

Diamond Knives

Introduction:

The ultra-microtome diamond knife is a remarkable instrument. Its extremely sharp and stable edge allows slices of tissue or other materials to be cut just a few molecules thin and then observed in the Transmission Electron Microscope at magnifications up to 100,000 times. This technique is used in research laboratories, hospitals and universities to make photographs which reveal in sharp detail the ultrastructure of cells and material samples just a few angstroms across.

Diamonds for microtome knives are selected from gem-quality crystals free of inclusions and internal flaws which could interfere with the formation of a perfect edge.

Sharpening and Quality Control:

Sharpening the diamond blade to generate the ultra-sharp edge is the most exacting part of the process. In contrast to glass knives, whose sharp edge is the direct result of breaking a glass block, the diamond slab has to be lapped and polished using high-precision equipment. The details of this operation are the key to the successful production of microtome diamond knives and are kept a commercial secret by the manufacturers.

Besides being extremely sharp, a microtome knife has to be defect-free along its entire length. Nicks or flaws in the order of 100 angstroms will produce visible lines on the section micrographs. After the sharpening process has been completed, the knife edge is examined along its entire length with Nomarski optics at a magnification of 1,000 times. Then, purple and gray sections are cut with the entire edge. Each one of the sections is examined optically, and some are analyzed with the TEM. Only if all the tests show a flawless edge with total absence of compression or striations is the knife accepted.

The finished diamond blade in its metal shank is precisely positioned in the boat so that the edge is level and the facets are at the proper angles. The microtome must adjust the microtome knife holder to the desired angle, usually 4° to 5°, as suggested by the label. Too small of a clearance angle causes chatter because the block rubs on the outside facet after cutting. A clearance angle too large, at 10° or more, would exert too much side stress on the knife edge during the cutting and would have the tendency to cause nicks.

Cleaning Procedure:

Although the diamond is the hardest material known, the edge of a diamond knife, being only a few atoms across, is very fragile and will break when improperly used. A good rule, which will prolong the life of a diamond knife for several years, is to **avoid touching the edge with any solid object** except the specimen block in the microtome, following the cutting direction and making sections no thicker than 2,000 angstroms. Solid objects include fingers, tissue paper, cotton swabs, styrofoam, wood sticks, brushes and cloth. Glass particles from Pasteur Pippets used during processing and small slivers from razor blades used to trim blocks are also hazardous to the edge of a diamond knife.

SEM photographs show that at least some of the marks and striations produced by a knife on the sections are caused by microscopic debris that adheres to the edge. This debris comes principally from the embedding materials that have been allowed to dry on the knife.

We recommend the following cleaning procedure:

1. Rinse the knife in distilled water, preferably using a small jet of pressurized water like the ones for dental use.
2. Immerse the knife in a weak solution of mild detergent such as Haemo-Sol, Photo-Flo, or Triton X-100. Strong chemicals, such as ammonia, MEK, caustic soda and acids, should not be used because, although they would not affect the diamond itself, they could discolor and corrode the metals in the boat and welding.
3. Repeat Step 1.
4. Dry with clean pressurized air or other clean gas.

We strongly discourage the use of wood sticks or any other solid object on the knife edge as this cleaning method may cause nicks on the cutting edge.

Resharpening:

Any used microtome diamond knife can be resharpened unless it has been totally chattered. The quality of the new edge will have no relation to the original one. For instance, a knife which was considered of poor quality can be given a new excellent edge by proper resharpening. Depending on crystal geometry,

a resharpened edge may be slightly shorter or longer than the original one. **We guarantee unlimited resharpenings** - assuming that the edge has not been nicked or misused. Resharpening cost is approximately 60% of the new cost. The turn-around time is 4 to 6 weeks.

Guarantee: We provide a thirty-day return policy, after the receipt of your knife, for testing its quality. In the case of a defective knife, it will be repaired or replaced if it is returned in its original condition.

Types of Knives:

(For Thick Sections and Cryo Microtomy)

To meet the expanding demands of the cryo microtomy field, we now offer the following knives specifically designed to provide better sections in freezing conditions. In particular, the knives are made with a special process which produces frozen sections remarkably free of compression.

STYLE-R for biological ultramicrotomy is supplied with 45° (± 3°) included angle mounted in a black anodized boat.

STYLE-CD for cutting dry sections in cryo microtomy. Mounted in a stainless steel holder capable of sustaining extremely low temperatures and designed for easy section retrieval. (No boat.)

STYLE-T for compression-free semi-thin sections between .5 and 2 microns thick.

STYLE-CW for cutting wet sections in cryo microtomy. Mounted in a stainless steel boat similar to those of our standard ultramicrotomy knives, but this boat is engineered to withstand low temperatures.

STYLE-MS for material science applications. These knives, although lower in price because their edges are not processed for biological work, will still provide flawless quality for difficult material specimens. Available with included angle between 40° and 60°.

STYLE-LM for light microscopy. These knives are designed for cutting samples from 0.1 to 6.0 mm.

Our knives are mounted in boats at 0° and are designed to fit all standard microtomes. Edge lengths are available from 1.5 to 10.0 mm.

Ordering Information:

When placing an order for a Diamond Knife you must specify the catalog number and the style of the diamond knife - R, CD, T, and CW. Specify included angle.

Style- R, CD, T and CW

Cat. #	Description	Size
08452-0	2.0 - 2.4 mm usable edge	1ea
08453-0	2.5 - 2.9 mm usable edge	1ea
08454-0	3.0 - 3.4 mm usable edge	1ea
08455-0	3.5 - 3.9 mm usable edge	1ea
18383-0	4.0 - 4.4 mm usable edge	1ea

Style-MS

Cat. #	Description	Size
18392-0	1.5 - 1.9 mm usable edge	1ea
18393-0	2.0 - 2.4 mm usable edge	1ea
18394-0	2.5 - 2.9 mm usable edge	1ea
18395-0	3.0 - 3.4 mm usable edge	1ea
18396-0	3.5 - 3.9 mm usable edge	1ea
18397-0	4.0 mm usable edge	1ea

Style-LM

Cat. #	Description	Size
21769-0	6.0 - 6.9 mm usable edge	1ea
21770-0	7.0 - 7.9 mm usable edge	1ea
21771-0	8.0 - 8.9 mm usable edge	1ea
21772-0	9.0 - 9.0 mm usable edge	1ea
21773-0	10.0 mm usable edge	1ea

To Order:

In The U.S. Call: 1-800-523-2575 • 215-343-6484

In The U.S. FAX: 1-800-343-3291 • 215-343-0214

In Germany Call: (49) 6221-765767

In Germany FAX: (49) 6221-764620

Order online anytime at www.polysciences.com

Should any of our materials fail to perform to our specifications, we will be pleased to provide replacements or return the purchase price. We solicit your inquiries concerning all needs for life sciences work. The information given in this bulletin is to the best of our knowledge accurate, but no warranty is expressed or implied. It is the user's responsibility to determine the suitability for his own use of the products described herein, and since conditions of use are beyond our control, we disclaim all liability with respect to the use of any material supplied by us. Nothing contained herein shall be construed as a recommendation to use any product or to practice any process in violation of any law or any government regulation.