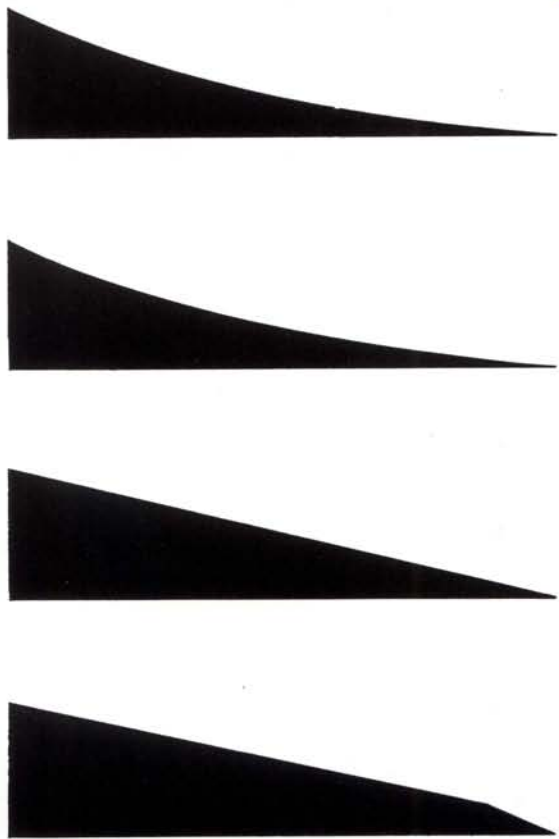
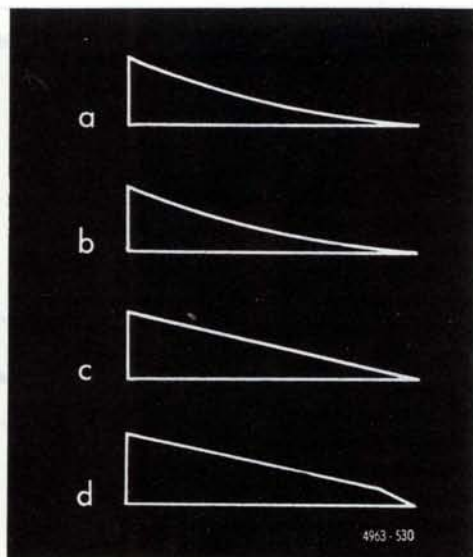


**Treatment
and maintenance instructions
for microtome knives**



An essential prerequisite for the preparation of good sections for microscopic examination is that the microtome knife should be in perfect condition. Besides certain given metallographic factors, such as the hardness of the steel and fineness of the structure, the condition of the knife edge and the knife face is of decisive importance.

The experience which we have gathered as a result of numerous experiments on the treatment and maintenance of the microtome knife is set out in this brochure. These instructions are designed to provide those using the microtome with a well-tried method by which perfect maintenance of the microtome knife is ensured at all times, once the necessary manual dexterity has been acquired.

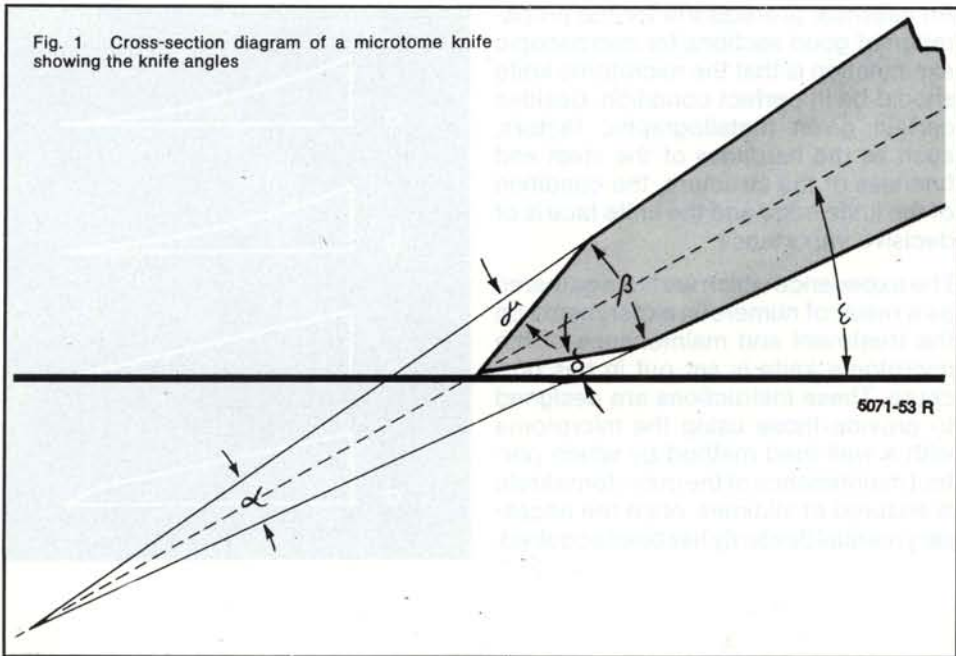


Types of microtome knives

Microtome knives are produced with four types of profile: -

1. **Profile a = strongly planoconcave**, for celloidin preparations
2. **Profile b = slightly planoconcave**, for fresh biological specimens
3. **Profile c = wedge shaped**, for paraffin preparations, wood, rubber, etc.
4. **Profile d = planing knife shaped**, for plastics and other hard materials.

Fig. 1 Cross-section diagram of a microtome knife showing the knife angles



In order to facilitate subsequent honing and stropping, all knives are designed with a bevelled surface. Fig. 1 shows the cross-section of a microtome knife with the corresponding knife angles, which have been distinguished as follows: -

1. The knife-edge angle α
2. The cutting angle β
3. The upper stropping angle (angle of bevel) γ and
4. The lower stropping angle (angle of bevel) δ

Also important for the cutting process is the angle of inclination ε , i. e. the angle between the surface of the block and a straight line passing midway through angle β (cf. fig. 1). In order to obtain a flawless section, this angle must always be greater than half the cutting angle β . In the present instance, the stropping angles (angles of bevel) and the cutting angle are of interest. They are created during the honing and stropping process in that the knife back is raised by sliding on a tubular shaped so-called stropping

bevel (cf. fig. 2), so that part of the front knife surfaces are ground off. The bevelled surfaces together with imaginary extension of the knife surfaces form the stropping angles. The bevelled surfaces and thus the stropping angles are fundamentally different with the microtome knives of various profiles (a, b, c, d). With knives of the same profile they can vary within certain specified limits.

The stropping bevel

This consists of a tubular sleeve open at one side, which is slid over the back of the knife (fig. 2). The length of the stropping bevel should always be the same as that of the knife edge. A laminated spring inside the device exerts pressure on the knife back, thus ensuring a secure fit. Owing to slight variations in the thickness of the knife backs, it sometimes happens that one particular stropping bevel does not fit equally well on all knives of one particular profile. It is therefore advisable to purchase one stropping bevel for every knife of the same profile. This is absolutely essential when using microtome knives of different profile (see above). Special attention is drawn to the stropping bevel for knives of profile d as shown in fig. 2; stropping this special knife is only possible by means of this device with its protruding strip.



Fig. 2 Stropping bevels, for profile d knives on the left, and for profiles a, b, and c on the right.

Strops and stropping paste

Stropping is carried out by hand on a strop coated with stropping paste.

There are two types of strop: – The four-sided Zimmer strop (fig. 4), and the simple leather surface strop No. 1241 (fig. 5) on a padded base. The Zimmer strop has four sides numbered 1-4 consisting in that sequence of a honing stone, a red and a black leather surface for the actual stropping, and a polishing leather. This small strop is recommended for stropping small knives (knives for the freezing microtomes 1213 and 1310). The longer and wider strop No. 1241 is suitable for stropping larger knives (knives for sledge microtome, for the Minot rotary microtome and for the base sledge microtome). For preliminary stropping, a red stropping paste is used with a coarse grain, while a black stropping paste with a fine grain is used for subsequent stropping (cf. fig. 3).

The wooden handle

A polished wooden handle is provided to guide the knife on the strop. This handle is either attached to the pin found on one side of the knife and secured by means of the clamping screw (for Jung knives), or it is screwed directly into the knife (for Loew knives).



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Fig. 3 Stropping paste, red paste on the right and black on the left

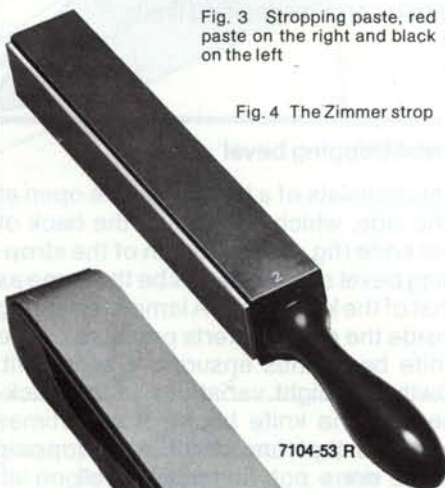


Fig. 4 The Zimmer strop



Fig. 5 Strop No. 1241 with padded base

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Microscope for controlling stropping process.

During the stropping process it is absolutely essential to inspect the particular state of the knife edge. For this purpose either simple transmitted light is used, or the control can be more expediently carried out in incident light (ULTRO-PAK[®]). The inspection should be carried out with a magnification of 200-300 x.

Stropping Technique

A little stropping paste is first spread over the leather of the strop with the finger or the ball of the hand. If the Zimmer strop is used, then the red leather surface is rubbed over with red stropping paste, and the black leather surface with black paste. Leather surface No. 4 remains untreated and is used as a polishing leather. If strop No. 1241 is being used, then the leather surface is divided into three equal sections, coating the first section with red paste, the second with black paste, and leaving the third section uncoated as a polishing leather.

The strop is then fastened to the work bench by means of a screw clamp, or preferably in a vice. Under no circumstances is it permissible to hold the strop in the hand, since not only would this render exact stropping impossible, but there is also the danger of injury if the knife should slip.

After attaching the stropping bevel to the back of the knife, and fastening the wooden handle to the knife, the preliminary stropping process is started. With the back of the knife foremost, the microtome knife is first drawn with slight pressure and then without pressure over the leather coated with red stropping paste, in such a manner that the knife edge slides over the leather in the direction indicated by the arrow shown in fig. 6a (oblique or parallel stropping). Flawless stropping is only possible if this knife movement is maintained. After completing one length of the strop, the knife is turned over using the stropping bevel (see fig. 6b) and the return motion in the opposite direction is carried out in the same manner. When stropping, the wooden handle should always be held in the right hand, while the thumb and fore-finger of the left hand hold the opposite end of the knife back with the stropping bevel (cf. fig. 6a). The stropping process is discontinued at intervals and the knife edge is inspected under the microscope. It should be expressly stressed once again that slight pressure should be applied only at the beginning, and that stropping should then be continued without pressure. With continued stropping pressure, a facet forms on the knife edge, and it thus remains blunt.

The preliminary stropping is completed when the knife is completely straight and shows at most only a very fine tootching.



Fig. 6a Illustration of stropping motion (oblique and parallel stropping)

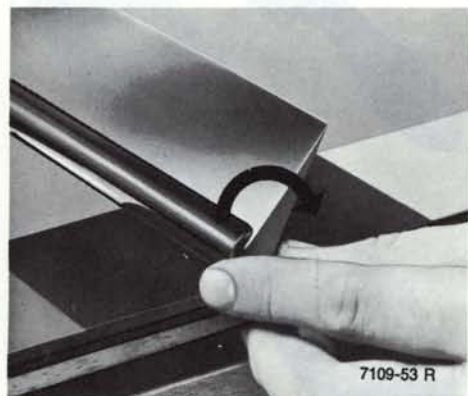


Fig. 6b Turning over the knife after each stropping stroke

The knife edge is observed from above, also when using incident light (ULTRO-PAK), in order to determine whether a facet has been caused through excessive pressure, which would be seen in the microscope as a relatively wide shining bright line. If this is the case, then the knife must be stropped again without any pressure on the leather (!). A knife which has been given a preliminary stropping in this manner can already be used for many cutting processes, wood sections, frozen sections and routine paraffin sections. For finer sections (thin celloidin and paraffin sections, plastic sections, textile sections), the knife must be given a subsequent stropping on the strop section coated with stropping paste. This stropping is carried out in the same manner as the preliminary stropping, but without pressure throughout and not too prolonged. Microscopic inspection is important. The subsequent stropping is completed when the knife edge is absolutely straight and no toothing is to be observed in the microscopic image (cf. fig. 7). In order to remove residues of the stropping paste remaining on the knife edge, the knife is stropped 2-4 times (no more!) carefully on the untreated polishing leather. Cleaning is also to be recommended when transferring from the red to the black leather. The knife edge can also be carefully wiped with a soft leather soaked in xylene.

The sharpness of the stropped knife can be easily checked by the hair test as follows. A thin (blonde) female hair held upright between the thumb and forefinger should be cut smoothly by a lightly drawn stroke of the knife. If the knife is blunt, the hair will only be bent over and not be cut. In most cases a blunt knife is caused by stropping with too much pressure (see above). This danger is particularly great when using the Zimmer four-sided strop for stropping large knives. Such knives are frequently pressed too hard onto the strop, because the firm base masks the pressure of the hand. The strop with a soft base (No. 1241), on the other hand, reacts immediately with a marked sagging if pressure is applied. It is thus easier to control the hand pressure.

The technique of stropping microtome knives is primarily a matter of experience. It is therefore not possible to acquire the technique immediately with the necessary certainty purely by consulting the instructions given. Considerable practice is required before the technique is fully mastered.

Maintenance of microtome knives

If after a microtome knife has been in use for a very long time it loses its cutting properties despite frequent stropping, then the bevel grinding must be renewed. This requires skill and practice, in order not to ruin the knife completely. When returning the knife to our works in Wetzlar, we can guarantee expert treatment by experienced specialists. Otherwise we recommend to sharpen the knife with the aid of a special hone. A suitable stone (for use with water and oil) can be supplied on request.

The stone is first thoroughly cleaned and is then coated with water or oil; the knife is honed by first passing it over the stone with light pressure, and then without any pressure (as in the stropping process), but with the cutting edge to the fore and in a diagonal direction. The hand pressure necessary in the first instance should be exerted on the front part of the knife, but not on the stropping bevel, since otherwise the latter will be worn down too much. The knife is well honed when the cutting edge shows a uniform fine tothing. The knife must now be stropped in the manner described above.

Sometimes new or honed microtome knives show a relatively coarse bevel grinding. This gives a sharp but relatively jagged edge. It is advisable to strop such knives well before use. Similarly the microtome knife edge can suffer

wear and tear through cutting hard materials or through prolonged use. This makes itself particularly apparent through scratch marks on the specimen block and in the section. In addition, residues of the embedding material or of the specimen collect in the minute fissures, which in time leads to tearing of the sections. Here also the only remedy is a careful stropping.

It is advisable to wipe off the microtome knife after the cutting process with a soft leather, and to clean off any residues of the specimen with xylene. Microtome knives which are to remain unused for a prolonged period should be greased with fine sewing machine oil or preferably acid-free vaseline, in order to prevent tarnishing or even rust. This applies particularly to microtome knives used for frozen sections. Only a carefully maintained knife will guarantee optimum and flawless sections.



Fig. 7 Microscopic image of a well stropped microtome knife, magnified 200X.



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