Sections this thin are only possible with great skill and patience. Beginners should be very happy with 5 micron thick sections until their skills (and luck) improve.

### 5. How long will my tungsten carbide blade last?

Edge longevity is primarily dependant on the types of sample being cut, frequency of use and care taken in handling the blade. Disclaimers aside, our experience shows that in clinical laboratories processing routine iliac crest biopsies of undecalcified bone, resharpening is usually performed once per month. These users are satisfied with the economy and performance of tungsten carbide compared to alternative blade materials.

### 6. How many resharpenings can I get before I need to buy a new knife?

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