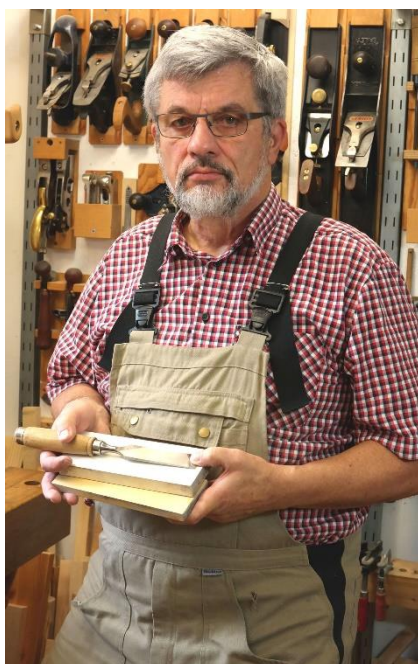


Friedrich Kollenrott

Sharpening chisel and plane blades 2020

freehand – fast – in top quality

Translation: C. Langfelder



These instructions are intended to help all those who struggle to keep their tools at peak sharpness or who think there must be a better way of keeping them sharp.

Woodworkers who nowadays chose to use unpowered hand tools for challenging projects are predominantly DIY enthusiasts, ie, people without specialist training. Where do they look for the necessary expertise, where do they find the information that they require?

There are books, periodicals, courses – but above all the Internet. It's where people interested in a common topic meet, it's where they discuss things, and it's where you'll find an endless amount of information – from dreadful through useful to remarkably good stuff – also about sharpening tools. Sharpening has to be a topic of interest for anyone working with hand tools, because dull tools don't work at all and poorly sharpened tools are a handicap. Only properly sharpened tools let you experience their full potential.

Sharpening chisel and plane blades is not really difficult. But what complicates the start for newcomers is the unbelievable variety of sharpening tools, working techniques and processes. Every hand tool user will eventually develop from these a more or less individual sharpening method. What I am describing and illustrating in this book is neither the best method nor the only right method, but quite simply my method. I leave it to you to decide what is worth testing and possibly adopting. I often take the opportunity of pointing out alternatives.

“Learning to sharpen” does not mean mimicking rhythmical movements on a whetstone. The first step is to understand the essence of sharpening. How do chisel and plane blades cut? What do you have to observe when sharpening to achieve a perfect cutting edge? How do you reduce sharpening time without compromising on quality? This is where this guide starts off. Then it shows and explains in detail the practical aspects of sharpening various blades. And how to restore blades in poor condition to working order. Different sharpening tools and accessories are also discussed in some detail.

I thank all those who in chats and discussions about the sharpening of hand tools¹ came up with ideas and suggestions and directed me to new and often exciting insights.

Above all I want to thank my dear wife Ingrid for her support and her patient tolerance throughout the drawn-out process of writing this guide.

Schladen am Harz, March 2020

Friedrich Kollenrott

¹ Above all here: http://www.woodworking.de/cgi-bin/forum/webbbs_config.pl

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Significant changes in this version (2020) compared to previous version (2019): Chap. 6.2 new

1 Woodworking with hand tools – including sharpening

Nowadays many people who use hand tools such as chisels, planes, scrapers and hand saws for ambitious carpentry work are neither poor nor backward, but privileged.

The times of unrelenting, heavy physical work in the woodworking trades are fortunately long past and it will be the rare woodworker who will do completely without some support from machines and power tools. But the number of people who enjoy doing some jobs in the traditional way “by hand” is clearly on the increase, above all among amateurs for whom productivity is not a primary aim. They will, for instance, smooth wooden surfaces with a hand plane or fashion traditional wood joints, such as dovetail and mortise or tongue-and-groove joints, using a hand saw and chisel. They get pleasure and satisfaction from such handiwork and more than likely they'll be more than a little proud of their skill.

Using hand tools for most or some operations certainly does not mean that you are lowering your sights when it comes to quality. On the contrary, you will be able to

- create workpieces that are more attractive to look at and touch than fully machined equivalents.
- work with amazing precision and – given the necessary skill and ambition – test and apply the virtually infinite possibilities and variants of craftsmanship evolved over many centuries.
- tackle bigger projects in a much smaller and modestly equipped workshop than would be possible with an entirely machine-based operation that would require very extensive equipment and a large working area.

If you are new to working with hand tools you must be satisfied with modest success. But from the very start you will profit from other benefits of unpowered hand tools:

- Using them subjects woodworkers and the environment to much less noise and dust than is possible with machines.
- It is nearly impossible to injure yourself seriously with these tools (while many woodworking machines are inherently highly dangerous).
- They are impressive examples of sustainability: no energy consumption, no consumables, recyclable, nearly infinite service life....

If you want to work with hand tools, you must learn not only how to use them but also how to sharpen them properly. In most cases, chisel blades, plane blades and scrapers must be sharpened even before you use them for the first time, and then regularly during subsequent use. Only handsaws (not covered here) can be bought perfectly sharpened, and types with industrial replacement blades are very popular.²

For my part (born in 1947, mechanical engineer and teacher, pensioner) I was already dabbling in woodwork at a very early age. And even then I always tried to sharpen my hand tools – I can well remember a coarse, black and deeply hollowed oil stone. As time went by I added power tools and simple machines. But I only managed to achieve woodwork of truly presentable quality after the 1990s when I changed for good to working with traditional hand tools on a workbench. Sharpening the tools – as ever by hand and by now with Japanese water stones – caused me problems for a long time, because regrettably I had neither an instructor nor clear instructions. I never quite got on terms with a sharpening guide that I used for some time. But then I discovered the microbevel on the English-language Internet. This was it! At once freehand sharpening became simpler and much faster, and the quality of the sharpening result improved and became more reliable. I've stayed with this approach – freehand and with microbevels – ever since and have improved it as I went along.

In my small workshop I build practical furniture (“practical” is a very important criterium for me), utensils, toys and similar things. My starting point is usually sawn timber, ie, roughly sawn boards and planks. My collection of new and old hand tools is wide and varied. Stationary woodworking machines include a circular table saw (which I really use only for ripping) and a bench pillar drill; a pole lathe can be erected when necessary. A key piece of equipment in my workshop is the ever-ready sharpening centre where I can return dulled chisel blades, plane blades and scrapers to full use within a matter of minutes.

I first published a sharpening guide in 2004, and I've revised it several times since then. The aim is to help all those who – like myself many years ago – experience difficulties with sharpening their blades.

² *I also sharpen my own saws.*

2 Sharpening chisel blades and plane blades: the basics

2.1 How do chisel and plane blades cut?

2.1.1 Cutting with a chisel

A chisel blade (**Fig. 1** left) has a **bevel** on one side and a flat back on the other. These two surfaces intersect to form the acute-angled wedge with its sharp **cutting edge**. The most important feature of the wedge is its **wedge angle β** (beta) that includes the back and bevel. For most chisel blades this angle is around 30° .

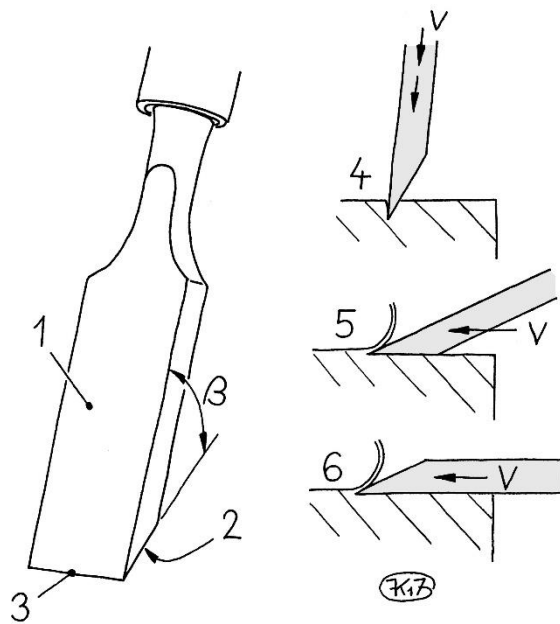


Fig. 1: How a chisel blade cuts

- 1: back
- 2: bevel
- 3: cutting edge
- 4: mortising
- 5: paring, sliding on the bevel
- 6: paring, sliding on the back
- v: movement of blade
- β (beta): wedge angle of cutting edge

You can use a chisel for **mortising** (the edge is driven into the wood by hammer blows to separate it and force it apart) or for **paring** (the blade slides on the wood and lifts off a chip that is deflected via the leading face of the wedge, also referred to as the **rake face**).

If the blade slides on the bevel (the back acts as rake face), the depth of cut can be varied by raising or lowering the handle. If it slides on the back (the bevel acts as rake face), the cut is exactly straight ahead.

Precise paring depends on the guiding function of the long, flat back extending all the way to the cutting edge. Chisels with bevels on both sides are carving tools, not suitable for joinery.

2.1.2 Cutting with a plane

A plane blade also has a **back**, a **bevel** and a **wedge** with wedge angle β . However it is not held by hand, but clamped into a plane on a slanting surface called a **bed**. The **sole** of the plane slides over the workpiece, so that the blade is guided at a constant angle and with a constant cutting depth (= shaving thickness).

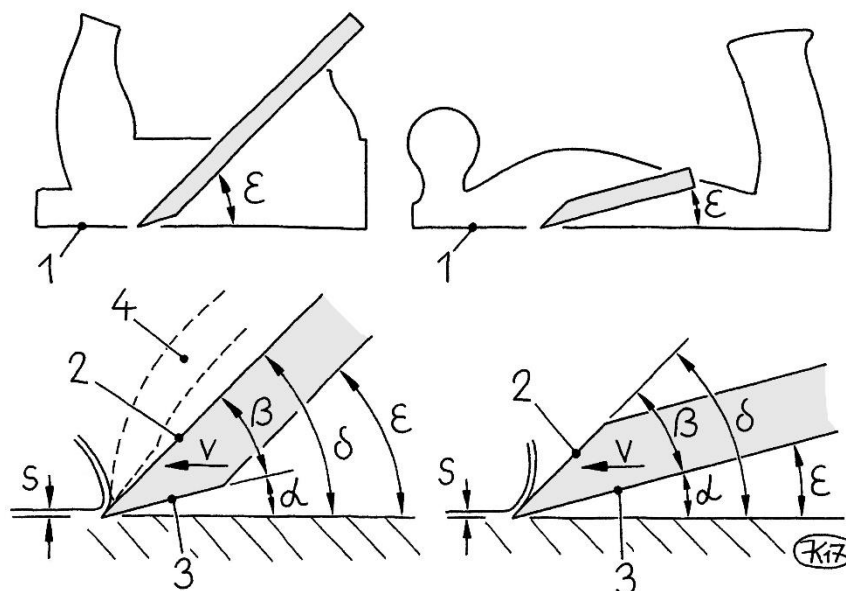


Fig 2: How a plane blade cuts

- left:** plane with bevel down
- right:** plane with bevel up (also called a BU or low angle plane)

- 1: sole of plane
- 2: rake face
- 3: clearance face
- 4: chipbreaker (optional)
- s: shaving thickness
- v: direction of movement
- α (alpha): clearance angle
- β (beta): wedge angle
- ϵ (epsilon): bedding angle
- δ (delta): cutting angle

The cutting process is quite different to that with a chisel, the crucial difference being the presence of a clearance angle.

Plane with bevel down (Fig 2 left):

This is the traditional design, found more commonly on both wooden and steel planes. The blade is fixed in the plane with its bevel facing down. The separated shaving slides over the back of the blade which acts as rake face. The bevel does not come into contact with the workpiece, it acts as clearance face. The wedge-shaped gap between bevel and cut surface is the clearance angle α (alpha).

The clearance angle avoids any unnecessary friction between the material and the cutting edge. When planing wood this angle should not be much less than 10° ³, so that the wood springing back after the cut does not rub against the clearance face. A sufficiently large clearance angle is a prerequisite for a good chip removal rate both for hand and machine tools.

Plane with bevel up (Fig. 2 right):

Now the blade is fixed with the bevel facing up. The wedge looks the same as for the plane with the bevel facing down, and the cutting process from the shaving's point of view is also identical, but the rake face is now the bevel of the plane blade and the clearance angle is between workpiece and back. These planes are also called low angle planes with reference to the flat configuration of the blade (small bedding angle ϵ). The plane's body with its thin wedge-shaped bed is always made of metal.

2.2 The cutting edge and the principle of sharpening

2.2.1 Sharp, dull, damaged

Chisel or plane blades for fine woodworking must be much sharper than machine tools⁴. How sharp? The simplest definition is: sharp enough to shave with. This sharpness can be achieved if both surfaces have a microfinished, almost a polished, surface where the bevel and back meet at a wedge angle β (beta) of, say, 30° . They then form a perfect, sharp cutting edge (**Fig. 3 left**), which in the (theoretical) ideal case would be absolutely sharp-edged without any radius formation, ie, with a curvature radius of zero.

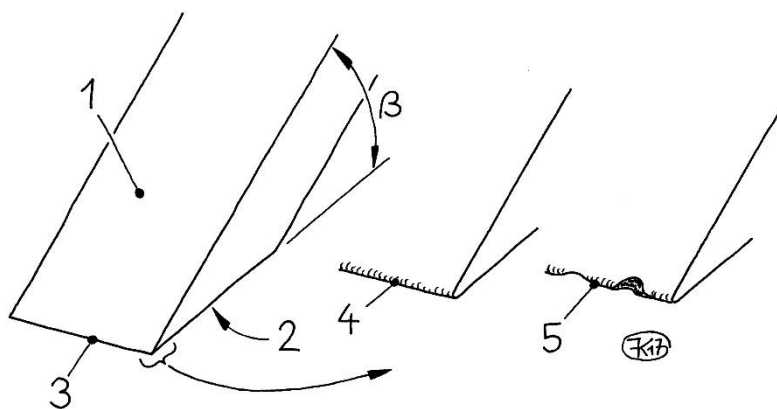


Fig. 3: State of cutting edge

left: sharp blade

centre: much enlarged: blade corner with dull (rounded) cutting edge

right: ditto, with dull and damaged cutting edge

1: back

2: bevel

3: sharp cutting edge

4: dull cutting edge

5: dull and damaged cutting edge

β : wedge angle

A blade this sharp will cut wood effortlessly. Once it has been in use for some time, the force you need to apply becomes noticeably greater and the cutting edge will no longer lift a thin shaving as readily as before. It is dull. If used carefully and gently, then the cutting edge has become dull simply through wear and tear. The soft but abrasive wood has attacked the hard steel and removed material (**Fig. 3 centre**). This has caused the cutting edge to become minimally rounded and roughened – it is no longer sharp. But if the cutting edge was overloaded or came in contact with hard foreign bodies (for instance, through mortising or planing wood with knots or mineral contaminants), the cutting edge will show additional evidence of damage such as notches or deformations (**Fig. 3 right**). These will leave visible marks on any surface cut with the blade.

You can see whether a cutting edge is sharp and undamaged or not, even without a magnifying glass. A perfect cutting edge is invisible – there's simply nothing to see; it's actually a non-existent thing. It becomes visible only once the cutting edge is either dull or damaged.

³ This is far more than in metal working, because wood is more elastic than metal.

⁴ Tools for wood must be far sharper because the cutting speed is much lower and the driving power very low. The sharpness of the blade is especially important when planing. Only a truly sharp plane works well. And how do you achieve a sharp plane? Quite simply by sharpening the blade of a dull plane.



Fig. 4: Cutting edge of a 13 mm wide skew chisel

(viewed from the back)

In good light against a darker background a dull cutting edge held at the correct angle will appear as a fine, uniformly bright line. Damaged points on the edge often show up lighter or sparkling.

This cutting edge is slightly dull and clearly damaged. In this light the back appears much more scratched than it actually is.

2.2.2 Principle of sharpening chisel and plane blades on bench stones

Good quality chisel and plane blades are very hard and as such can only be worked on by grinding and certainly not with a steel file! The typical grinding tool for sharpening by hand is a block-shaped, flat bench stone, called this because it is used lying on a flat surface or bench⁵.

You sharpen the blade by **regrinding the bevel**. This means that a thin layer of steel is removed. In effect, the old cutting edge is removed to reveal a new, sharp one. The blade ends up negligibly shorter, but the geometric relationships at the cutting edge (**Fig. 1** and **2**) are left completely unchanged.

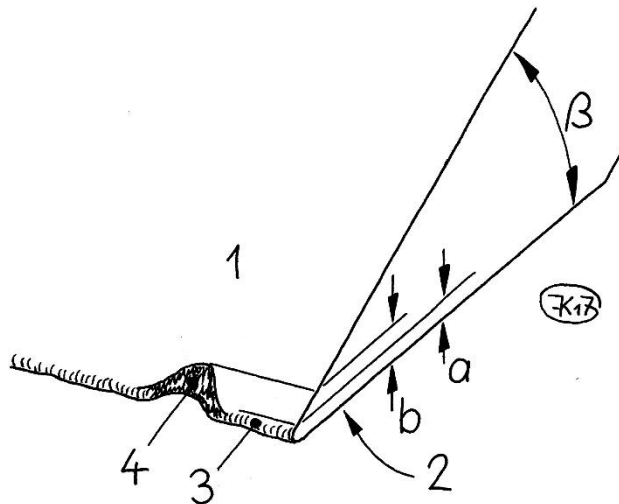


Fig 5: Sharpening principle: corner of a blade

showing the layers on the bevel that are to be ground away (highly magnified)

1: back

2: bevel

3: cutting edge, dull (worn)

4: nick

a: material removal at the bevel to eliminate wear at the cutting edge

b: material removal at the bevel to eliminate a nick in the cutting edge

β : wedge angle

If the blade was merely dull (worn), the layer to be ground away is very thin, just a few hundredths of a millimetre (**Fig. 5** layer **a**). But if you are repairing damage to the cutting edge, then more must be ground away (layer **b**). To save sharpening time and to maximize the service life of the blade you should never grind off more than necessary.

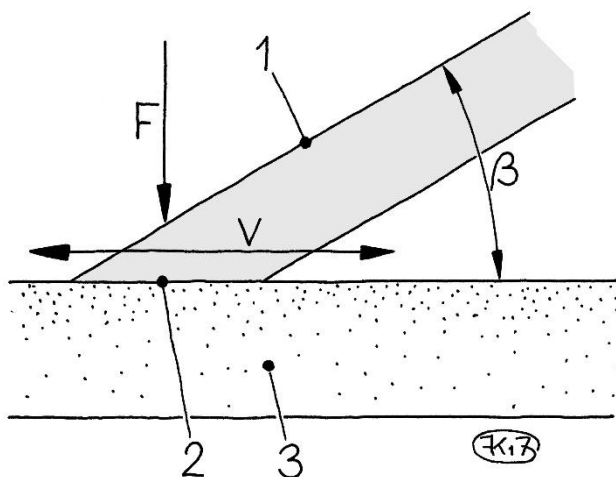


Fig. 6: Sharpening principle: grinding on a bench stone

1: back

2: bevel

3: whetstone

F: applied force

v: grinding movement

β : wedge angle

Press the bevel of the blade onto the stone and move to and fro, making sure you hold it at the correct angle (wedge angle β) to the stone.

⁵ Choose a hard-wearing, moisture-proof work surface, definitely not your workbench!

This creates a freshly ground area – and a new cutting edge. Quite simple in principle – in practice, however, somewhat more complicated, because the stone that is used to create the fine surface for a good cutting edge has only a very small removal rate⁶. You will also need to do something about the burr that usually develops – exactly along the line where you want your cutting edge to be.

That is why it is good practice to sharpen in three stages:

In the first stage the bevel is ground with a **coarser whetstone** (about J800 to J1000⁷ grit) until all signs of wear and damage have been removed from the cutting edge.

In the second stage the bevel is honed, ie, ground a second time, but this time with a very fine honing stone (about J3000 to J10000 grit) that leaves a fine surface finish.

In the third stage the back is honed to remove all unavoidable scratches and any small signs of damage from the cutting edge, as well as the very fine burr that usually forms when the bevel is honed.

2.3 Speeding up and improving sharpening – with microbevel and back bevel

Sharpening as described above involves honing the entire surface area of both the bevel and the back. There is absolutely nothing wrong with sharpening a blade in this fashion, but it has drawbacks.

- Honing the whole bevel area to a high quality takes time and is only straightforward if you guide the blade precisely during sharpening. This is quite a feat if you sharpen freehand and sometimes things go wrong (eg, you fail to pick up the whole cutting edge).
- When honing the back, you can remove only a very thin layer – because of the large area and the fine stone. You are unlikely to remove deeper scratches, caused perhaps by errant coarse grains. These scratches will increase in number and will form tiny notches if they continue to the cutting edge. If you want a truly perfect cutting edge you will either have to spend a lot of time honing the back or remove these scratches thoroughly from time to time, and that involves regrinding and then again honing the back.

You can avoid this laborious process:

Regardless of the length and thickness of the blade, the actual cutting process takes place right in front, at the cutting edge. In other words, it is enough if only there (ie, over the **first tenths of a millimetre**) the geometry and surface finish satisfy the requirements for a good cutting edge. It is quite sufficient to hone just this narrow area in front at the cutting edge! This is made possible by a **microbevel** and a **back bevel**.

2.3.1 Microbevel

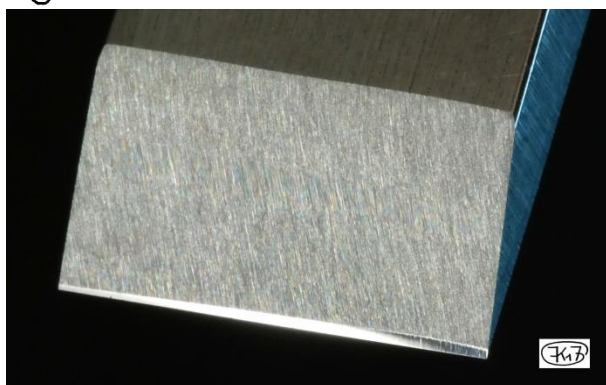
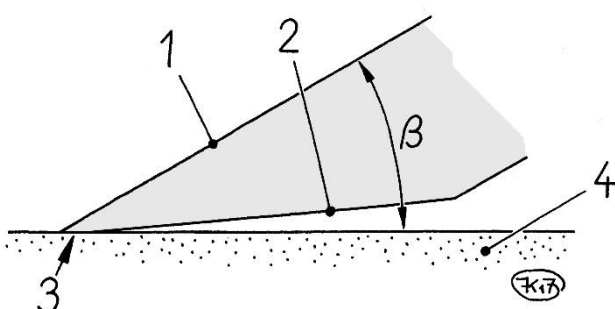


Fig. 7: Microbevel – how to produce it and what it looks like

above: honing the bevel only near the cutting edge

- 1: back
- 2: bevel, ground
- 3: producing the microbevel
- 4: honing stone

For a wedge angle (at the cutting edge!) of, say, $\beta = 30^\circ$ I start by grinding a bevel of 25° and then I regrind this coarsely ground cutting edge on a honing stone at 30° . Beginning at the cutting edge and increasing in width as I continue with the honing, this creates the narrow, microfinished microbevel. Even a microbevel just a few tenths of a millimetre wide will reliably remove all traces of grinding with the coarse whetstone at the cutting edge.

below: ground bevel and honed microbevel on a 12 mm wide chisel sharpened by hand.

Width of the microbevel: here approx. 0.3 mm

⁶ Removal rate = removed volume of material per time.

⁷ Whetstone grit grades see **Chap. 5.2**.

Only a tiny amount of steel has to be removed for creating a microbevel – this takes just a few seconds even with a very fine honing stone.

Moreover, no special effort is needed to keep the microbevel free of bigger scratches, because coarser grains or chips will not stick to its underside (as is the case with a larger area).

Another advantage is that you can increase the wedge angle on a chisel with a microbevel without having to regrind the whole blade. For instance, a cutting edge with 30° wedge angle is overtaxed for mortising in hard wood: no problem, simply add a 35° microbevel to the existing 25° bevel. And next time you sharpen the chisel for another, less strenuous job you simply reinstate the 30° microbevel.

And finally: producing a microbevel substantially reduces the precision with which the blade has to be guided compared with the case where the entire area of bevel has to be honed. This is especially welcome for people who sharpen by hand.

But remember: the microbevel must **always be narrow**, only then will you enjoy fast results in high quality!

Summing up the benefits of a narrow microbevel:

- Honing, even with an extremely fine stone, takes a fraction of the time that would otherwise be needed
- The quality of the microbevel and hence also of the cutting edge is especially good.
- A chisel can temporarily be given a microbevel with a more robust cutting edge without extra effort.
- The microbevel greatly simplifies sharpening by hand.

2.3.2 Back bevel (on planes only!)

Because the back of plane blades (as opposed to those on chisels) is not used to guide the cutting motion (see **Chap. 2.1**), there is no need for it to be flat all the way to the cutting edge.

To make the task of sharpening a plane blade easier you can also produce a small microfinished bevel at a flat angle on the back. This is called a back bevel.

Instead of having to hone the larger area (of the back) all you need to produce now is a minute edge (the back bevel a few tenths of a millimetre wide); again, with all the benefits of significant time savings and reliably good quality.

Like the microbevel, the back bevel must always be narrow, only then will you enjoy fast results in high quality!

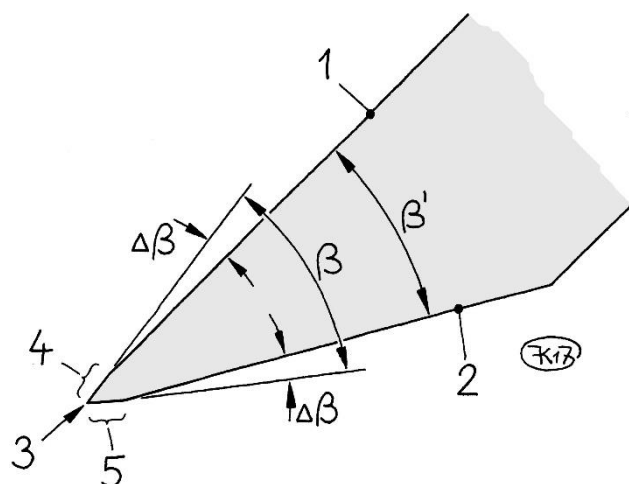


Fig. 8: Plane blade with microbevel and back bevel

- 1: back
- 2: ground bevel
- 3: cutting edge
- 4: honed back bevel
- 5: honed microbevel
- β : wedge angle (at the cutting edge)
- β' : angle between ground bevel and ground back
- $\Delta\beta$: angle difference between microbevel and ground bevel and back bevel and back, respectively.

Bevel widths and angle differences are exaggerated in the drawing.

The back bevel will normally not come into conflict with the chipbreaker (on bevel down planes), because if correctly produced, it is much narrower than the usual spacing between cutting edge and chipbreaker. Problems can, however, occur if the chipbreaker is placed very close to the cutting edge (for more details see **Chap. 4.2**).

Producing a back bevel on blades for bevel up planes and a 12° bedding angle is also no problem. $\Delta\beta = 3^\circ$ (relative to the back) leaves a 9° clearance angle, which is always ample.

The cutting edge of a sharpened plane blade with a microbevel and back bevel not only looks like a razor blade, it can also be just as sharp as can be seen in the photo.

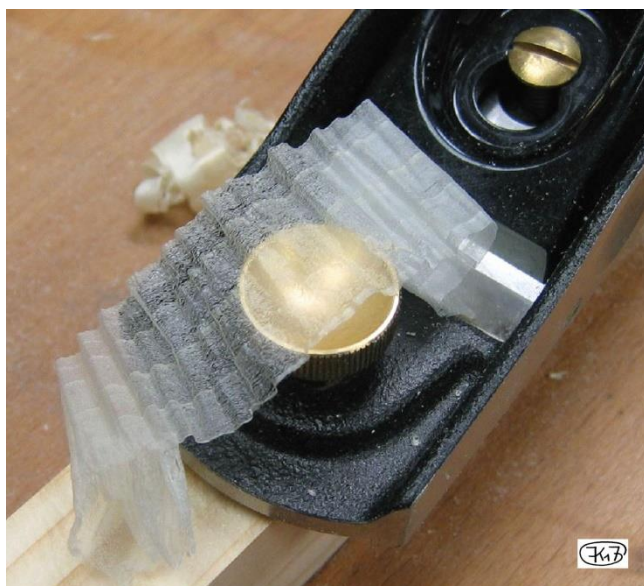


Fig 9: Low angle block plane with a “5-second shaving”⁸

Wood: spruce.

The blade used here has a microbevel and back bevel, both honed with an 8000 grit stone.

The practical value of such a fine shaving is limited and it cannot be produced with every type of wood; but the photo shows what is possible with a really well sharpened blade.

Summing up: benefits of a narrow back bevel (with existing microbevel):

- The time spent on sharpening is once more reduced, because the honing operation now takes less time and it is never again necessary to refinish the whole back to remove scratches
- A microbevel (on the bevel side) and a back bevel (on the back side), both freshly honed to a high quality give you a truly perfect cutting edge!

A variant for bench planes: plane blade with cambered cutting edge

The reliably straight cutting edge, obtained by producing a microbevel and back bevel, looks handsome but is not ideal for bench planes – ie, everything from a smoothing to a jointer plane. These plane blades should be given a minimally cambered cutting edge with a protruding centre.

- Detailed information on the benefits of a cambered cutting edge on plane blades: **Chap. 8.11.**
- How I sharpen a plane blade to produce a cambered cutting edge: **Chap.3.3.**

2.4 Techniques for sharpening with microbevel and back bevel

This section covers the basic techniques for sharpening blades with a microbevel and possibly a back bevel and draws attention to important considerations. Simple, routine sharpening⁹ of chisel and plane blades with a straight cutting edge is described fully in **Chap. 3.1** and **3.2**.

Routine sharpening entails the following work steps (in the sequence shown):

Chisel blades: regrind bevel – create microbevel – hone back

Plane blades: regrind bevel – create microbevel – hone back bevel

2.4.1 Regrinding the bevel (on a blade that is to be given a straight cutting edge!)

State of bevel <u>before</u> :	State of bevel <u>after</u> :
<ul style="list-style-type: none"> • Ground • With microbevel (without only if the blade is to be changed to one with a microbevel) 	<ul style="list-style-type: none"> • Wedge angle (β', see Fig. 8) “sufficiently accurate”; more on this later • Microbevel has disappeared, palpable burr along the whole length of the cutting edge • Ground cutting edge straight and at right angles to the longitudinal side (or symmetrical axis) of the blade, equivalent for skew blades

When regrinding the bevel, it is vital that the grinding tool is flat (freshly dressed stone or diamond plate)

⁸ Takes five seconds to drop to the floor from your outstretched hand.

⁹ “Routine sharpening” refers to a blade that is dull and must be resharpened, but is otherwise perfectly acceptable.

I sharpen freehand and that's what I describe here; the alternative would be to use a sharpening guide (also called sharpening jig) about which more in **Chap. 8.3**.

To determine the correct angle β' between the back of the blade and the surface of the stone I use a small angle gauge (see **Chap. 3.1** and **5.3**) and keep the blade steady at this angle as best I can while grinding. Chisel blades are easy to hold and guide¹⁰ with the handle in your right hand (see **Fig. 10**). For plane blades, which are often very short, I use wooden holders (see also **Chap. 3.2** and **5.4**). When grinding I press the blade firmly onto the stone in front near the cutting edge with one or more fingers of my left hand (shown in the drawing by the force vector **F**).

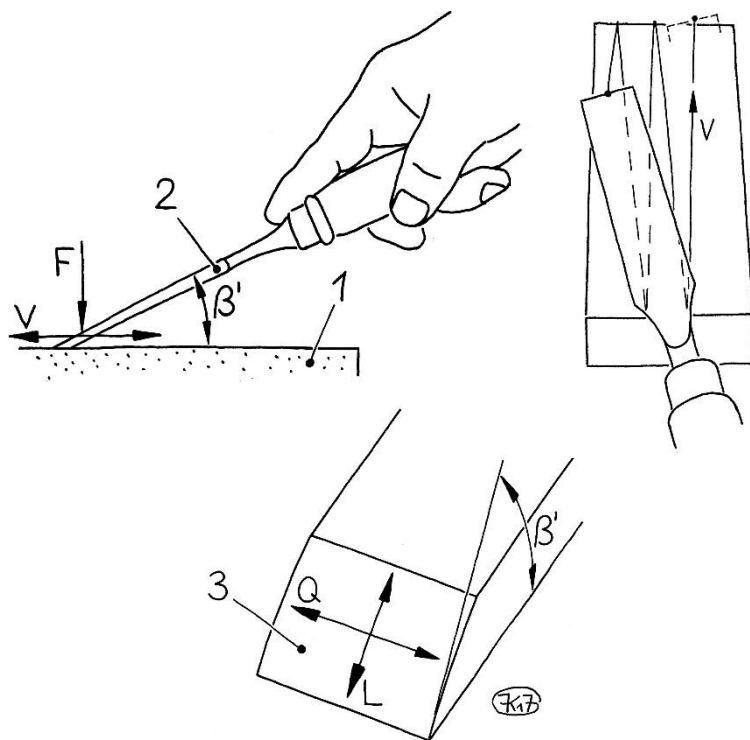


Fig. 10: Freehand regrinding the bevel of a chisel blade

above: holding the blade, movement forward-back

1: whetstone

2: chisel blade

F: applied force

v: grinding movement

below: bevel ground freehand

3: bevel, curved lengthwise

L: longitudinal direction of bevel

Q: transverse direction of bevel

β' : wedge angle, ground

(angle in front at the cutting edge)

The curvature of the bevel is exaggerated in the drawing!

My preferred grinding movement¹¹ is the simplest of all: in straight paths **forward-back**, with a small lateral shift from stroke to stroke and from the left edge of the stone across to the right edge, ie, in a zig-zag movement. In this way I use the full width as well as the full length of the stone. If I hold the blade so that its cutting edge is a little bit skew to the edges of the stone, I can with a wide blade even go beyond the ends of the stone and in doing so ensure more uniform wear (**Fig. 10** top right).

When grinding freehand it is not possible to keep the angle between the blade and the stone really steady, the resultant bevel will always be a little curved in the longitudinal direction (**Fig 10** below). This has no effect on the function of the blade, all that matters is that the wedge angle in front at the cutting edge is sufficiently accurate. How accurate is that? For instance, if the bevel is ground at 25° and the microbevel (also freehand) is honed at 30°, then the two areas should be neatly separated from each other. And this is doable, I at any rate have no problems with it.

Pressing the bevel onto the flat whetstone reliably ensures that the bevel will not be curved and that the cutting edge will be ground straight. It's only with very narrow blades that you might tend to wobble and the cutting edge will get a kink.

If necessary, the rectangularity of the cutting edge (to the long side) can be corrected slightly by rotating the handle of blade. With wider blades you can additionally apply one-sided pressure on the stone.

I continue grinding until I can feel a burr along the whole length of the cutting edge. Then I can be sure that I've completely removed the old cutting edge and no section of it has accidentally survived.

¹⁰ That is, if they are normal length. The ultra-short butt chisels look cute, but are far from optimal for accuracy – whether in use or during sharpening.

¹¹ I have tried various regimes, including the so-called "lying 8-pattern" (no good for me). The left-right movement that is rightly recommended for producing the microbevel (see **Chap. 2.4.2**) is not suitable for regrinding the bevel, the removal rate is simply too small.

2.4.2 Producing the microbevel (for a straight cutting edge!)

State of microbevel <u>before</u> (after regrinding the bevel):	State of microbevel <u>after</u> :
<ul style="list-style-type: none"> Non-existent (burr left from grinding the cutting edge along its whole length) 	<ul style="list-style-type: none"> Microbevel over the whole length of the cutting edge (full width of blade), a few tenths of a millimetre wide (see Fig. 7) Microfinished surface, coarser structure left by grinding in front at the cutting edge completely removed

Important: the honing tool must be flat, eg, a freshly dressed stone or lapping plate or diamond plate checked for flatness.

If you don't want to work freehand, you can naturally produce the microbevel using a honing guide.

Sharpening freehand, I again align the blade with an angle gauge when producing the microbevel. The blade then touches the stone only along the previously ground cutting edge, as shown in **Fig. 11**, above. There is a wedge-shaped gap with an angle $\Delta\beta$ (typically 5°) between the bevel and the honing stone. Along the line of the ground cutting edge the honing stone produces the minutely narrow microbevel. The blade should be held as steady as possible, as it was for grinding the bevel.

The movement for producing the microbevel can be the same as for grinding the bevel, ie, forward-back. For honing there exists an extremely interesting alternative, viz. left-right or side sharpening¹², where the cutting edge is moved over the stone much like a skate blade on ice.

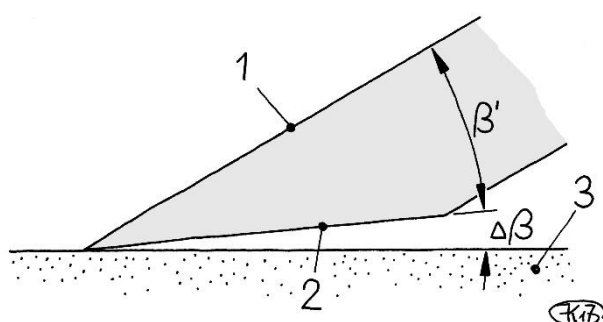


Fig. 11: Producing the microbevel: forward-back or left-right

above: aligning the blade with the stone

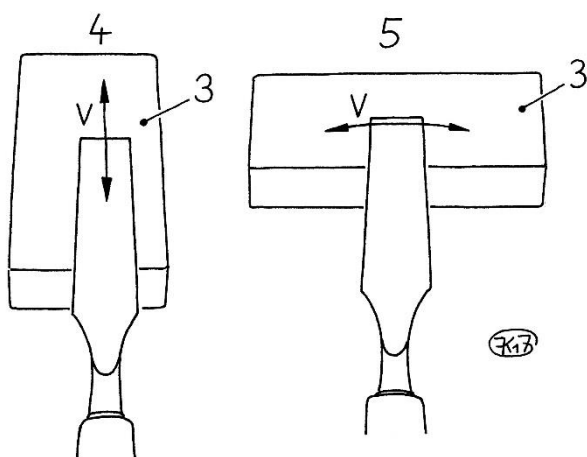
1: back

2: bevel (ground on a flat stone, ie, not curved in transverse direction)

3: honing tool, eg, stone, flat

β' : wedge angle, ground

$\Delta\beta$: difference of angle between bevel and future microbevel



below: movement for producing the microbevel:

4: forward-back movement

5: left-right movement

v: honing movement

Sharpening freehand as I do, a curved left-right movement as implied here is simpler and more ergonomic for me than a straight movement. The application is shown in **Fig. 20**.

Both movement regimes work well for me, but forward-back is distinctly faster (and preferred by me¹³), while left-right probably results in superior sharpness, judging by the shaving performance.

If you apply pressure in the centre you end up with a uniformly wide microbevel.

¹² <http://www3.telus.net/BrentBeach/Sharpen/sidesharpen.html>

¹³ Certainly for a straight cutting edge. For a cambered cutting edge (**Chap. 3.3**) I find left-right is better.

2.4.3 Honing the back (mandatory for chisel blades)

State of back <u>before</u> (after producing the microbevel):	State of back <u>after</u> :
<ul style="list-style-type: none"> Fine surface (as left by a honing stone) but possibly slightly scratched, with minor signs of wear in front at the cutting edge and a very small burr (from producing the microbevel) 	<ul style="list-style-type: none"> Honed to a microfinish including the corners, at worst still very slightly scratched Free of traces of wear (fine finish right up to the cutting edge!) No burr on the cutting edge

Important: the honing tool must be flat, eg, a freshly dressed stone or lapping plate or diamond plate checked for flatness:

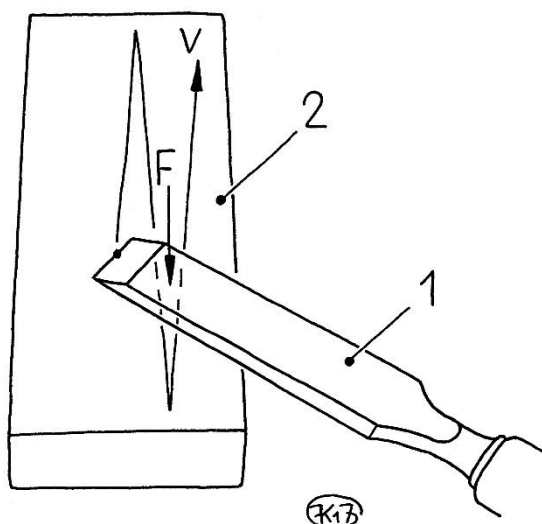


Fig. 12: Honing the flat back on a bench stone

1: chisel blade

2: honing stone, flat

F: applied force

v: path of blade over the stone (example)

Place the blade with back flat on the stone, press down firmly near the cutting edge and then move the blade over the stone, preferably in a zig-zag path as shown in **Fig. 12**, or across if you prefer.

Important is that the blade is **guided by the flat face of the stone**; be careful that your right hand (on the handle) does not press the blade down or lift it up!

Honing the back is complete once the first one or two centimetres from the cutting edge and including the corners are uniformly microfinished (in line with the fineness of the honing stone used). You should not be able to see any visible signs of damage (scratches, wear) on the cutting edge.

2.4.4 Honing the back bevel¹⁴ (only for plane blades, and here for a **straight** cutting edge:

This is the one operation where I do not work freehand, but guide the blade with a small tool.

State of back bevel <u>before</u> (after producing the microbevel):	State of back bevel <u>after</u> :
<ul style="list-style-type: none"> At most a very narrow remnant, with signs of wear and possibly a very small burr 	<ul style="list-style-type: none"> Back bevel over the whole length of the cutting edge (full width of blade), a few tenths of a millimetre wide Microfinished surface of the back bevel, coarser structure left at the cutting edge by grinding completely removed No burr, no signs of damage on the cutting edge

Important: the honing tool must be flat, eg, a freshly dressed stone or lapping plate or diamond plate checked for flatness.

Place the plane blade (with its back down) on the freshly dressed honing stone and raise the rear end so that only the cutting edge is in contact with the stone and the back is at an angle of $\Delta\beta$ ($= 3^\circ$ or 5°) to the surface of the honing stone. The blade must be held at this flat angle while you move it over the stone.

¹⁴ Once the microbevel is finished, traces of the back bevel will mostly still be visible. This doesn't matter, but it is the reason why I write about honing the back bevel and not about producing a (new) back bevel.

Most sharpening guides do not allow for such a small angle. When I hone a back bevel, I put a permanent magnet on the back of the blade that slides on a small plastic strip placed on the stone. The angle is determined by the thickness of the magnet and its distance from the bevel. The honing movement can be forward-back or left-right, it's arbitrary for this particular operation.

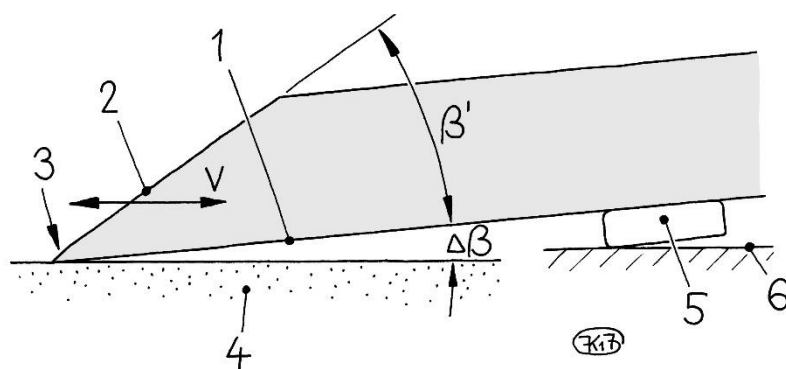


Fig 13: Blade aligned for honing the back bevel

- 1: back, ground, flat
- 2: bevel, ground
- 3: microbevel, honed, narrow
- 4: honing stone, flat
- 5: sliding block (permanent magnet)
- 6: sliding face (plastic)
- v: honing movement (here forward-back)
- β' : wedge angle, ground
- $\Delta\beta$: angle between back and back bevel

2.5 Summary: why backs and whetstones have to be flat

Because so much depends on it, I'd like to summarise once more why flatness is so important.

Honing completely flat backs:

Only if the back and honing stone are both perfectly flat, will you **successfully and effortlessly** remove the burr (left after processing the bevel/microbevel) along the full length of the cutting edge. Working with these perfectly flat surfaces also makes it easy to remove a tiny amount of material along the full length of the cutting edge in order to remove minor damage. And you can be sure the sharpening result will be acceptable. By contrast, a crooked back or a crooked stone (or both in a worst-case scenario) turns blade sharpening into a lottery; the quality of the cutting edge produced is always a matter of luck.

Honing microbevels and back bevels:

Here it is important to reliably remove all traces of the roughly ground bevel face at the cutting edge or scratches and signs of wear on the back. This should be achievable **in a short time even with a fine-grained stone**, ie, by removing a minimal amount of steel.

For instance, if a microbevel with a 5° angle difference to the ground bevel is 0.3 mm wide, then material removal at the cutting edge will be 0.03 mm deep; this will certainly be enough to eliminate anything that might reduce the quality of the cutting edge. Material removal of constant depth along the whole cutting edge (detectable by a uniform width of the microbevel) is only possible if the previously ground bevel is straight (ie, was produced on a flat whetstone), and also if the honing stone that was used to produce the microbevel was flat. If these conditions are met, you are close to reaching your goal of producing a continuous microfinished and flawless microbevel, significantly under 0.3 mm wide, at the cutting edge. And getting there in as short a time as possible.

The same applies to the back bevel: it will only be uniformly wide (and deep), if both the back and the honing stone are perfectly flat.

Making sure that the whetstone and the back are both flat enough takes some effort. The effort will be rewarded by rapid sharpening and a reliably high quality of the cutting edge. On balance you will find that it pays off.

That leaves the question: “What is “sufficient flatness”? (there is no such thing as “absolutely flat”!)

- What degree of flatness do I need for routine sharpening: **Chap. 3.4.1.**
- How to flatten whetstones and honing stones and keep them flat: **Chap. 6.**

3 This is what it looks like! Sharpening with water stones

From here on I won't make any references to alternative sharpening tools.

3.1 Sharpening chisel blades

If you're a novice at sharpening by hand, chisel blades are the right place to start. Please note that I'm right-handed; this is reflected in the descriptions, explanations and illustrations.

State of the blade before sharpening:

- The blade is dull and possibly shows signs of damage at the cutting edge.
- The back is acceptable as described in Chap. 3.4 (otherwise it must be reconditioned before you can start sharpening, see same chapter).
- You know the bevel and microbevel angles that you want to grind and/or hone. I have blades with different geometries so I have labelled each one (with a spark recorder).



Fig. 14: Old English chisel blade labelled:

ground bevel 25°
microbevel 30°

Step 1: Grinding the bevel

The whetstone or honing stone should be thoroughly wet, as should the clinker used for flattening them. I use a squirt bottle with water to which I have added detergent and wet them repeatedly (I won't mention this at every step).

Before grinding: dress the whetstone (every time!) (see Chap. 6.3)

The whetstone must be flat, otherwise you will experience problems during subsequent honing. With narrow chisel blades stone flatness is not critical, with wide blades you should take it quite seriously. It may be necessary to dress the stone again from time to time during long grinding sessions.

Aligning and holding the blade:

I use small home-made gauges of plastic for aligning the blade (more on gauges: Chap. 5.3).



Fig. 15: Aligning the blade on the stone using an angle gauge (here: to 25°)

Holding the chisel with your right hand, place the blade on the stone. Position the angle gauge with your left hand and then slide the back of the blade under the slope of the gauge. If you now vary the angle between the blade and the stone by gently lifting and lowering the handle, you will sense exactly when the back fits closely against the gauge; the angle is now right.

Keeping this angle constant, put the gauge aside and press one or two fingers of your left hand onto the back of the blade – and off you go. Movement: forward-back (see Fig. 16).

In order to keep the angle close to constant as you move the chisel over the length of the stone, I suggest that you adopt a special movement pattern. What I do is to stand with my left foot slightly forward, ie, in the "orthodox fighting position" and then move my upper body and arm more or less in unison forward and back; effectively I am rocking forward and backward, starting from the legs up. I must admit it looks a bit funny.....



Fig. 16: Grinding a chisel blade on a bench stone

Points to observe during grinding:

- The bevel must be pressed firmly onto the stone.
- The angle between stone and blade must be held as constant as possible.
- The rectangularity of the blade (between cutting edge and side) must be ensured, or produced by corrective measures.
- The stone should be used over its whole face so that wear is as even as possible.

When grinding in a forward movement (away from the body) I apply more pressure when pressing the blade onto the stone than when pulling backwards. If the cutting edge is at right angles I press uniformly in the centre. If the cutting edge is skew, I correct this by rotating the blade (right or left as appropriate) with my right hand (on the handle). For minor corrections the bevel should continue to make contact over its full face; you don't want a kink in the bevel. Only if major corrections are required will you need to grind a completely new bevel face, starting from the corner of the cutting edge that protrudes too far. If the angle between the blade and the stone changes, you will hear it and feel it – the thicker the blade, the more pronounced this will be¹⁵. You should also observe how the grindings move up the back on the forward movement. If no grindings appear, the microbevel hasn't been removed yet, the ground bevel face doesn't yet reach all the way to the cutting edge. Or you're busy decreasing the bevel angle. If grindings appear in quantity, it means you're grinding predominantly in front at the cutting edge, ie, you're increasing the bevel angle

Time to stop grinding the bevel:

- As soon as the grinding pattern is uniform and the bevel is not curved too much in the longitudinal direction (observe reflections from a lamp or similar on the still wet bevel and wobble the blade a bit from side to side to see roughly how curved or straight the bevel is)..
- + The rectangularity is correct. On chisel blades it is enough to judge by eye.
- + The microbevel has been removed completely (feel the burr along the whole cutting edge).
- + There are no more defects visible on cutting edge..

The burr (grinding burr) is a very narrow, thin and sharp metal edge with a hook-like profile, that curves away from the ground surface. It is created mainly because steel right at the cutting edge, ie, at the thinnest part of the acute-angled wedge, is deflected instead of being ground right away (**Fig. 17 left**).

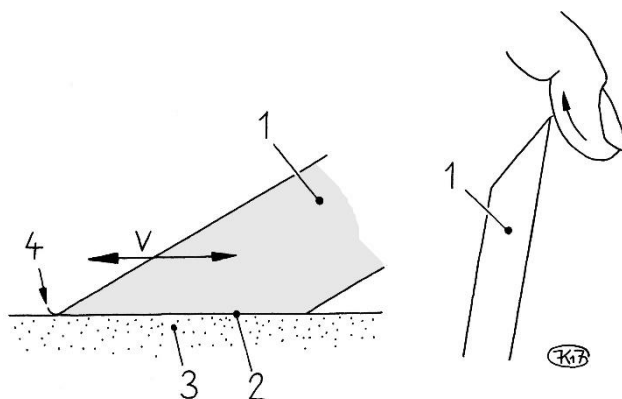


Fig. 17: Grinding burr

left: creating a burr during grinding

- 1: blade
- 2: bevel
- 3: whetstone
- 4: burr
- v: grinding movement

right: checking for the presence of a burr
note: check by moving your finger like this (arrow)

The burr is tiny, you can hardly see it – but you'll certainly feel it if you draw the tip of your finger along the back across the cutting edge (**Fig. 17 right**). The burr indicates that steel was actually ground away at the cutting edge – where you can feel a burr you can be certain that the old cutting edge was removed, and that is all that matters.

¹⁵ I find the grinding sensation somewhat irritating on laminated blades, because the grindings in front (at the cutting edge) give you quite a different feedback than at the back, where the steel is softer.

Step 2: Removing the burr

Generally, I remove the burr prior to honing (but this is not a must!) because of the risk of it scratching the microbevel or later the back. I use a honing stone for this (but do not specially dress it for this operation) and draw the cutting edge **once**¹⁶ across it with a swiping movement (**Fig. 18**), taking care to press the cutting edge only very, very lightly onto the stone, finishing with blade standing nearly at right angles on the stone's surface.

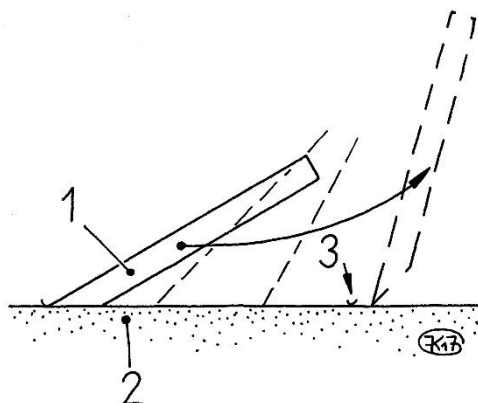


Fig. 18: Removing the burr prior to grinding the bevel

- 1: blade with burr, starting position (end position right, dashed line)
- 2: honing stone
- 3: removed burr

The burr is bent over towards the back and at the same time separated at its root by the grinding action of the honing stone.

The cutting edge suffers no damage that would not be removed by the subsequent production of the microbevel!

Step 3: Producing the microbevel

Essential: Prior to honing dress the honing stone and rinse (each time!)

The honing stone must not only be flat, but also free of contaminating coarser grains. That is why it must be carefully rinsed after dressing (**Chap. 7.1.2**). I rinse the stone in a container of water, and if I want to be extra fussy I scour it with a small brush. The ready-to-use stone should appear uniformly light-coloured and clean, without any visible contamination.

Now it is time to produce the microbevel. Use the gauge to align the blade on the honing stone at 30°. In this position it will touch the stone only with the ground cutting edge (see **Chap. 2.4.2, Fig. 11**).

First variant: forward-back movement (the usual method, just like grinding the bevel)



Fig. 19: Start producing the microbevel

If you were to press the blade onto the stone at this point and move it forward it would cut into the honing stone¹⁷.

To make sure of avoiding this, you start with a pulling movement (back). Press the blade firmly onto the stone. It will leave a distinct dark trace, indicating that steel has been removed and that a microbevel (albeit a very, very narrow one) is being produced.

Now comes the critical challenge for a narrow blade on a soft stone: how to perform the forward movement without cutting into the stone. The answer is to apply only the slightest pressure on the forward movement, and now it helps to reduce the angle by a tiny amount.

This problem never, or only rarely, occurs with harder honing stones, but it is nonetheless important not to let your concentration lapse, because a deep nick in the stone is annoying.

To produce a microbevel with an 8000 grit stone on a chisel with an easy-to-sharpen, medium-width blade takes about 5 strokes (five times forward and back)..

¹⁶ Once your finger test tells you the burr is gone, that's it. Otherwise repeat.

¹⁷ The blade tends to cut into the stone more readily if it is very narrow and the stone is soft (as is the case with my 8000 grit Naniwa). If the problem recurs frequently, a harder honing stone may be the answer.

Initially you should check the result using a magnifying glass. It is important that the narrow honed microbevel at the front edge (the cutting edge) is completely free of any residual traces of the coarser grinding patterns left by the whetstone. If the angles while grinding and honing were more or less observed (ie, the angle difference $\Delta\beta$ between the faces is in fact about 5°), the microbevel will be only a few tenths of a millimetre wide and have precise limits (see **Fig. 7**). My own first attempts also left something to be desired, but I didn't have to wait long for improvement.

Second variant: left-right movement (not bad either!)



Fig. 20: Producing the microbevel

The traces visible on the stone show the side-to-side movement and the generous radius of the chisel blade. The chisel blade was previously aligned to 30° .

This movement along a curve is (for me) more ergonomic and lets me maintain the angle of the microbevel more effectively than a parallel blade movement.

The left-right movement lets you sidestep any starting problems. Material removal is however substantially less than with the forward-back movement. And you have to take care not to cut into the stone by tilting the blade.

As long as the finished microbevel is continuous and of flawless quality at the cutting edge, it will make no difference to the function of the blade if the microbevel is very wide or non-uniformly wide or not cleanly separated from the ground bevel. But it does imply that the work on the microbevel was inaccurate and that more material was removed than was actually necessary; this will have wasted time.

Step 4: Honing the back

First: dress the honing stone and rinse it off (every time!)¹⁸

Honing the back removes the microscopically small burr created by honing the microbevel and any fine scratches. A perfect microbevel is worth only half as much without a good back!



Fig. 21: Honing the back

Place the back of the blade face down on the honing stone. Honing must be guided by the stone's surface! Press and push in front at the cutting edge of the blade because that is where you mainly want to remove material¹⁹. Your right hand should be holding the chisel loosely.

Move the chisel forward and back over the stone. The burr is removed immediately. Removing any deeper scratches on the surface can take quite a bit longer, and need not be complete. What is important is that the zone along the entire cutting edge (including the corners) is being honed.

¹⁸ *Complicated or taxing? Neither. Merely a question of habit. Because my honing stone is a ready-to-use component of my sharpening station it takes roughly 10 seconds-*

¹⁹ *For wide blades (20 mm or more) it can be very helpful to work with a grooved stone (see also **Chap. 5.2.2**).*

If honing takes long then it will pay to dress the stone again from time to time. This will not only improve its flatness but also make for a better grip for faster material removal.

Honing the back is complete once the band along the cutting edge is uniformly microfinished without any traces of damage. This can be assessed with the naked eye. If you're unsure use a magnifying glass.

The cutting edge is now finished. If you're working to exceptionally high standards you can then lightly rehone the microbevel and finally also the back (to remove the last residual traces of the burr). I usually don't.

Step 5: Testing the cutting edge

I test for sharpness by shaving my lower arm or the back of my hand. This is perfectly safe; I've never cut myself using this method. If the (dry) hairs fly off the cutting edge, it is sharp. If this does not happen and the cutting edge tears at the hairs, it is not sharp enough. If it doesn't shave at all, something is completely wrong.

If the shaving test (or a trial on wood, for non-shavers) reveals serious imperfections of the cutting edge, you can inspect it through a magnifying glass with about 10-fold magnification²⁰. This is highly recommended for beginners because it shows clearly where improvement is required.

What the cutting edge should look like under the magnifying glass:

- There is no visible damage to the cutting edge.
- The microbevel shows no traces of the coarser grinding pattern left by the whetstone.
- There are no traces of wear on the back at the cutting edge (tiny scratches are inevitable).

Step 6: Dry the blade and protect against rust

A freshly ground or honed surface, if wet or moist, can show the first signs of rust within a matter of minutes. Dry the surface immediately with a clean, absorbent cleaning rag or, better still, with some kitchen paper. Then apply a thin layer of oil as rust protection especially on the back. What type of oil? I use Ballistol (Kaiser Willis gun oil). Normal sewing machine oil (white mineral oil) is probably just as good. I've stopped trusting the rust protection properties of camellia oil, but if you're happy with it by all means keep using it.

3.2 Sharpening plane blades with a straight edge (for a curved edge see **Chap. 3.3**)

I won't keep repeating that it is essential to dress the whetstone or honing stone **before each operation**.

State prior to sharpening:

- The plane blade is dull and may show signs of damage at the cutting edge.
- The back is acceptable as described in **Chap. 3.4.1**.
- The ground/honed bevel, microbevel and back bevel angles are known.



Fig. 22: Plane blade with a straight cutting edge and its plane (simple bevel up Stanley 102 plane)

View of the back

Clearly visible is here the partial hardening (bright/light = hard, see also **Chap. 7.3**)

Precise rectangularity is more important on plane blades than on chisel blades. It is a good idea to check occasionally (using a small try square) whether some corrective measures need to be taken prior to sharpening.

²⁰ Information about magnifying glasses and their use: **Chap. 5.5.1**.

Do not hold the cutting edge against the try square; instead hold the blade of the try-square against the back:

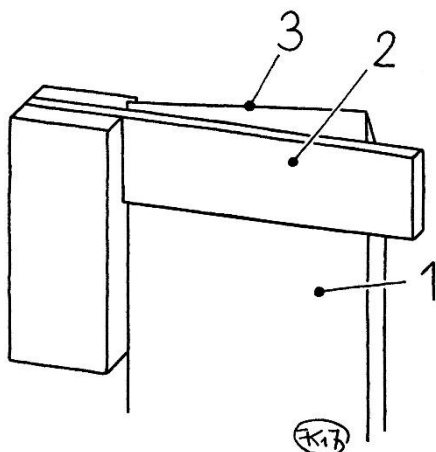


Fig. 23: Checking the rectangularity of a plane blade

- 1: Blade (back)
- 2: Blade of try square
- 3: Cutting edge (skew!)

Step 1: Grinding the bevel



Fig. 24: Grinding a plane blade using a holder

Plane blades are screwed to a wooden holder for working on the bevel and microbevel.

You align and grind a plane blade the same way as a chisel blade. But now you can and should press a bit harder with your left hand to save time. If it's necessary to improve the rectangularity, rotate the holder with your right hand while increasing the pressure on the target corner of the cutting edge with your left hand.

Pressing your right forearm firmly against your upper body makes for a steady guidance of the blade. Again the forward-back movement emanates from your legs, your upper body and arms hardly move.

Step 2: Removing the grinding burr (optional, but I always do this)

Same as for a chisel blade. The plane blade stays screwed to the holder.

Step 3: Producing the microbevel

Aligning and honing same as for a chisel blade. The blade stays screwed to the holder. As for chisel blades, you may find it easier to produce the microbevel using a left-right movement.

Step 4: Honing the back bevel

Since compiling the 2013 version of this guide, I have significantly changed the way I work at this point. It now resembles the ruler trick of David Charlesworth²¹, widely respected and not only by British and North American woodworkers. Charlesworth creates a back bevel at an angle of only about 0.5°. I prefer a somewhat larger angle relative to the back of 3° or 5°. This way I can remove much more material and I am able to repair even sizeable damage to the cutting edge very quickly and reliably.

²¹ You can view this as a video on the Internet (search for ruler trick charlesworth), it's well worth having a look at. David Charlesworth shows here how the method works in principle. To sharpen a rather stressed iron, where somewhat more material has to be removed, he too, however, will have to work more energetically than is shown in the video.

As shown above in **Chap. 2.4.4, Fig. 13**, a magnet is placed on the back as a sliding block; its thickness and distance from the cutting edge determine the angle. The disk-shaped magnets used are 2, 4 and 6 mm thick and 20 mm in diameter. For very short blades I use rectangular magnets 1 mm thick. More on magnets: **Chap. 5.5.2**.

Important: beware of the risk of magnetizing plane blades (also **Chap. 5.5.2**)!

A 1 mm thick soft plastic glue spatula serves as the sliding area on the honing stone.

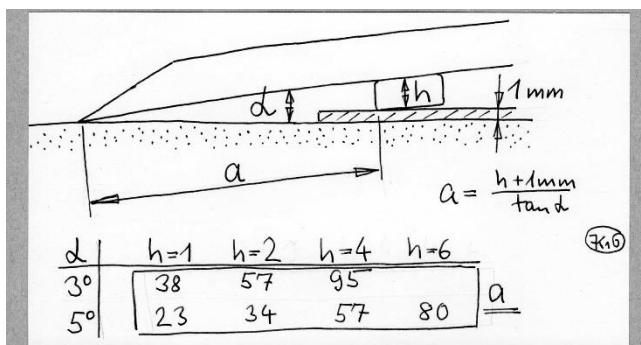


Fig. 25: Magnet on back

above: this table is pinned to the wall behind my sharpening station. It shows the working method and how to select the magnet thickness h and the distance a .



below: magnet on back, 4 mm thick, 95 mm from the cutting edge. Results in a back bevel angle of 3° .

(Bevel up blade from Veritas)



Fig. 26: Honing the back bevel

Place the blade with its cutting edge on the whetstone. The magnet sticking to the back slides over the light-yellow spatula. Perform the honing movement, pressing the cutting edge lightly onto the whetstone with 1 or 2 fingers.

It is immaterial whether you move the blade to and fro or left to right. There is no risk of cutting into the stone.

5 to 10 strokes should suffice to hone the back bevel. Nothing could be simpler, it is the least problematic step of the whole sharpening process.

In this way I provide all my plane blades with a back bevel. For very short blades I use flat rectangular magnets.

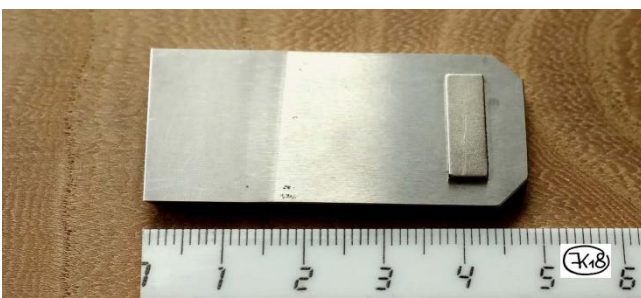


Fig. 27: very short plane blade with 1 mm thick rectangular magnet for the 3° back bevel

The narrow, polished band along the cutting edge of the blade (left) is the back bevel.

(Bevel up blade for LN 100)

The cutting edge is now finished. On plane blades, too, you can remove the very last residual traces of burrs by first lightly rehoning the microbevel and then also the back bevel. I don't usually do this, the effect is small, and possibly even zero and for plane blades it is much more labour-intensive than for chisel blades, because of the holder

Step 5: Checking the cutting edge (preferably shaving test, as for chisel blades)

Step 6: Drying the iron and protecting it against rusting.

Rust protection is especially important for plane blades that are screwed against a chipbreaker. If you're not careful and if you leave any residual moisture you will find when next you detach the blade after a longer period of inactivity that a surprising amount of rust will have formed between the back of the blade and the chipbreaker. Flat angle planes made of metal are also at risk from rust: the back of the blade rests flush against the bed and moisture has no chance of escaping. You can have some very unwelcome surprises...

3.3 Sharpening plane blades with a cambered (slightly curved) cutting edge

You'll find more details on the practical implications of cambered cutting edges on bench planes in **Chap. 8.11**. The sharpening requirements are identical to those of plane blades with a straight cutting edge (**Chap. 3.2**). Above all make sure **whetstones and honing stones are always flat!**

You will be looking for a very slight camber in your cutting edge and will have to sight quite accurately along the cutting edge to register any deviation from a straight line. You won't be able to check either the amount of curvature nor its shape until you inspect the shaving produced by the plane. Then you can see whether the cutting edge has the desired curve (not too much and not too little). This is where experience counts.

The camber of the cutting edge depends exclusively on the form of the microbevel and back bevel, because only these two make up the cutting edge. I start by honing a cambered microbevel which even at this stage forms a suitably curved (but qualitatively still unfinished) cutting edge with the flat ground back. I now hone the back bevel in such a way that it is uniformly wide over the full extent of the cutting edge, leaving its camber unchanged.

How to produce a curved microbevel:

A curved microbevel on a straight ground bevel²² would be narrow in the middle of the blade and much wider at the corners (**Fig. 28** above) – so wide, in fact, that it would be quite laborious to produce it using a honing stone. That is why it is a good idea to grind the bevel roughly to the required form – it is quite sufficient to ease back the corners of the bevel (**Fig. 28** below), so that it forms a minimally trapezoidal cutting edge with the back. This trapezoidal form is chamfered during the production of the microbevel to end up with the desired curvature.

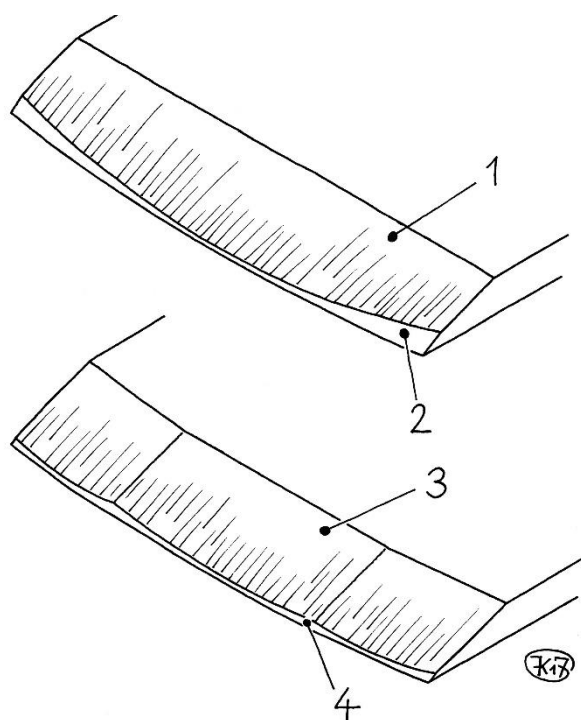


Fig. 28: Curved microbevel for a cambered cutting edge, the basic method

above: ground bevel not adapted
1: bevel, ground straight
2: microbevel for cambered cutting edge

below: ground bevel adapted
3: bevel, corners eased back
4: microbevel for cambered cutting edge

The curvature is exaggerated for the purpose of illustration!

²² Straight = not curved in transverse direction, see **Fig. 10**.

This is how it's done:

Step 1: Grinding the bevel (for cambered cutting edge)

You grind using a normal holder. First grind a straight bevel until a burr is formed. Then slightly tilt the corners of the ground bevel and make several grinding strokes while **pressing one corner of the blade onto the whetstone and twisting the holder in that direction**; repeat on the other side.

How many strokes? This depends on how pronounced you want the final camber to be²³. For a blade that previously didn't have a cambered cutting edge, I find that five to ten strokes on each side are usually sufficient on a thin plane blade. You won't need any more for a thick blade – provided there is a rough-ground relief bevel (to save on grinding effort, see also **Chap. 8.6**). **Fig. 29** shows a thick bevel-up blade with relief bevel and cambered cutting edge.

If the blade previously had a cambered cutting edge and if the corrected bevel form did not quite disappear when it was first ground with pressure in the centre (burr formation only at the centre of the cutting edge), then you will need fewer strokes to restore the previous state at the corners.

Step 2: Removing the grinding burr

To deal with the burr along its full length, you perform the swiping movement shown in **Fig. 18**, once in the middle and once on the right and left sides.

Step 3: Honing the micro-bevel (for curved cutting edge)

Honing turns the minimally trapezoidal shape into a minimally curved cutting edge. Some time ago I changed my procedure for producing a curved microbevel; because it really does work better I have essentially switched to a left-right movement.

After aligning it with an angle gauge, move the cutting edge from left to right across the whetstone, as shown previously for chisel blades in **Fig. 20**. Use your left hand to press the blade lightly onto the stone. Do not apply the pressure in the middle, but rather towards the following cutting edge²⁴ (eg, when moving to the right, press on the left side of the blade). You do this by applying pressure with two fingers, alternating between fingers that apply the greater pressure, or by twisting the holder with your right hand.

This method supports the creation of a curved form. If you inspect the intermediate result after a number of strokes, you will see where you have to press a bit more in order to arrive at a microbevel of uniform curvature.

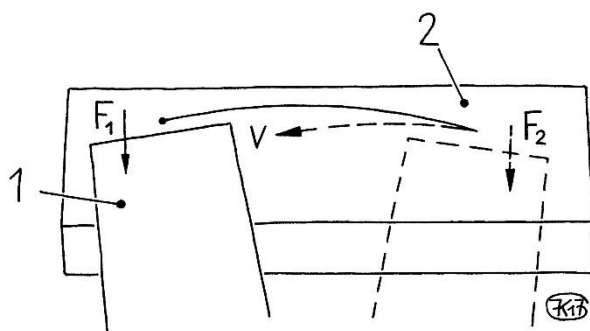


Fig. 29: Producing a curved microbevel

above: movement and applied pressure

1: plane blade (visible back)

2: honing stone

F₁: pressure for movement to right

F₂: pressure for movement to left

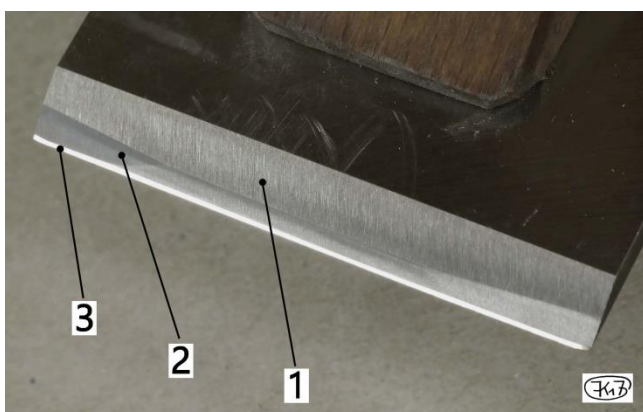
v: movement left-right

below: result

1: rough-ground relief bevel, 25°, straight

2: ground bevel, 35°, with corners eased back

3: microbevel, curved, 40°



The blade shown here belongs to a bevel up smoothing plane (Veritas). Because of its small bedding angle, it needs a very pronounced curvature (see **Chap. 8.11**), and owing to the rough-ground relief bevel with just 10° difference to the ground bevel, the eased back corners are readily visible. On a bevel down plane with a thin blade (without relief bevel) you'll hardly see anything of the modification to the ground bevel and the curvature of the cutting edge!

²³ See **Chap. 8.11**.

²⁴ Do not press on the other (leading) edge, the blade could dig into the stone!

Step 4: Honing the back bevel

To hone the back bevel, follow the procedure for blades with a straight cutting edge (**Chap. 3.2**). The only difference is that to give the back bevel a curved form that matches the existing microbevel, you will have to transfer the pressure (applied with both fingers) from the left corner past the middle to the right corner of the blade and back again. The idea is to finish with a back bevel that despite the curved cutting edge is more or less uniformly wide over its entire length.

Finally: Test the cutting edge, dry the blade and protect it against rust (as ever).

3.4 If necessary: refinishing the back

From **Chap. 3.1** to **3.3** it will always be assumed that the back is acceptable, ie, flat enough. If this is not the case it must be refinised, before the blade can be sharpened properly.

I'm talking here of backs with small blemishes, not the backs of old, shabby or spoiled blades that are dealt with in **Chap. 8.10**.

3.4.1 Is the back acceptable?

A "serviceable" back is free from rust scars, wide scratches and similar flaws. Above all it is flat

A back that is flat enough for sharpening the blade on a bench stone without any trouble is always flat enough for unproblematic use²⁵.

How flat must a back be so that a blade can be sharpened properly? The deviation from flatness²⁶ is not measurable by manual means. A common practice for estimating flatness in metalworking, the light-gap method using a straightedge, is of doubtful value here. Moreover, I'm of the opinion that a woodworker cannot be expected to use a straightedge during routine sharpening sessions. Suitable in practice are:

- **Visual check for sloping edges:**

A back will reflect light. Even one that is only ground will reflect light, if you look across it at a very flat angle. Good reflecting objects are linear light sources such as fluorescent tubes. If their reflection is noticeably distorted near the cutting edge (snapped off or rounded) then the back has a sloping edge at that point and is not flat enough

and above all:

- **Checking for flatness "on the stone"**

If a back doesn't make satisfactory contact with a freshly dressed honing stone²⁷, ie, after a few grinding strokes the first centimetres from the cutting edge including the corner are not completely reground, then the back is not flat enough. This process is described in detail below.

A lack of flatness of the back is the usual state of used blades that haven't been sharpened with care; it is also a frequent flaw on brand new blades (see **Chap. 8.17**). On chisel blades where the back is routinely honed when the blade is sharpened, the flatness of the back will also deteriorate over time, even if the honing stone is perfectly flat! See **Chap. 3.4.4**.

Reworking an insufficiently flat back always begins with grinding it flat again.

3.4.2 Grinding the back flat on a bench stone

Very important: it's not enough to dress the whetstone at the beginning; it must be dressed repeatedly!

The grinding process:

I place the blade back down on the whetstone but while grinding I apply pressure in front near the bevel where I want to remove most material.

The aim is not to grind off a plane-parallel layer of the blade but rather a wafer-thin wedge that is thickest at the cutting edge. That is where material must be removed.

²⁵ Such a back causes no problems either with incomplete contact between chipbreaker and blade or with insufficient straightness of the cutting edge of plane blades.

²⁶ This is the distance between two imagined parallel planes, between which a plane can be inserted that is known not to be perfectly flat. The amount of deviation of flatness can be determined only with a CNC measuring machine.

²⁷ In the case of ground backs a freshly dressed whetstone will also do, as of course will a flat diamond plate.



Fig. 30: Grinding the back of a plane blade on a bench stone

Move the blade in a zig-zag movement over the bench stone (to and fro, at each stroke shifting it slightly sideways). I hold the blade at an angle to the edge of the stone. And I take care that my right hand does not press the blade down or lift it up. Occasionally I turn the stone around its vertical axis (swapping the front and back ends). In this way the surface is used **as evenly as possible**.

A flat surface forms in front at the cutting edge. Initially, this surface will not extend over the whole width or to the cutting edge – continue grinding until this state has been reached.

But keep in mind: Sooner or later the stone itself will inevitably lose its flatness – normally it will become dished (concave) – at this point it will be impossible to create a flat surface on the blade. That is why the stone must be freshly dressed from time to time. If you skimp on dressing the stone, you will end up with convex back that is bound to create problems!

Testing the result “on the stone”

Example: a plane blade. The blade was ground flat (1000 grit stone), the surface is bright and clean. The grinding structure is diagonal to the edges of the blade, because that is how it was held during grinding.

Now test the flatness. First the whetstone is carefully dressed again (flattened) and then the blade is reground with a few strokes, but this time in the blade’s **longitudinal direction**.

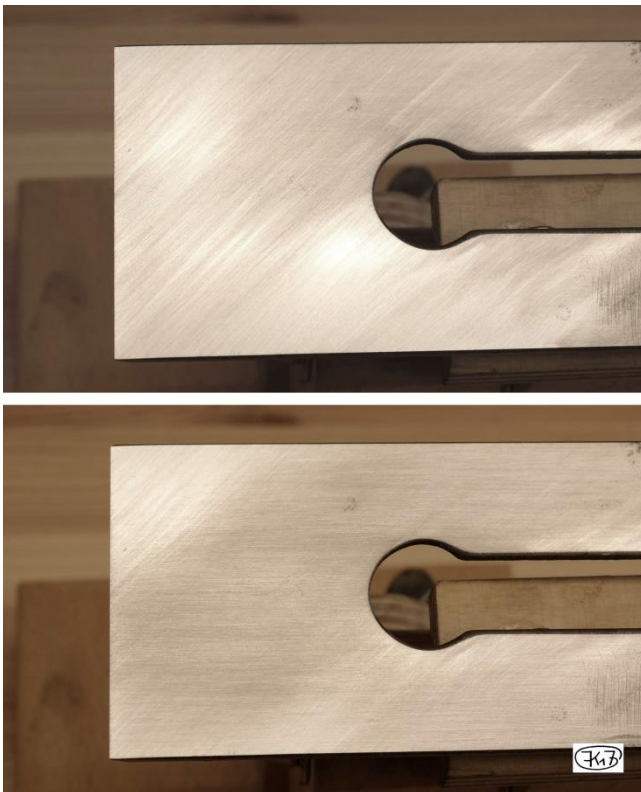


Fig. 31: Testing the flatness of a ground back “on the stone”

above: reground back with diagonal grinding pattern. The surface structure is uniform.

below: testing by slight regrind on a freshly dressed stone; longitudinal grinding pattern.

Result: the left corner of the cutting edge (below) shows that it has been ground, but the right corner (above) shows no sign of having been ground.

Evaluation: the flatness of this back is anything but perfect, it can and should be improved.

For the sake of clear photos, this example is intentionally very obvious. You’ll be able to spot far finer shortcomings with the naked eye!

Here testing “on the stone” is nothing but the critical inspection of the current state during grinding, without any special test procedure!

If after further grinding (with a properly dressed stone!) a subsequent test (again with a freshly dressed stone) shows a satisfactory result, the back of a plane blade, still to be provided with a back bevel, is finished. The back of a chisel blade is subsequently honed.

3.4.3 Honing the back of a chisel blade after grinding

I find my hard and aggressive 6000 grit stone is ideal for this job. It won't produce the fine surface finish that I look for on the backs of my chisel blades, but that will come all by itself through routine sharpening with the 8000 grit stone.

Always important: the honing stone must be dressed at the beginning and frequently during the process!

Make sure the honing stone meets the strict requirements for flatness and cleanliness. It must be freshly dressed and rinsed. And (for wider blades) it is very helpful if one side is grooved (see also **Chap. 5.2.2**).

Honing process

The blade is guided for honing as it is for grinding (see **Fig. 30**).

Ideally the honing stone will make contact uniformly over the whole area, so that after a short time the roughness left by grinding will have disappeared.

Often, however much care you take, this does not happen. Parts of the surface – usually one or both of the corners – do not make full contact with the honing stone. This happens when the grinding stone was dished, even very slightly (not dressed often or accurately enough!), resulting in a convex back.

If the lack of flatness is obvious it is better to return to a freshly dressed coarser stone. It would be totally wrong to try putting ever increasing pressure on the honing stone until it is finally hollow enough to fit the convex back of the blade. That would postpone but not remove the problem – when next you hone a blade, the freshly dressed honing stone would once again not make contact with the whole width of the blade! For very slight deviations simply dress the honing stone from time to time and be patient.

Testing the result “on the stone”

After just a few strokes on a freshly dressed honing stone the back should make sufficient contact with the stone (ie, over the first centimetres from the cutting edge and including both corners). Change the direction of movement (as previously shown in **Fig. 31**) for improved visualization.

Here too, this test is basically no more than a careful inspection of the most recent honing operation!

3.4.4 Do backs stay permanently flat?

With plane blades that are sharpened by applying a back bevel, the back is never again reground or otherwise touched, which is why it remains flat.

It is different for chisels. Here the back is honed every time the chisel is sharpened and sometimes it is reground to remove scratches. Look at **Fig. 12** and **Fig. 21** to see how I move the blade over the stone; this is more or less the conventional way. The idea is to press on the front of the blade (directly behind the cutting edge) because it is here that you want to remove most material; as you move along you want to remove less and less, and nothing at all where the back ends, usually in a step up to the thicker neck of the blade. As soon as the back in front at the cutting edge is bright and free of burrs and blemishes, you can stop.

All things considered, it would be quite surprising if the back were to stay flat while all this was happening. And sure enough, it doesn't. You won't notice anything when working with the chisel, but you'll notice the difference during sharpening. When honing, it becomes progressively harder to achieve a uniform surface near the cutting edge, the stone is no longer in contact with the whole area. Testing “on the stone” would show you that something is wrong, but deterioration is gradual...

I have used a straightedge to check the backs of chisels that I carefully ground flat some time ago and which I had used and sharpened since then without checking them again. What I found was that there was a usable flat area at the front, on the first few centimetres from the cutting edge, but closer to the handle this flat area changed to a gradual ramp. In other words, when checked along its full length with a straightedge, the back had a definite dip at about its midpoint.

All the chisel blades that I have used for some time have developed this deformation of the back, and the more I used (and sharpened) them, the more marked it became. The dip in the back of the blade – estimated by slipping a feeler gauge under the straightedge – was no greater than some hundredths of a millimetre. Not much and not noticeable while using the tool, but irksome when honing. It means that the backs of these blades should be refinished on the whetstone (along the whole length!).

A refinish of this kind will solve the problem, but it is also possible to modify the chisels in such a way that once you have achieved a flat back, it will stay flat for keeps (see **Chap. 8.18**).

4 Special cases: gouges, chipbreakers, scrub plane cutters, router plane cutters

4.1 Sharpening gouges

I own several gouges which I use mainly for making spoons and similar implements. All have their bevel on the outside (as is customary) and most of them are straight. And naturally I sharpen them.

4.1.1 Sharpening tools for gouges

I grind the strongly curved bevel of gouges on the same flat whetstone as all other tools. Likewise, the microbevel is produced using a normal, flat honing stone. But there's no way I can use flat stones to grind and hone or deburr the inside edge, which is why I use (home-made) cylindrical slip stones for this purpose.

4.1.2 Grinding the bevel of gouges (bevel outside)

For grinding the bevels on straight gouges, I align them with the usual angle gauge (see Chap. 5.3) and then guide them freehand.

Coarser preparatory work and eliminating geometric errors

This is the method I use, eg, when the cutting edge is skew. I move the blade forward and back on the stone using the familiar zig-zag movement. As I traverse the width of the stone with about 6 to 10 strokes²⁸ from left to right, I gradually rotate the blade in such a way that the point of contact (where the bevel and stone touch and material is removed) migrates from the right to the left end of the bevel (Fig 32 left). Then the same thing in reverse and repeat as necessary. If only part of the bevel has to be worked on (cutting edge is skew), then the blade is only rotated in this area. In this way I get a bevel that is geometrically roughly correct but as yet not particularly uniform.

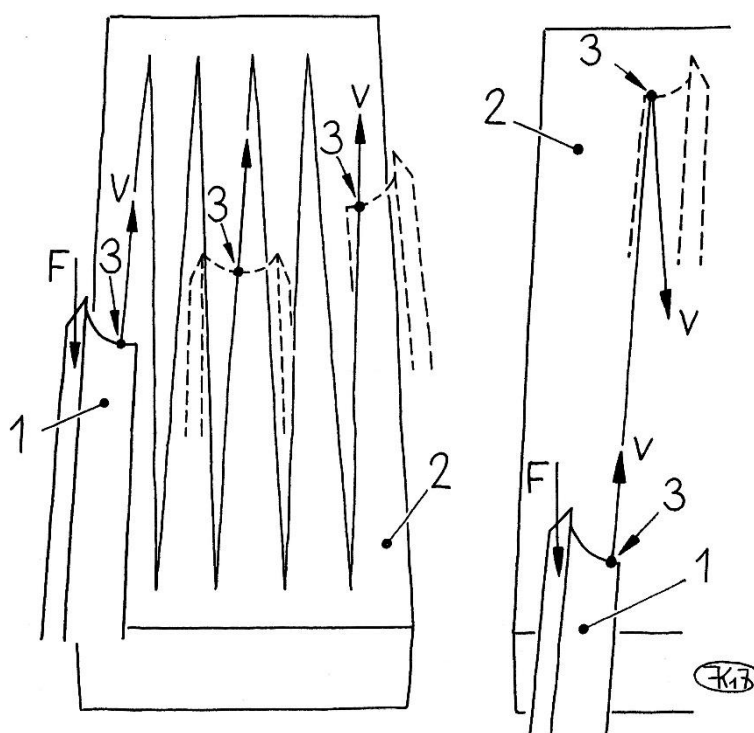


Fig. 32: Grinding the bevel of gouges: forward-back movement and blade rotation

left: preparatory grinding

right: finish grinding, grinding while sharpening

1: gouge with channel, starting position

2: whetstone

3: contact point

F: pressure area (on left edge of blade)

v: forward-back movement

Finishing the bevel or routine sharpening

My method now deviates from the one above. Again, I use a forward-back movement, but during the forward movement I rotate the blade in such a way that point of contact migrates along the whole bevel and during the back movement I rotate the blade back to its starting position (**Fig. 32 right**). In this way I end up with a uniform bevel where all that is lacking is the microbevel.

For a really handsome ground bevel you can try holding the blade not as shown in **Fig. 32** but at an angle of 30 to 45° to the grinding movement, similar to the chisel blade in **Fig. 12**. It works for me.

It is also possible to grind the bevel with a left-right movement, but the removal rate is quite low, so this method is time-consuming.

²⁸ One stroke = forward and back

Producing the microbevel

The microbevel is produced with a left-right movement as for a flat chisel blade (see **Fig. 20**), but with an additional rotational or rocking movement. When moving to the right, the point of contact is transferred from the right to the left corner of the bevel (similar to **Fig. 32** right), and the rotation is reversed when moving back to the left.

Bevel/microbevel on curved or elbowed gouges

Curved and elbowed blades cannot be aligned to the stone using the usual gauges. For my two curved gouges I made special gauges with which I am able to align the blades reliably and reproducibly in two angular positions, one for grinding the bevel, and one for producing the microbevel. It is best to map out the geometry of such a gauge by using a large-scale drawing²⁹ (as shown in **Fig. 33**).

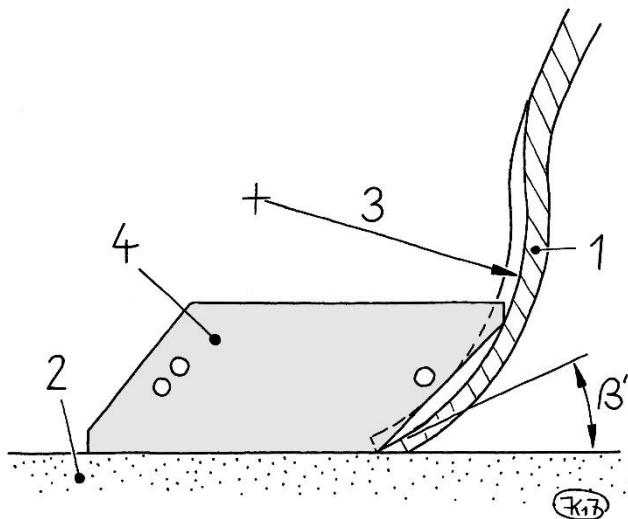


Fig. 33: Angle gauge for a curved gouge blade

- 1: gouge, curved (cross section, hatched area)
- 2: whetstone
- 3: elbow radius
- 4: gauge (photo: **Fig. 42** above right)
- β' : wedge angle, ground

The two sides of this gauge give me the angles required when either grinding the bevel or honing the microbevel.

Both my **cranked gouges** are relatively thick and I align them by feel when the bevel comes into contact with the stone. I find that I am very reluctant to sharpen these tools, which is why I avoid using them whenever I can.

4.1.3 Working on the inside of gouges when sharpening

Gouges with the bevel outside always slide on the bevel when cutting. Unlike ordinary chisels (see **Fig. 1** for comparison) they are never guided by the opposite face, be it cylindrical or toroidal. That is why applying a back bevel or something similar is permitted.

Slip stones

It is quite easy to fashion your own slip stones for working on the inside of gouges. You can use bench stones that have become very thin over time or that had cracked because they were dropped. You can also cut strips off these stones with an angle grinder. Round the long edges to a cylindrical profile, with a radius that is a little bit smaller than the internal radius of the blade that you want to sharpen.



Fig. 34: Stones for working on the inside of gouges

The roughly cylinder-shaped stone edge is first rounded on a coarse diamond plate (that has become blunt and is of no use for anything else) and wet abrasive paper. Use a dressing plate to touch up the stone so that it keeps its cylindrical shape and does not develop a waist.

The stone on the right was once a grooved honing stone, then one day it dropped onto the floor....

²⁹ The elbow radius of the blade can be determined by cutting a round piece of cardboard to a shape that fits snugly against the radius of the blade.

Grinding and honing the inside of straight gouges

I grind straight gouges to a cylindrical shape, without a back bevel. At the beginning this involves a bit more effort (because the inside has to be ground out to a decent quality), but it results in an extremely good cutting edge that is easily resharpened.

Preparing the inside of straight gouges with a whetstone

This is necessary on all blades, even new ones that tend to show a distinctly sloping cylindrical surface at the cutting edge, and on old blades anyway.

I lay the blade on my grinding base and grind the inside lengthways by moving the cylindrical rounded edge of a suitable slip stone forward-back. At the same time, I roll the gouge blade from side to side on its cylindrical outside to ensure that the stone makes contact with the whole inside of the gouge. The radius of the stone will gradually take on the shape of the blade. I dress the cylindrical surface of the stone regularly with a rocking movement on the clinker for the stone to stay straight (and the inside of the blade to end up as a **straight** cylinder).

Honing the inside of straight gouges (during routine sharpening)

is exactly analogous to grinding, but with a finer stone.

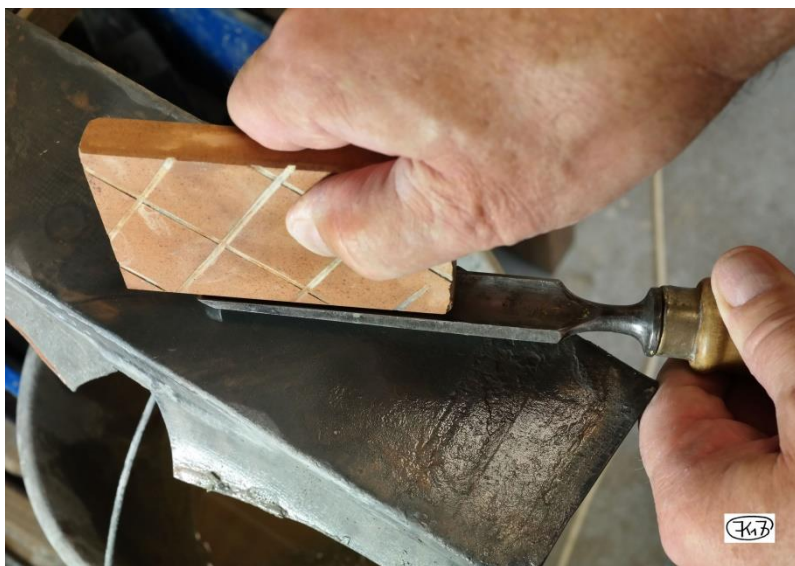


Fig. 35: Honing the inside of a straight gouge

The blade rests on the platform of the sharpening centre, where normally the stones lie. The slip stone is moved forward-back (and pressed down at the same time) while the blade is slowly rotated to and fro with the left hand.

The inside of a gouge is ground in precisely the same way as when it was prepared, but using a coarser stone.

If you feel this is too much effort, you can simply add a minimal back bevel to the inside of a straight gouge, as you would do for curved gouges.

Honing the inside of curved/elbowed gouges

This is not especially difficult if all you want to do is to remove the burr that resulted from producing a microbevel. It is a matter of taste whether or not you call it a back bevel. Whatever you call it, there will be nothing wrong with the quality of the cutting edge achieved this way.



Fig. 36: Deburring the inside of curved gouge

here: freehand, but you can also rest the blade (or the stone) on a support or clamp it, eg, in a vice.

The rounded edge of the stone is rotated in the hollow inside of the blade and held in such a way that it touches the cutting edge at a minimal angle to the ground inside (as if a back bevel was being produced). In fact, all you really need to do is to remove the burr.

4.2 Preparing (and adjusting) the chipbreaker for plane blades

Most bevel down bench planes have a chipbreaker on their blades. When planing against the grain its function is to prevent or suppress the lifting of wood fibres and any resultant tear-out by squashing the chip to some extent³⁰. In order for this to work the chipbreaker must have the right shape and be positioned very close to the cutting edge.

Functional form of a chipbreaker and how it is produced

There are many variants and there is no consensus about the best configuration. But one thing is clear: along its front edge the chipbreaker must sit flush on the blade and not leave even the slightest gap for a chip to find its way through!

My bevel down bench planes are old Stanley models. Their chipbreakers have the profile shown in **Fig. 37** above: they are relatively thin, curved and slightly elastic at the front. On old tools, the front edge, critical for the squashing function, is often badly worn or lacks a defined geometric shape. On such chipbreakers I grind the curved front bright and smooth and then add a small bright “chipbreaker” bevel at the front edge, at an angle of about 60° to the back of the blade (all freehand on a whetstone and honing stone). Prepared this way, the chipbreakers work well.

For really seamless contact between the chipbreaker and the blade’s flat back, the front edge must be straight and have a slight relief angle to ensure that only this edge presses down onto the back. I therefore grind the front edge of the chipbreaker at a flat relief angle from below. The stone used for this task is the whetstone I also use for sharpening.

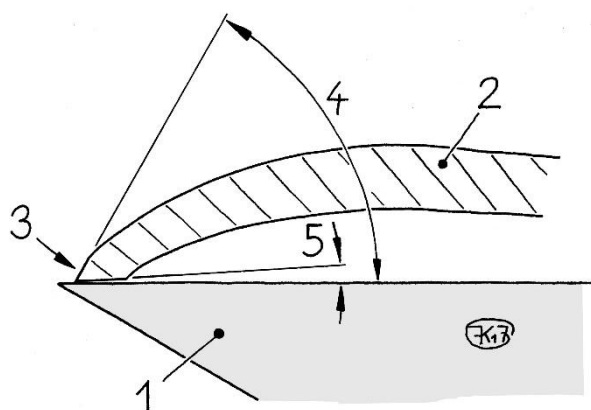


Fig. 37: Chipbreaker: profile and grinding the relief angle

above: profile of a Stanley chipbreaker on the back of the blade

- 1: plane blade (**cutting wedge**)
- 2: chipbreaker
- 3: bevel at the front edge of the chipbreaker
- 4: chipbreaker bevel angle (approx. 60°)
- 5: relief angle (a few degrees)

Microbevel, back bevel not shown!

below: grinding the relief angle at the front edge of the chipbreaker

Place the whetstone on a smooth, hard, flat surface (here a granite tile). Insert a screw into the hole of the chipbreaker. The head of the screw will slide on the flat surface. Use the nuts to adjust the length of the screw so that the chipbreaker slopes down slightly from the whetstone (for the relief grinding). Grinding takes place along the side of the whetstone.



- For the chipbreaker to have any effect on thin shavings it must be positioned a short distance behind the cutting edge of the blade. The smaller this distance, the better the chance of preventing tear-outs. Without exception, the blades of my bench planes have a cambered cutting edge and therefore also a curved back bevel. I position the chipbreakers on the back so that they are as close as possible to this back bevel.

³⁰ An alternative hypothesis asserts that the chipbreaker is not meant to squash the chip, but only to suppress any oscillations of the blade. In fact, the chipbreakers of some manufacturers have an angle at the front edge as acute as the plane blade itself. I'm not convinced. Is doing away with a chipbreaker bevel by any chance meant to promote the sale of frogs with an increased bedding angle?

The distance to the cutting edge is then about 0.5 mm, possibly a little less. This suffices completely as far as my expectations for no tear-out with these planes are concerned. Normally I don't change either the position of the chipbreaker or the mouth width on my Stanley's. I value them just as they are, ergonomically outstanding, relatively fluently operating planes for rough and ready jobs.

For very thin shavings and for higher expectations regarding tear-out I prefer my bevel up bench planes, smoother and jointer. These planes with their large cutting angle and tightly adjusted mouth (adjustable with just one easy action) are superbly suited for zero tear-out planing even of tricky wood. And you don't have to fiddle with adjusting a chipbreaker, because there isn't one.

If you want to optimize the tear-out properties of bevel down planes, you have to take the trouble to adjust the mouth tightly and above all move the chipbreaker to within a few tenths of a millimetre from the cutting edge³¹. But that leaves no room for the curved 5° back bevel I prefer. You can do without it or use the ruler trick (**Chap. 3.2**, Step 4) – the resultant back bevel (if you even want to call it that) is so shallow that thanks to the relief bevel at its front edge the chipbreaker still forms a seamless joint along the contact line.

4.3 Sharpening the blade of a scrub plane

The blades of scrub planes have a distinctly curved cutting edge. This requires the bevel to be ground curved. The blade of my roughing plane has a microbevel and a back bevel, admittedly a bit of an overkill, but both are easy and quick to achieve.

Grinding the bevel and producing a microbevel can be achieved in the same way as for a gouge (see **Chap. 4.1**). The flat back is ground flat and a back bevel is added as for a plane with a slightly curved cutting edge (**Chap. 3.3**). No problems there.

4.4 Sharpening the cutter of a router plane

Because of their angled shape the cutters of router planes³² are rather awkward to sharpen, but now and then it's also their turn. Router planes have bevel up cutters.

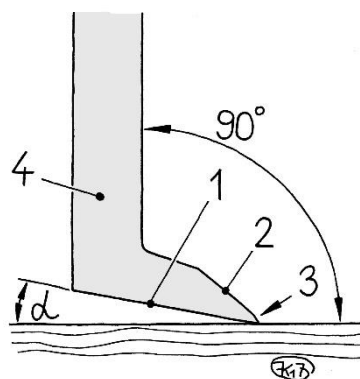


Fig. 38: Cutter for a router plane

left: blade

1: clearance face

2: ground bevel

3: microbevel

4: shank

α : clearance angle

right: sharpening, here grinding the bevel

The geometry of a router plane cutter can be varied within wide limits without having to fear the consequences. The reference for the angles is the imagined wood surface (to which the shank of the cutter is at right angles). The cutter must always have a small clearance angle, the ground bevel should have an angle of about 45°, but all this is not really critical, the main thing is that the cutter is sharp.

When grinding, I guide the cutter once I feel that the bevel is making full contact with the stone (see **Fig. 38**).

For producing the microbevel I again place the cutter on the honing stone, then raise the cutter from this position by a few degrees and get going.

The back is honed across its whole surface, the cutter finds its own position on the stone, as is the case with chisel blades (it is just a bit wobbly because of the small area, but that's all).

³¹ ...and both are reset just as quickly for different shaving thicknesses...

³² These are not really true planes, they lack the functionally important feature of a mouth.

5 Sharpening equipment and accessories

5.1 My sharpening centre

As a hand tool user, you will vastly improve your working conditions if you can make space for a sharpening centre in the vicinity of your workplace. This sharpening centre should cover all your sharpening needs and you need to be able to access it **without first moving or rearranging anything**.



Fig. 39: Sharpening centre

In my workshop my sharpening centre stands right next to the sink. It is a small table with a 750 x 450 mm worktop. It is heavy and stable and easily dismantled for on-site assignments.

One of the basic design ideas was to reduce contamination in the workshop by collecting and trapping as much water and slurry as possible. That is why the stone does not lie on the table but on a platform that projects from the table. Under this platform the table legs are at an angle to keep the table rock-steady.

The platform is 900 mm from the floor, 70 mm wide and 270 mm long. A sturdy plastic sheet is glued to the top.

Fig. 40: Sharpening centre, ready to go



This sheet has tails from which water and slurry drip into a bucket suspended below³³. A flat stop is screwed to the back of the platform; at the front a moveable, stainless steel clip can fix different length whetstones. Between them they stop the stone from sliding around. When grinding the bevel of a router plane cutter the shank of the cutter hangs over the side of the stone (see **Fig. 38**).

³³ The slurry that ends up in the bucket underneath the platform and in the blue water container can set quite firm and also form hard crusts. It is best not to pour it down the drain!

The blue plastic box is filled with water in which I rinse stones and blades. Coarser grains quickly sink to the bottom so that the water is also always suitable for honing stones. At the bottom of the box is a U-shaped metal strip: this is for stones that take longer to soak up water and stops them lying in the slurry. To keep the stones wet there is a squirting bottle with water and some dish-washing detergent from the kitchen.

Stones in frequent use are stored in a rack, a wooden frame with angled aluminium supports arranged so that the water does not run down but drips onto the stone below. The finest stones are at the top, the coarse roughing stone is at the bottom, so that coarser grains do not drop onto the finer stones.

In front on the right on a rubber mat (rectangular floor mat) rests a clinker for flattening whetstones and honing stones (see **Chap. 6**). The clinker for dressing the roughing stones is on the lower shelf of the sharpening centre along with the third clinker.

Kitchen paper³⁴ is ideal for drying the blades after sharpening, which is why there is a holder for a paper roll (cut down the middle with a knife) under the worktop on the right.

The wooden gripper block on the right side of the station is used to grip scrapers for burnishing burrs.

5.2 Water stones

Water stones are probably the most frequently used sharpening tools employed by woodworkers. I do all my sharpening with water stones, using only artificial (industrially manufactured) varieties. The following notes therefore deal only with these. Other tools for sharpening by hand, for instance, natural stones or diamond-coated plates, are discussed in **Chap. 8.5**.

5.2.1 General notes on water stones

Water is a must!

Water is essential to flush away grit and grindings from a bench stone. If you're using a water stone it should really be so wet that some water shows on the horizontal working surface. Porous stones are thoroughly soaked in water (until no more bubbles appear) prior to use. In the case of stones impermeable to water, it is enough to immerse them in water or hold them under a tap before using them. It is usually necessary to add more water during grinding, hence the squirting bottle.

Mechanics of a whetstone, hard and soft stones, grit grades

The grinding action of a whetstone is based on the fact that it consists of hard, abrasive grit that is bonded together (in natural stones this could be with a clay mineral, in artificial ones a ceramic structure, a synthetic resin or similar). The grit of artificial stones consists mostly of **corundum** (Al_2O_3) or **silicon carbide** (SiC). The sharp edges of the grit at the surface act like small steel tool edges in that they remove tiny chips from the metal surface. The cutting forces on dulled grit increase (as happens on any other cutting edge), until this grit breaks free from the bond to expose new, sharper grit. This keeps a whetstone sharp when in use – in contrast to sand paper that becomes increasingly dull through use until it finally turns into waste. This also explains why a whetstone will wear down during use and increasingly diverge from its starting geometry (for a bench stone this is a perfectly flat surface).

A **soft stone** has a soft bond (rather than soft grit!) which results in the rapid exposure of new sharp grit, which makes it highly suitable for working even on hard materials. The downside is that it will also wear more rapidly. This means it must be dressed more frequently, ie, restored to its original shape.

A **hard stone** (with a firmer bond) retains its flatness longer. The grit will break away only when it has become very dull or when very high pressure³⁵ is applied during grinding³⁶.

Coarse stones (with coarse grit) achieve a higher removal rate (= volume removed per time) than finer stones, but the ground surface is relatively rough. Whether a stone is classified as coarse or fine depends on the size of the grit. In specifying a stone, it is not the grit size (eg, in microns = thousandths of a millimetre) that is specified, but rather the **grit grade**. This is the fineness (mesh per inch) of a sieve through which the grit can just pass. The finer the grit the finer the mesh, and therefore the larger the grit grade.

³⁴ Toilet paper is less suitable, because it is intended to disintegrate when wet.

³⁵ Pressure equals force/area. The required force therefore depends on the size of the area worked on.

³⁶ Stones can be too hard; the bond is so strong that self-sharpening fails (dull grit does not break free). Such stones are useless.

In Europe, grit grades are standardized by FEPA (Federation of European Producers of Abrasives) and when listed are prefixed by an F, eg, F800.

A similar standardization exists in Japan. The code number for grit grade according to the Japanese standard (JIS) is prefixed by a J, so that the grit grade is given as, eg, **J1000**.

Note: for the same grit size, the grit grade specification according to FEPA and to JIS will differ – sometimes very widely! For more details see Chap. 8.13.

Grinding or polishing

A **ground** surface shows typical score marks oriented in the grinding direction, corresponding in fineness to the grit grade of the stone. However long you grind, the grinding pattern won't change, because new abrasive grit (of the same size) will keep coming to the surface of the stone. A metal surface that has been worked on with a very fine whetstone may at first sight appear bright and "polished", but if you check with a magnifying glass you will see a grinding pattern, albeit a very fine one. Grinding always removes material.

A **polished** surface by contrast will appear totally free of score marks, even under a magnifying glass. The polishing procedure removes hardly any material, and plastic deformation also plays a role when smoothing. The extremely fine polishing agents are used mostly as suspensions or pastes, often on soft bases (for instance, the leather straps used for razor blades). You can also get polishing grain that combines a usable removal rate with good polishing ability; its coarser abrasive grains are not homogeneous crystals, but sintered together from much finer primary crystals. The coarse grains disintegrate under mechanical stress, after which the released primary crystals take over the polishing work. This behaviour – material removal followed by polishing – is also exhibited by honing stones (see **Chap. 5.2.2: Polishing honing stones**).

Some further points

I've stopped storing stones in water. Some do not take at all kindly to water, they swell up and the surface becomes soft. And then again there is always a slippery layer on the stones and on the walls of the water container; sometimes there is an unpleasant smell that is caused by decay. It's better to store them dry.

The first thing to do with new stones is to dress them properly – not only to make them perfectly flat, but also to remove any "skin", often found on artificial stones, that would hamper grinding.

5.2.2 Bench stones for sharpening chisel and plane blades

None of the stones should be too small – 60 to 70 mm wide and 200 mm long is a good size.

The whetstone (or: sharpening stone)

This is the stone for what I call grinding in this instruction. It is coarse enough to remove the required amount of steel in a short time during routine sharpening, but fine enough so that the resultant surface can be smoothed without problems with a fine honing stone³⁷. The stone will usually have a grit grade between J700 and J1200.

The roughing stone

This is no more than a coarser whetstone (grit grade in the range of J100 to J300) with a correspondingly higher removal rate. Use it, for instance, to change a stone's geometry, to get rid of greater signs of damage or to flatten a very irregular back. This stone will leave a relatively rough surface not conducive to flattening with a fine honing stone. It is best practice to follow rough-grinding with a whetstone before turning to the honing stone.

The honing stone

This is the crucial sharpening tool. It alone creates the cutting edge and as such determines the quality that can be achieved! A honing stone for sharpening joinery tools should have these attributes:

- It should be able to produce a very fine surface finish which appears largely free of score marks when viewed without magnifying aids.
- It should also be dimensionally stable and provide a sufficient removal rate for the job, because only then can it quickly remove the roughness left by the whetstone and give the wedge a defined geometry.³⁸

³⁷ In any case, this is how I do it (whetstone immediately followed by a single final honing stone). It works very well, because my tools have a microbevel and back bevel. There are people who sharpen with three or even more stones (with increasingly fine grit grades). Much too complicated for me.

³⁸ That is why, for instance, a leather strap with polishing paste cannot completely replace a honing.

Honing stones usually have grit grades between J4000 and J10000. My honing stones are 8000 grit. Extremely fine stones with grit grades beyond 10000 have a negligibly small removal rate. These are not suited for my sharpening regime (with just one honing stone following the whetstone), but only for adding a final fine polish to a finished surface.

Polishing honing stones³⁹ are, in fact, capable of producing a polished surface. Their removal rate is nonetheless good enough for them to be used directly after the whetstone session. My explanation: these stones use an abrasive grit that disintegrates during the honing process to a much smaller grit size (see also “Grinding and polishing” in **Chap. 5.2.1**). This polishing grit is not flushed away, but – and this is the crux – makes its way into the stone’s working surface. At least this is what I assume. What is clear, however, is that the light-coloured stone becomes discoloured, ie, the used areas become darker. It forms a permanent, smooth surface layer that is clearly much finer than the specified grit grade. An area honed with the 8000 grit Naniwa is in fact polished and will also appear free of scratches under a magnifying glass. This is quite different from what other stones with a grit grade of J8000 would leave behind⁴⁰. The removal rate in “polishing mode” is negligibly small. Before the stone is used again it must be reconditioned (see **Chap. 5.2.3**).

Honing stones with grooves are especially good for wide surfaces such as blade backs. When honing such surfaces, a relatively solid, pulpy layer of slurry that hinders the process will form on some stones; grooves help to drain this off.



Fig. 41: Grooved honing stone (Cerax 6000)

Here the grooves form a diagonal diamond pattern with about 30 mm spacing, 3 to 4 mm deep. The pattern need not be uniform. My 6000 grit Cerax is grooved on one side only. I use two 8000 grit Naniwa stones: one with grooves, one without.

You can’t buy grooved stones; if you want grooves you must cut them into the stone yourself. I cut the grooves with an angle grinder and a simple flexible disk – grooves cut with a diamond disk are very narrow and clog up quickly.

Some comments on honing stones

- A honing stone should have the right hardness (but what is “right” depends on the user and the sharpening method!). A stone that is too soft will not just wear quickly. It can also lead to problems when producing the microbevel – the blade will dig into the stone if you don’t work with the utmost concentration. Stones that are too hard create other problems: they can appear scratchy and gravelly when honing or lose their grip (sharpness) during honing, because they have become dull. Some hard stones will also leave unsightly scratchy surfaces.
- Some Japanese honing stones are supplied together with a nagura stone which produces a slurry on the stone that is supposed to result in a milder, finer honing experience. I have tried this, but I decided it was not for me.
- Honing stones should have a light colour, eg, uniformly yellow or white. This helps, for instance, in assessing the state of the stone (uniformly dressed or not) or seeing the trace on the stone left by the blade.
- Combination stones (one side for grinding, the other for honing) are popular starter stones because they cost somewhat less. Nonetheless, I use and recommend single-purpose stones. Only a single-purpose honing stone can be grooved on one side (see above). And single stones, once they have become thin, can be glued⁴¹ to a tile cut precisely to shape and then used to the bitter end – well worth it, considering the cost of a quality stone.

³⁹ I use “stones” in the plural here, because I assume that there are several stones of this kind that I just haven’t encountered up to now. I know of just two polishing honing stones: the 8000 and 10000 grit sharpening stones, both from Naniwa.

⁴⁰ I’m aware of the on-going discussion as to whether a polished cutting edge is really superior to a precision-ground edge, but this is not for me to decide.

⁴¹ With an epoxy resin adhesive as used in model making; a tile adhesive should also work.

5.2.3 My water stones (in spring 2020)

With no guarantee and no claim to completeness!

It is difficult to get to grips with the huge variety of water stones on offer and it is practically impossible to test a wider range of stones because of the high cost involved. Over the years, I have however tried out a large number of stones and I list below the stones that I'm currently using in my workshop – **without in any way implying that these are the best around**. I use the same stones for all my woodworking tools, regardless of the steel that the blades are made of, and for knives (including rustproof ones), scissors and similar implements.

Stones for routine sharpening:

I get by with just two stones: a 1000 grit whetstone and an 8000 grit honing stone. The whetstone is always the same one, whereas I treat myself to the luxury of a choice of two honing stones:

The whetstone: Shapton Professional Series 1000 (yellow, designation also: Ha-no-kuromaku). I've used this stone for ages. An outstanding stone, very hard with good form retention, yet a decent removal rate. Because of the small amount of slurry produced, the ground surfaces are clearly defined – even small changes in direction from freehand grinding of bevels are very easy to spot. This helps and trains you at the same time. If carefully dressed, this stone has an enormous service life. Non-porous. Doesn't take to being stored in water, where it forms a soft surface layer.

The honing stones:

Cerax 8000 (white). For some time now my go-to honing stone. It is decidedly harder than the 8000 grit Naniwa that I had used exclusively for many years. With this stone I have no problems cutting into the stone when producing the microbevel. The 8000 grit Cerax doesn't polish but produces a very fine and uniform grinding pattern, without any coarser scratches. It achieves a very good level of sharpness. The stone imparts an extremely agreeable, silky-soft feeling when honing. But it is extraordinarily porous and needs a lot of water, must be soaked even before use for several minutes!

Naniwa 8000 sharpening stone (yellow). A honing stone that actually polishes! For years I used virtually no other stone, today I use this stone when I'm looking for a truly perfect cutting edge. It is relatively soft, and I had recurring problems with digging into the stone when I was honing the microbevel of narrow blades with my mind not fully on the job. Its great strength is that it polishes fantastically well – this is the stone for producing ultimate microbevels, back bevels and blade backs. (For an example see **Fig. 7**). Because it polishes it must be frequently (if briefly) dressed. Its operating cycle then starts anew: first decent material removal, then progressively less removal, with the stone appearing increasingly finer. It's a good idea to groove one side of a Naniwa (or the side of a second stone) if it is used for honing wide backs.

Other stones that I own and use as required

Roughing stone: Sun Tiger 240 (turquoise): a good, sharp-textured stone with a nice grinding action, with a very good grip also on large surfaces (backs). A big disadvantage is that it wears quickly, produces lots of slurry and must be reconditioned frequently – nonetheless it is fairly long-lived because when new it is very thick. It must be thoroughly soaked prior to use. This is the roughing stone that I turn to most often. My first Sun Tiger has been used up, the second is already quite thin.

Roughing stone: Shapton Professional (Ha-no-kuromaku) **120** (white): an extremely hard roughing stone with good shape retention. You have to press down extremely hard on this stone to produce the necessary pressure for the self-sharpening to take effect. Well suited for working small areas, eg, the bevels of chisel blades, very good also with soft steels, eg, for reworking rustproof knives.

Roughing stone: Shapton Professional (Ha-no-kuromaku) **220** (moss): a roughing stone not quite so good at material removal and not quite as sharp-textured as the Sun Tiger, but with the advantage that it wears much more slowly. Compared to its 120 grit brand colleagues it develops a far better grip on larger areas. A compromise, but a good one.

Nobody needs three different roughing stones, but I have tested these three and they are really quite different, so I pick the one that I think is best for the job. Overall my need for roughing stones has dropped almost to zero, because nowadays I rarely refurbish old tools.

Honing stone: Cerax 6000 (dark yellow⁴²): I use this stone quite frequently, when I want to remove more material than my 8000 grit stones are capable of, eg, for removing scratches from backs (which are then further improved during subsequent routine honing with an 8000 grit stone). It is a hard stone, yet aggressive, and it produces a fabulously uniform grinding pattern. A very good honing stone for somewhat coarser jobs, for instance sharpening the cutting edge of kitchen knives.

⁴² I've used this stone for at least 12 years, new stones with the same designation are beige rather than yellow and unfortunately quite different (softer and less aggressive).

Honing stone: Shapton Professional 8000 (listed as “melon-coloured”, light-grey in my opinion). I’ve used this stone for some time, but never got used to it. I achieve a perfect sharpness, and there is no digging in because it is a very hard stone. It doesn’t polish. It often felt unpleasantly scratchy and gravelly during honing. Any microbevels and back bevels honed with this stone appeared perfectly in order when viewed without the help of a magnifying glass, but the backs of my chisel blades ended up not matt but distinctly scratched, which I didn’t like at all. So this stone has been relegated to a back seat, but it is nonetheless a suitable stone.

Stones on which I have formed an opinion

Whetstone: King 800 (reddish brown): I used this stone for many years, until I came across the 1000 grit Cerax. A good stone, better at removing material than the Cerax, but doesn’t retain its shape as well, more slurry. Inexpensive.

Honing stone: Imanishi Bester 10000 (white, borrowed for testing). Hardness between Cerax 8000 (which is softer) and Shapton 8000 (a harder stone). Fine grinding pattern (finer than either 8000 grit stones), but unfortunately disfigured by many scratches. Slight polishing effect. Tends to be a bit gravelly. No soaking required.

Honing stone: Arkansas translucent (Norton), 3”x 8” in size (again a stone I borrowed). I don’t use oil, so contrary to usual practice I used it with water, which also does the job. Extremely hard, much harder than artificial Japanese stones. No discernible wear and slurry formation. Nonetheless adequate removal when producing microbevels and back bevels. Good-looking, uniform grinding pattern, similar to that attained with the Shapton 8000. Honing backs is difficult with this stone, because you have to apply a lot of pressure and work very slowly, it won’t grip otherwise. Becomes smooth when dressed on the clinker, obviously a bit of a mismatch.

5.3 Angle gauges for dressing prior to freehand grinding/honing

I align the blade with the stone with the help of a small angle gauge; I then try to keep the angle I’ve achieved as constant as possible during freehand grinding or honing.

The angle gauges (for the various angles I need for my blades) are cut from 2 mm thick translucent plastic⁴³. They look a bit like skew parallelograms. Each gauge offers two angles, for instance 25° and 30°, both of which are used for the same blade, viz. for the bevel and microbevel. How to use the gauges see **Chap. 3.1**.

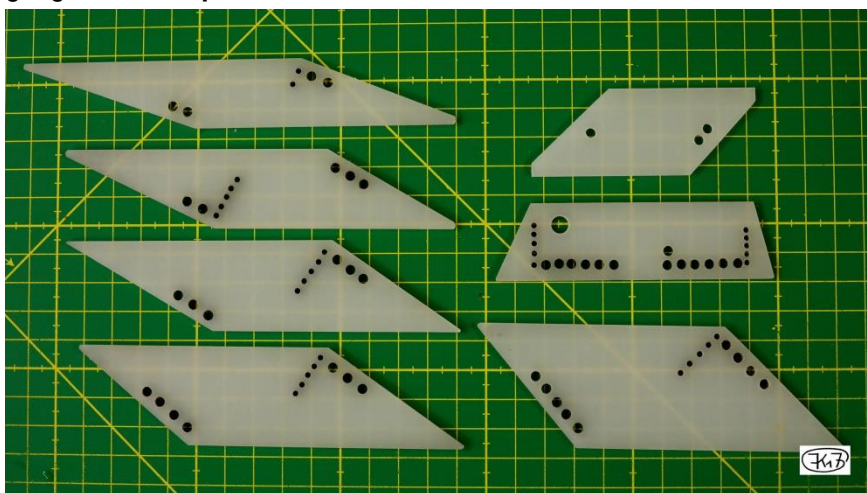


Fig. 42: Angle gauges for dressing prior to freehand grinding/honing

(on 1 cm grid)

The gauges are designated indelibly by drilled holes, eg, bottom left, by 35°/40°

The gauge top right is used for aligning curved gouges (see **Chap. 4.1.3**)

The gauge second from top on the right (65°/75°) is for sharpening scissors.

5.4 Holders for grinding and honing plane blades

Chisels (blade plus handle) are long enough and shaped so that they can be held safely and comfortably for freehand sharpening. Plane blades by contrast are short, often very short, sharp-edged, broad and flat – obviously not meant to be held by hand.

That is why suitable holders are very useful for freehand sharpening of plane blades; there are many blades that I would just not be able to sharpen by hand without a holder. I have made wooden holders (several, because plane blades come in many different shapes) to which I can fasten the blades by means of screws.

Longer holders greatly improve accuracy when grinding, nonetheless I have shortened them somewhat compared to earlier versions.

⁴³ Polycarbonate “Lexan”, soft and tough, much better than splintery Perspex, very easy to saw and to plane to size (yes, to plane!)



Fig. 43: Holders for plane blades
above: 10° holder
below left: 10°, 20° and 30° holders plus two holders for blades without a hole
below right: holder with mounted blade and face spanner

The mounting faces for the blades are inclined at different angles so that holders can always be held at roughly the same angle, regardless of the different bevel/microbevel angles on the plane blade.

Slope of mounting face	For grinding/honing at an angle (to the back)
10°	Approx. 20 to 30°
20°	Approx. 30 to 40°
30°	Approx. 40 to 50°

A relatively large angle between the holder and the stone increases the removal rate considerably (a forward movement presses the blade more forcefully onto the stone). This can be helpful when grinding, but may cause problems when honing (eg, danger of digging in).

An M8 coach bolt is cemented into the 10° holder for screwing down the blade. I use a large rustproof knurled nut with two bore holes for a face spanner⁴⁴. The 20° and 30° holders are for the blades of low-angle planes. These have different and smaller bore holes, which is why here M6 threaded bushes are cemented into the holder and the blades are fastened with a knurled screw with washer.

The grooves at the end of the holder (see **Fig. 43** above) are not meant for all four fingers, but just for my little finger. I hook it into one of the grooves – depending on whether I grip the holder higher up or lower down – to prevent the holder gradually sliding through my hand.

Very small and short blades – for instance, for router or scraper planes – can also be held with small self-grip pliers:



Fig. 44: Scraper plane blade, held by self-grip pliers

⁴⁴ This wrench is slightly offset (see Fig. 43), so that if it slips off, my knuckles can avoid contact with the cutting edge of the blade, a somewhat creepy prospect...

5.5 Further technical aids

5.5.1 Magnifying glasses – and how to use them

Especially in the beginning a magnifying glass is very important. You can use it to detect:

- Why a freshly sharpened blade does not cut as well as expected
- Whether a cutting edge is damaged
- Whether a honed surface is really free of scratches

The magnifying glass you'll need is not your granny's large reading glass, but a small magnifying glass with approximately 10-fold magnification. These are mostly folding magnifiers or watchmaker's loupes that are held close to the eye. Decent models have multiple lenses, "Triplet" is a popular designation. The experienced loupe user optimizes the illumination and avoids reflections by holding the loupe and the object in the best position relative to the light source (a loupe with integrated lighting is not to be recommended!). It's easy to scan into the depth of the object by changing the focal plane. This way there's much more to see than can be shown on photos taken with modest equipment⁴⁵.



Fig. 45: Using a strong folding magnifier for checking the cutting edge

The loupe is held close to the eye and then the object is moved closer.

5.5.2 Permanent magnets

The permanent magnets that I use as sliding blocks (see **Chap. 2.4.4**) are commercial neodymium magnets, nickel-coated and with rounded edges, ideal for this purpose.

Caution! Plane blades of hardened steel become permanently magnetized if exposed to strong magnetic fields (remanence). Abraded particles will stick to the blade, which is annoying, and you will need special and very expensive equipment to demagnetize it.

That is why I don't recommend magnets with too great a field strength. For disk-shaped axially-magnetized permanent magnets field strength increases with the thickness of the disk (you can see this if you compare the specified holding forces of magnets of different thicknesses). The critical parameter is not the surface area of the magnet, but its thickness. I use 2 mm thick neodymium magnets (20 mm diameter), which my experience has shown do not present any problems. If I need a thicker sliding block, I do **not** stack 2 or 3 magnets as purchased on top of each other, but glue a magnet to 1 or 2 demagnetized⁴⁶ magnets using an epoxy resin adhesive.



Fig. 46 Permanent magnets (neodymium)

1, 2, 4 and 6 mm thick. The round disks have a diameter of 20 mm.

4 and 6 mm high sliding blocks consisting of one original magnet bonded to one or two demagnetized magnets..

⁴⁵ I have tried it with a (somewhat superior) USB microscope. The impression you get from these pictures is largely dependent on the lighting conditions, which I cannot reproduce with the means at my disposal; stopping down for a practicable depth of field is not possible ...disappointing.

⁴⁶ How to demagnetize a neodymium magnet? Heat the magnet briefly to 250 °C in your kitchen oven, that will result in the permanent loss of virtually all its magnetism.

6 Keeping whetstones and honing stones true and flat

This is an important topic for anyone who does not use diamond plates or other grinding tools that stay flat, but whetstones that will wear and therefore have to be trued from time to time. All the methods known to me do this by using an exactly true **reference surface** that exhibits whetstone-like properties. The stones are dressed on this reference surface and adopt its flat shape – they are trued.

There are various means of fashioning such a truing tool, eg, sandpaper on a sheet of glass, metal plates with a diamond coating – for more details refer to **Chap. 8.9**. I use a clinker (paving brick) that I lapped flat myself. This is an unusual solution and 17 years ago it was simply a fixation of mine, but it has proven unexpectedly successful and has since been adopted by many other woodworkers. The advantages of a clinker? It costs virtually nothing, and it is very easy on expensive whetstones and honing stones, which it keeps true with minimal removal of material for a long service life. If it loses its flatness, it is quick and easy to recover the correct shape. And a clinker will last for decades.

6.1 Clinkers?

Clinkers are moderately hard-fired solid bricks (without cavities), measuring, eg, 24 x 12 x 5 cm. I simply used the clinkers I had to hand, they worked well and I have never tried others. You can obtain suitable clinkers from a DIY store or builders' merchants. It is best to take an ordinary specimen, not especially hard, not glazed nor one with a nearly glaze-like firing skin. The ones shown in **Fig. 48** will do (they'll have no grooves, of course, and lapping them is also up to you).

Clinkers are well suited, because they are soft enough to be lapped flat with relatively little effort, but hard enough to get to grips with the usual whetstones and honing stones that you want to dress. Moreover, though they are quite fine-grained, they will not rub down to a polished surface.

Above all, the clinkers should be thick (ie, no face bricks or similar!). Thick clinkers are very rigid and significant deformations can be ruled out. Their hefty weight helps when you lap them flat as described below and they stay safely and securely in place while in use.

6.2 A DIY reference surface: lapping the clinkers flat

6.2.1 Lapping basics

Lapping is grinding with loose grit. A small amount of abrasive grit and water is introduced between two surfaces. The surfaces are pressed together and rubbed against each other. The hard, sharp-edged grit rolls between the surfaces and abrades both wherever they are in contact.

If you continue with lapping you will end up with the two surfaces in complete contact. But it is a matter of luck whether the surfaces produced this way are flat. For instance, you may end up with two spheres (one convex, the other concave) or cylinders. Other forms are also possible. So this doesn't work!

To be sure of producing reliably flat surfaces, it is imperative to lap (at least) three faces against each other.

The three faces are lapped against each other in a cyclical (repetitive) pattern; each clinker is lapped with both the other clinkers, and top and bottom clinkers are also swapped. Move the top clinker forwards and backwards on the bottom clinker, making small circular or similar movements (to achieve material removal) and **at the same time rotate the clinker slowly**. As you continue the lapping process all the faces automatically progress towards a faultless plane surface. This method will produce, entirely by hand and virtually out of nowhere, optical flats of the highest order on circular glass blanks. A remarkable phenomenon.

6.2.2 Lapping rectangular clinkers

Lapping movement with or without rotation?

A gradually increasing rotation of the top workpiece around its vertical axis during lapping, as practised when grinding round optical elements, doesn't work in the case of elongated rectangular clinkers. The position where the two faces form a cross is obviously not suitable for lapping a plane surface.

That is why I started lapping my very first dressing clinkers without any rotation, ie, I kept the clinkers parallel to each other. To my surprise I ended up with acceptably flat surfaces on the clinkers – certainly more than sufficient for the job at hand. I saw no reason to change this method which I have since promoted.

Many years later it was pointed out to me that plane lapping without rotation does not somehow generate faces with an increased deviation of flatness (that wouldn't be a problem). Rather one of the components that make up the specific form deviation of the three starting faces is preserved: viz. the

distortion (the twist of the clinker about its longitudinal axis)⁴⁷. The lapped surfaces end up **distorted**, and in fact, all three to the same degree and with the same orientation. Distorted surfaces checked along and across parallel to the edges appear error-free, but when you check the diagonals you find that one diagonal is convex, the other concave. The distortion may be negligibly small (what you then have are decent flat surfaces), or it may be rather large, in which case the surfaces are unusable.

Where is the problem? The size of the final distortion is unknown before you start lapping; it's just a matter of luck. And there is no chance of reducing or eliminating the distortion by simply carrying on with the lapping (without rotation)!

An existing distortion can be eliminated by corrective measures (see **Chap. 6.2.4**). But in my opinion, **it is better to lap in such a way that a form deviation of this kind is reliably avoided** (if all that is needed is prolonged lapping).

I have therefore modified my lapping process: now I rotate the top clinker – but not an arbitrary amount, but only so far as is practicable considering the elongated rectangular form of the clinker. In short: from the central position where both clinkers are aligned in parallel to positions left and right where the top clinker's diagonal is superimposed on the diagonal of the bottom clinker.

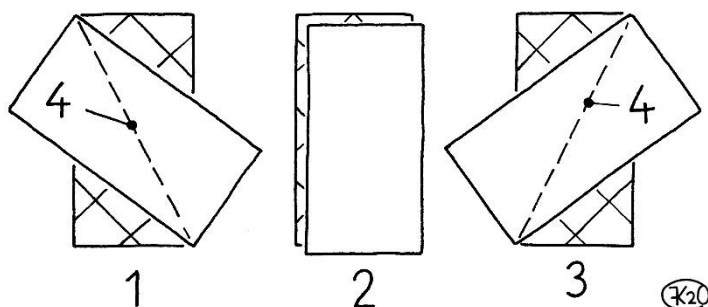


Fig 47: Relative rotation of clinkers during lapping

- 1: Top clinker after maximum rotation to the left
- 2: Central position
- 3: Top clinker after maximum rotation to the right
- 4: Common diagonal in the two extreme positions

Incidentally, you can complete the whole lapping process with the same side of the clinkers (eg, the side with the numbering notches I, II, III) always facing you. Rotating the clinkers by 180° has no effect on distorted faces.

I followed this scheme to plane lap a new set of rather crooked clinkers to perfect flatness (which was to be expected). But another result was far more important: applying this lapping procedure (with rotation) to a previously lapped set of clinkers with distinctly distorted faces resulted in three perfectly plane faces without any distortion. So much was certain: it worked.

The lapping cycle:

The bottom clinker is swapped cyclically:
 1-2-3-1-2-3-1-2- etc.

On this the clinker next in line is lapped, ie:
 On 1 first 2, then 3 On 2 first 3, then 1 On 3 first 1, then 2.

This results in the sequence (shown pictorially):

2	3	3	1	1	2	2	3	3	1	1
1	1	2	2	3	3	1	1	2	2	3

etc.

6.2.3 Lapping virgin clinkers

If possible, you will choose clinkers that already have a relatively flat side⁴⁸ which can easily be lapped flat. Use an angle grinder and a grinding disk to cut grooves: a diamond pattern with approx. 50 mm spacing, about 6 mm deep and wide. The grooves prevent a layer of abrasive grit and slurry collecting between the two faces during lapping, which would hamper the process.

⁴⁷ A rectangular surface is distorted if its opposite edges are both straight but not coplanar. A distorted surface has two opposite corners higher (the diagonal between the corners is concave) and two opposite corners lower (the diagonal between the corners is convex).

⁴⁸ Alternately, they can be roughly prepared beforehand; this can be done quickly and efficiently on a typical concrete slab, more or less new, using corundum and water.

I make them this deep and wide, so that when the clinkers are later used for dressing stones, they do not clog up as fast with hard-setting slurry. The clinkers are also numbered:



Fig. 48: Grooved clinkers with numbering I, II, III

Shown here on completion of lapping, together with the ruler used for checking.

As lapping agent for the initial flattening of the clinkers I use an 80 grit and 150 grit (FEPA) corundum mix and water, together with some detergent. The corundum mix is readily available over the counter and is a cheap, recycled material, used as a blasting abrasive. 1 kg covers the life-long needs of a diligent young tool sharpener. High-quality corundum is naturally just as suitable, as is silicon carbide.

The abrasive material is spread onto the bottom stone, like sprinkling salt onto potatoes, a small amount well distributed. I use a small shampoo bottle with a 3 mm hole in the cap. Onto the top stone I squirt water to which I have added kitchen detergent.



Fig. 49: Lapping the clinkers

The clinker on top is gripped with two hands and moved vigorously while being pressed onto the clinker underneath. Applying more force helps and accelerates the process, there's no point in being squeamish.

Any finer points of lapping techniques can be ignored at this stage. I move the top clinker forwards and backwards, sometimes the top and bottom clinker are parallel, sometimes the top clinker is at an angle to the bottom one (less than shown in Fig. 47), resulting in a lapping movement at the corresponding angle. Sometimes the lapping stroke is shorter, sometimes longer.

Look for irregular movement, but make sure that you work the whole face with roughly uniform intensity.

As soon as the hissing typical of lapping stops I feed fresh abrasive between the stones, and enough water. The detergent foam keeps the abrasive in motion. The abrasive grit that disappeared into the grooves of the bottom clinker reappears and gets back into action as soon as it is on top again. Very uneven clinkers rumble against each other to start with, but that will soon peter out.

It is, however, essential that the cyclical sequence for swapping the clinkers is scrupulously adhered to! And that you always swap the clinkers after roughly the same time. At this initial stage this would be 1 to 2 minutes.

Once all three faces are as good as completely reground (at most small residual spots, scars or pinholes is all that remains of the original surface structure), life gets interesting. **From now on you will be lapping "with rotation"** and you will check from time to time the state of flatness of the faces. And it is time to reduce the force you exert on the clinker; the applied pressure should be generated by the clinker's own weight.

Lapping with rotation:

The actual lapping movement of the top clinker that is responsible for material removal now corresponds to small circles of about 40 to 50 mm in diameter – similar to the disk movement of an orbital sander. At the same time the clinker is slowly rotated alternately left and right.

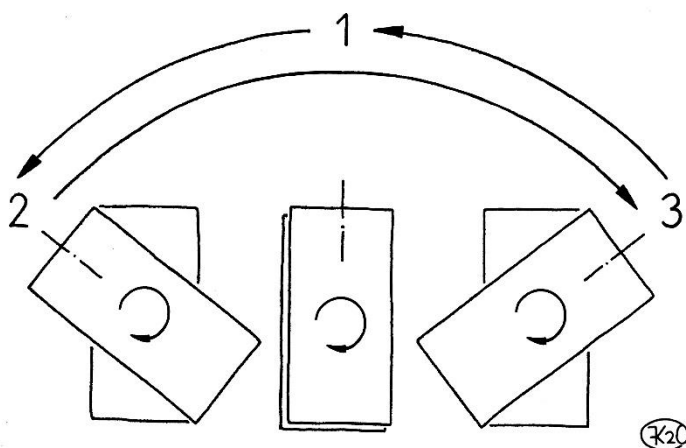


Fig 50: Lapping rectangular clinkers with rotation

- 1: Central position. Lapping starts, while tracing small circles the clinker is rotated left.
- 2: End position after left rotation (diagonals of clinkers are superimposed). From this position the clinker is rotated right.
- 3: End position after right rotation (diagonals of clinkers are superimposed). From this position the clinker is rotated left, back to the central position.

The sequence of rotations (1 to 3) should be completed before changing to the next clinker pairing. I generally start with about 40 to 50 small circles, and reduce this number to about 20 as I approach the end of lapping (ie, the frequency of change increases).

It is obviously not vital to follow this procedure to the letter. But a planned, standardised approach (as described or a variation thereof) has undeniable benefits; a haphazard approach cannot be recommended. I make it a practice to follow the steps described here, with good results.

Testing the surfaces:

I test with a quality rustproof ruler, 300 mm long, 1 mm thick, with ground edges (see Fig. 48).

Previously I used the light gap method for testing, but there is a more convenient and better method. I place the edge of the ruler on the clinker, and holding the ruler in the middle, I slide it across the face of the clinker at right angles to its length. You will notice immediately whether the face under the ruler is concave (the ruler rubs at the ends and can be pressed down slightly in the middle) or convex (the ruler rubs mostly in the middle and the ends are not in firm contact with the surface). By contrast, if the surface is perfectly flat, you will be able to slide the ruler without hindrance, feeling the even contact between ruler and clinker.

The clinker is tested along its length and diagonals, by all means also across its width, not that this is of much use.

In this way clinkers can also be tested when wet; the light gap method only works with dry clinkers.

On the last lap:

Continue lapping and checking until you find that the form deviations are now distinctly smaller and you sense hardly any difference between any of the clinker pairings. At this point you could change to a finer grit (150)⁴⁹. But this is not a must.

Continue lapping until you fail to detect obvious form deviations on any of the three faces. The clinkers are finished if you used a finer grit during the last stage. If you lapped with an 80 grit at the end, it is a good idea to finish with one or two lapping cycles without the addition of abrasives to get rid of any roughness on the clinker surface⁵⁰.

Before using them for dressing whetstones and honing stones, I clean the clinkers carefully, using a brush under running water to remove any coarse grains from the surface and from the grooves.

The time required for lapping flat a set of three clinkers depends largely on their original condition. Plan for a session lasting about three hours. If you are lucky it will go faster, but it may also take longer.

Clinkers flattened and checked in this way are sufficiently flat to serve as reference surfaces. If you dress your stones (frequently!) on these clinkers, you will not experience any problems when honing wide backs, let alone when grinding or honing bevels, microbevels and back bevels. If you check the clinkers regularly during use with a ruler, you will spot and be able to correct incipient deviations from flatness, before they create any kind of problem during sharpening.

⁴⁹ In my opinion the finer grit results in a more uniform removal of material.

⁵⁰ If you omit this step the clinker's rather rough finish will abrade fine (softer) honing stones scheduled for dressing. It is always better to use a freshly lapped clinker first on a whetstone.

6.2.4 Reconditioning clinkers that are distorted or have lost their flatness

Clinkers diagnosed as distinctly distorted:

I now tested clinkers that I had previously always lapped without rotation and found that they were definitely distorted. And I was able to confirm that clinkers superimposed along their diagonals exhibited a distinct wobble in one of the two diagonal positions (see **Fig. 47**), the reason being that contact between the faces was concentrated at the opposite high corners of the clinkers. I removed this specific distortion by lapping in just this position (cyclically, with a 150 grit) after which I finished lapping the clinkers, now with rotation.

Clinkers that have lost their flatness through use:

This will happen now and then, but all it means is that the clinkers have to be lapped again. This is very easy and takes no time at all. For this job I use a finer grit (150) and I lap sticking to the normal cycle and lapping movement (with rotation) as depicted in **Fig. 50**. It is a matter of minutes before faultless flatness is restored to all three clinkers.

6.3 Dressing whetstones, honing stones and roughing stones on clinkers

You dress stones by pushing them to and fro on the clinker while applying light pressure – wet, without any addition of abrasives⁵¹. Remove only enough material from a whetstone or honing stone to prevent incipient dishing. Before I use any stone, I dress it briefly on the clinker. It is always to hand (see **Fig. 40**); this helps, of course!

When being dressed, the stone assumes the form of the clinker surface – if it is flat, then the stone will become flat as well. In the beginning, I frequently tested my stones for flatness and always found that I could rely on them being flat after dressing. Nowadays it's the clinkers that I check carefully for flatness; I tend to ignore the stones.

On principle I dress whetstones and honing stones on the same clinker. To largely avoid the cross contamination of coarser grains from the whetstone to the honing stone, I take care to rinse the honing stone thoroughly after dressing.

For dressing the roughing stone, I always use one of the other clinkers. This eliminates any risk of contaminating the honing stone with the coarse grit of the roughing stone.



Fig. 51: Dressing a whetstone on the clinker

Move the whetstone you want to dress across the clinker in such a way that it sweeps over the entire surface. A very deformed stone will catch on the clinker's grooves. That will change quickly, you'll notice how your whetstone begins to match the shape of clinker's surface. Dressing is complete once the stone moves evenly and smoothly on the clinker and the uniform surface finish shows no signs.

How to keep a clinker flat

Dressing whetstones always takes its toll on clinkers (much less obviously in the case of honing stones). The fact that the clinker gets thinner is irrelevant, it won't lose more than 2 mm per year – that's nothing to worry about at my age. What you do have to watch out for, however, is that the clinker stays flat despite the wear.

When you are flat lapping the clinker (**Chap. 6.2**), the process makes sure that the flatness deviation always decreases as you continue. The situation is quite different when you are dressing a whetstone or honing stone on the clinker. There is no cyclical swapping, the stone is always on top and, what's more, it is quite a bit smaller than the clinker. What chance has the clinker of staying flat?

It is clear that the stone must be moved in such a way that it sweeps over the whole area of the clinker. This means that it will overshoot a bit at the front and back of the clinker as well as the sides. This "bit" is the overhang. The amount of overhang matters. If the overhang is too small, the clinker will wear more in the middle than along the edges; it will become hollow (concave). If the overhang is too large, the clinker will wear more along the edge, it will become convex.

⁵¹ In the case of extremely hard honing stones the residual grindings of a previously dressed whetstone on the clinker can help. But this is really a special case.

My whetstones and honing stones all measure about 200 x 70 mm (l x w), the clinker 240 x 120 mm. When dressing a stone I guide it in long, narrow, ellipses over the clinker, shifting sideways by roughly uniform amounts from stroke to stroke.

I look for an overhang (of the stone beyond the edges of the clinkers) of two to three finger widths at the front and back, and about one finger width⁵² on the right and left.

Fig. 50 shows what is meant. Using two hands (see **Fig. 51**) makes it easy to guide the stone safely and accurately enough while applying the necessary pressure.

You thus traverse the clinker from left to right, then back and repeat the whole process, if necessary. From time to time (for instance, before my first sharpening job on a given workshop day) I rotate the clinker around its vertical axis. ie. the front and back reverse positions.

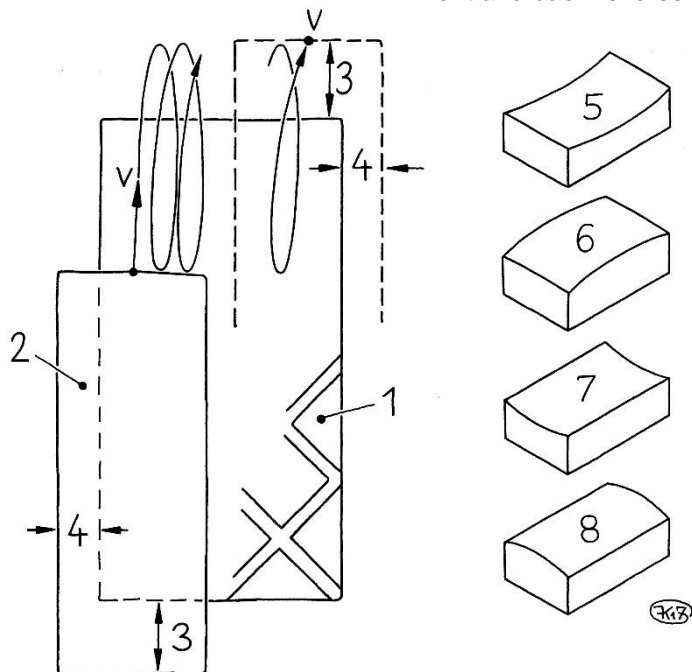


Fig. 52: Path of the stone as it is dressed on the clinker

- left:** movement of the stone being dressed with overhang
- 1: clinker
 - 2: stone being dressed, starting position (end position: above right, hatched)
 - 3: overhang front/back
 - 4: overhang left/right
 - v: dressing movement
- right:** deviation from flatness of the clinker
- 5: lengthwise concave
 - 6: lengthwise convex
 - 7: crosswise concave
 - 8: crosswise convex

These “procedural rules” may sound complicated, but they actually aren’t – eventually they should just become a habit. And experience has shown that the clinker will then stay flat over long periods of time!

But when a check with the ruler plainly shows that the clinker is threatening to lose its flatness, then you can take specific countermeasures by altering the overhangs while dressing.

Clinker is concave lengthwise: → sharply increase the overhang front/back

Clinker is convex lengthwise: → sharply decrease the overhang front/back

Clinker is concave crosswise: → sharply increase the overhang left/right

Clinker is convex crosswise: → sharply decrease the overhang left/right

(and combinations of these, eg, bulging in the middle = lengthwise and crosswise convex → decrease overhang front/back and left/right)

This is an easy method for getting rid of small deviations **before they actually turn into a real nuisance.**

Should a clinker ever become noticeably deformed⁵³ – this happens to me very rarely – I swap it against a previously unused one. If all three are deformed, I again lap them against each other, a job that takes about a quarter of an hour.

This process only works, however, provided the deviations from flatness that have to be removed from the stone during dressing are really small. A visibly crooked stone, which you want to dress for the very first time on the clinker, should be roughly preflattened on wet sandpaper with corundum on a (more or less new) concrete slab or similar, out of consideration for the clinker.

⁵² A finger width here is simply judged by eye. There’s no need to measure the width of your finger!

⁵³ “noticeably” means that the light gap when checked is clearly more than one tenth of a millimetre wide.

7 Steels used for chisel and plane blades

Enough books have been written about steel to fill whole libraries. I'm going deal only with what is really useful for woodworkers to know.

7.1 Tool steel

Steel is a malleable metallic material whose main constituent is iron (Fe). It is produced in steel mills from a mixture of pig iron and scrap. Tool steel is extremely pure (free of slag, sulphur and other contaminants) and it contains about 0.6 to 1.5% by mass carbon (C) so that it can be hardened to a high degree. Other metals such as chromium (Cr), manganese (Mn), molybdenum (Mo), vanadium (V), tungsten (W) are often added to the melt to produce alloys that improve specific properties of the steel.

The composition of a steel type can be deduced from its designation; the nomenclature is subject to various international standards⁵⁴, that anyone who is interested can delve into. I use these designations here without explaining the codification.

The production of high-quality standard steels, including tool steels, is well understood and it's not rocket science. Unhardened steel is delivered to the tool manufacturers as bars or rolled sheets. The tool manufacturer fabricates the products and tempers the steel to the required hardness. Heat treatment of steel is today an exhaustively researched standard process fully mastered by industrial fabricators.

How a tool steel behaves when used as a tool depends not only on its composition, but **at least as much on its microstructure, which is produced by the heat treatment!** It takes no skill at all to turn an excellent steel into lousy iron. Simply get the heat treatment wrong – et voilà!

7.2 Steel types for hand tools

The steels listed in the tables below are **cold work steels** (they retain their hardness only at relatively low working temperatures, as is the case for hand tools). These are only a few examples, there are many more!

Unalloyed tool steels (carbon steels):

These are the classic steels for hand tools. Before alloying of steels gained in importance towards the end of the 19th century, other tool steels didn't even exist. Today's carbon steels (because of the customary utilization of scrap metal in steel mills) are normally not totally free of metallic alloying elements. Their share is however kept so low that they do not appreciably affect the properties of the steel.

Unalloyed tool steels achieve a high degree of hardness and are said to be very easy to sharpen, but they tend to corrode easily. Examples:

Designation	Material no.	Other country designations	Most important mass fractions
C80U	1.1525		0,8% C
C105U	1.1545		1,05% C
		T10 (PRC)	1,0 % C
		White paper steel (JPN)	1.1 to 1.2% C

Alloyed tool steels

These contain metallic alloying elements that alter the properties (compared to unalloyed steels) in ways that are more or less noticeable. An aim of alloying could be the improved edge holding property of tools made from the steel. Or it could be improvements of a kind that have no effect on the performance of the finished tools, perhaps the reduction of the hardening distortion or greater resistance to corrosion during transport to the end customer.

These steels are often used for woodworking tools. As the content of alloying elements increases, it can result in sharpenability that is significantly worse than that of normal carbon steels.

⁵⁴ http://www.tetec-mueller.de/Dokumente/Pdf/Common/d/Material1_d.pdf.

Examples of **low-alloy steels** (with low share of alloying elements⁵⁵):

Designation	Material no.	Other country designations	Most important mass fractions
90MnCrV8	1.2842	O2 (US)	0,9% C, 2% Mn
100MnCrW4	1.2510	O1 (US)	1,0% C, 1% Mn, 0,6% Cr
115CrV3	1.2210		1,15% C, 0,75% Cr

Examples of **high-alloy steels** (with high share of alloying):

Designation	Material no.	Other country designations	Most important mass fractions
X100CrMoV5-1	1.2363	A2 (US)	1,0% C, 5% Cr, 1% Mo
X153CrMoV12	1.2379	D2 (US)	1,5% C, 12% Cr

Rustproof knife steels

These have undoubted benefits in the kitchen and in dishwashers, but none reach the hardness and edge holding qualities of the tool steels listed here. They are not commonly used for woodworking tools.

High-speed steels (HSS)

These are high-alloy hot work tool steels that can withstand temperature stresses during metal machining or dry grinding, they are extremely robust. They are seldom used for plane and chisel blades (mostly because of their poor sharpenability), but frequently for machine plane cutters and wood-turning tools.

Powder metallurgical (PM) tool steels

These are (mostly high-alloy) steels that are not alloyed like conventional steels in a crucible, but are produced by sintering a mixture of metal powders that has been pressed into blanks. This shows in their cost, but seeing they are particularly stress-resistant, their use in industrial metal processing often makes economic sense. You'll also find plane and chisel blades made of PM steel.

Damascus steel

This is not a type of steel, but the result of a forging technique: steel is folded together, forge-welded and then forged again into a thin layer. This is repeated several times. You end up with a forging blank with often a clearly visible build-up of thin layers. In days gone by this was a recognized method for producing break-proof blades from the poor steels available at the time. Today high-quality steels are generally available and from the technical point of view damascening is neither necessary nor advantageous; it merely serves to bring out interesting, often elaborately accentuated looks⁵⁶. Damascus steel today is mostly produced industrially.

7.3 Heat treatment of tool steels

Tool makers turn the unhardened rolled steel into chisel and plane blades, using processes like forging, cutting, grinding. During the subsequent heat treatment, the tools are first **hardened** by heating to red heat and then quenched; this forms a hardened microstructure called martensite. There are steels where a subsequent sub-zero treatment further improves this structural transformation. Then they are **annealed**, ie, for a specified time they are held at a temperature of about 200 to 300 °C (depending on the steel type); this decreases the hardness and improves the toughness. The whole process (hardening and annealing) is also referred to as **tempering**. The aim is a good compromise between hardness (resistance to wear) and toughness (protection against chipping of the cutting edge).

The transition of the microstructure to martensite causes the steel to increase in volume, and because this never happens quite uniformly, compressive and tensile stresses build up in the steel that in part are compensated by pushing and pulling the component into a crooked shape; this results in the virtually unavoidable **hardening distortion**⁵⁷. Carbon steels are quenched in water and tend to be subject to high distortion. A less abrupt quenching in oil or even cooling off in air is adequate for alloyed steels; this reduces the hardening distortion and thus the cost of subsequent grinding.

Many blades are **partially hardened**: only the end near the cutting edge (mostly about 5 cm from the cutting edge) is heated for hardening, for instance inductively or in a salt bath, and after quenching only this part will be hard. It's easy to spot after honing the back: the hard zone is bright, the soft zone matt-grey (see **Fig. 22**). It is not an indication of better or poorer quality.

⁵⁵ Overall not more than 5 mass percent.

⁵⁶ The knife and sword people like to take a different view. But it is so.

⁵⁷ "If it's not crooked, it's also not hard". There is some truth in this.

Some manufacturers specify the tool's hardness (in the tempered state); usually this is in the range of about 56 to 64 HRC⁵⁸. Values at the lower limit suggest a rather more resilient, tough blade, higher values a highly wear-resistant but brittle blade. You won't be able to verify this value, but do not over-estimate the significance of the hardness figure.

Temperatures and timing are specified precisely for the heat treatment of steel and must be adhered to; only then, and also if the steel meets the specifications exactly, can you expect **reliable quality to a high standard**. You can expect this from experienced tool manufacturers with modern hardening facilities. Experience and equipment have their price, that is why good tools cannot be cheap. You get what you pay for, here as elsewhere.

As a user of tools (made of cold work steels covered in this section!) you must take great care not to overheat the steel. Overheating is most likely if you grind the blade on a high-speed disk grinder without a coolant. Overheating acts like an involuntary continuation of the annealing process: the steel gets softer, it doesn't even have to take on blue tinge⁵⁹. In principle, the damage would be remediable through renewed hardening, but normally this expense cannot be justified.

7.4 Criteria for a steel's suitability

From the user's point of view a heat-treated steel suitable for woodworking tools should meet the following requirements as closely as possible⁶⁰:

- **Excellent edge holding property**, ie, a long service life before the cutting edge must be resharpened.
- **Good sharpenability**, ie, investment of little time and effort to restore a sharp cutting edge after a blade has become blunt.

Both these points have been exhaustively discussed in various publications. And often myths are simply repackaged. Nonetheless, I'll try to discuss the topic, very carefully.

Edge holding property

Despite many years' experience with hand tools I find it difficult to make a firm statement on the edge holding properties of my blades. It would be very difficult to make objective comparisons; I would have to perform the same operation with different blades on the same type of wood, and for plane blades, with the same shaving thickness. That doesn't happen in my workshop. Moreover, which criterium do I apply for the blade getting blunt? Is this a measurable quantity or is a visual inspection sufficient? Furthermore, how do you rate a very hard blade that shows little wear on its cutting edge, but instead the occasional notch? Not so easy, you'll agree.

There's no doubt that there are differences in edge holding properties, but they are possibly not quite as sensational as users are told by manufacturers hoping to persuade them to buy new blades. Not even my once unwavering belief in the undisputed superiority of laminated Japanese chisels over standard European chisel blades was confirmed by my attempts to compare them directly with each other⁶¹. It would be more than curious if one could in fact extract significantly more from marginally different steels in one part of the world than another. The case is probably that the Japanese prefer a somewhat harder blade and in return accept a steel of greater brittleness. It's one way to go, but it's not magic.

Sharpenability

When sharpening by hand, sharpenability is considered good, if material removal on the whetstone is rapid and the tendency to form burrs is low, and if there is no rubbing or sliding. All this does not depend solely on the steel, but also on the sharpening tool that is being used!

⁵⁸ HRC is the Rockwell hardness, which is derived from the penetration depth of a diamond cone.

⁵⁹ Steel that is tarnished blue (ie, heated to about 300 °C) is definitely useless for chisel and plane blades. But steel can be damaged even at lower temperatures. Initial, still very slow, annealing processes start at about 80 °C, with the really critical stages setting in no later than at 200 °C. Heating to higher temperatures generally means a loss in hardness – whether damage actually occurred can only be ascertained by a hardness measurement. The approximate allocation of annealing colour (and thus the annealing temperature) to a particular hardness (familiar from manual hardening) is valid only for the first annealing process after quench hardening, but not after subsequent overheating of already tempered steel. You are on the safe side if you avoid any overheating.

⁶⁰ There is no such thing as the "best steel". Every steel with its properties represents a compromise.

⁶¹ Which is why – some years ago now – I replaced most of my Japanese blades with European ones whose slimmer form I prefer.

My water stones are clearly the best and most pleasant to use for sharpening carbon steel blades⁶². Most of my blades are unremarkable when being sharpened, but a few give me a whole lot of trouble when I sharpen them. These last included a D2 blade, that I considered particularly good at edge retention (it is no longer in my possession). Even more troublesome is my only PM-V11 plane blade⁶³. I haven't had it for very long and I suspect that its edge retention won't prove to be so good that I will gladly accept the extra effort it takes to sharpen it.

But again: the situation might be quite different with other sharpening tools!

It is often asserted that fine-grained steel types⁶⁴ result in very sharp cutting edges, perhaps based on the notion that the cutting edge consists of an arrangement of whole grains and therefore cannot be more pointed than a single grain. This certainly is not the case, grains can be ground down (every metallurgist does it); therefore, the microgeometry of the cutting edge is most certainly not dependent on the grain size. On my blades I detect no steel-dependent difference in sharpness when I grind them on water stones and **I doubt that a significant difference of this kind even exists.**

7.5 Steel types used by manufacturers

Even if it is not possible to deduce much about the tool quality from the steel type (always keep in mind the heat treatment!), it is nonetheless quite interesting to find out what steel was used.

North American manufacturers mostly make no secret of it (though they won't divulge the composition of their PM steel). The vendors of Japanese blades also often tell you which steel was used for the cutting edge layer. Probably they assume that a buyer will associate a well-known steel name, eg, A2 or white paper steel, with a high-quality tool.

German tool manufacturers, on the other hand, do not give much away. For instance, you may spot a tool labelled "chrome vanadium", which doesn't tell you anything. Schmitt & Comp. in Remscheid⁶⁵ told me in as many words when questioned that they had developed an in-house formulation using a low-alloy tool steel with high carbon content. Other manufacturers that I contacted didn't even bother to answer. Such reticence may not be in keeping with the times – objectively there is nothing wrong with it. Because the specification of a steel type that is highlighted for promotional reasons tends to detract from the fact that what matters more for the quality of the tool is the experience and due diligence of the manufacturer.

⁶² I also recognize them by the typical grey-black abrasion particles on a whetstone or honing stone.

⁶³ It has an especially hard job to do in an edge plane, and it does it well. Nonetheless...

⁶⁴ A "grain" in the steel microstructure is a zone of uniform crystal orientation. Carbon steels are in fact very fine-grained.

⁶⁵ Manufacturer of Kirschen branded tools.

8 Any more questions? (FAQs)

8.1 I don't feel like sharpening. Can't I use a sharpening service?

Certainly you can! All you have to do is look for one. There are tool dealers and manufacturers who offer tool sharpening service. And at least one dealer supplies new tools with a voucher: one-off sharpening at no cost.

Once, when I was presenting my sharpening set-up at a fair, a couple of friendly, young carpenters told me that they had stopped sharpening their own blades and left this part of their business to a sharpening service. I found that astonishing.

I do not want to comment on how professionals chose to maintain their last remaining hand tools in an economical fashion. I take the view of a hobby woodworker who prefers to work with hand tools. Who uses them to fashion all sorts of joints, to smooth wooden surfaces...

Just imagine: after half an hour's work with the plane you take out the now dull blade. And then – you parcel it up and take it to the post office? Instead of sharpening it in at most 10 minutes? You must be joking. Not to mention the costs involved and the waiting time before you can resume work with the resharpened blade.

It's true that the mostly carbide-tipped machine tools known for their enormous service life that must meet exacting criteria for sharpening precision can only be sharpened on purpose-built automatic sharpening machines. The sharpening service will have these. By contrast, traditional hand tools must be sharpened much more frequently, and they are absolutely suitable for sharpening by woodworkers themselves – certainly the cabinetmakers from pre-machine days didn't know any different.

For me sharpening tools with my own hands is a totally natural part of working with wood. I recognize my sharpening in how the tools behave, and that is as it should be. I would not be happy for an unknown tool sharpener or a sharpening machine to come between me and my hand tools.

One thing is certain as far as I am concerned: anyone who wants to use chisels and planes as a hobby woodworker, must also be able sharpen them. As to the "how" that is totally up to the individual.

8.2 What about sharpening with a machine?

You can really achieve top quality results by sharpening by hand. I hope to convince the reader of this one fact: it's a skill that needs to be learnt and practiced, but it is not as difficult and laborious as it is often thought.

Of course, you can use machines to sharpen your tools. But I must begin with an important cautionary note:

To be avoided at all costs are the popular bench grinders⁶⁶ that work without coolant, but run at high rpm and with no way of precisely guiding the tool you're sharpening. They are too coarse and nowhere near precise enough. Above all, however, they are much too dangerous for a tool that can be ruined all too quickly through overheating. (For risk of overheating refer to Chap. 7.3.)

Special machines for sharpening tools are mostly wet grinding machines that eliminate any risk of overheating. It is, however, problematic or even impossible to produce really faultless flat surfaces (backs) with conventional sharpening machines⁶⁷. There are people who use a machine and then still process or post-process backs by hand.

I won't go into details about the many design and functional principles of sharpening machines; this topic is covered exhaustively on the Internet and by specialist providers. Some woodworkers, it seems to me, put a lot of time and effort into searching for the ultimate sharpening machine – possibly more than they would need to turn themselves into perfect hand sharpeners. I take great pleasure in the fact that I don't have to bother with this aspect of tool sharpening.

Sharpening by hand is always something of a challenge, which makes it interesting. And it is an activity that goes well with woodworking using hand tools. Over the years I have yearned for many tools and machines. But since discovering that thanks to the application of microbevels and back bevels I was able to sharpen by hand quickly and to a high quality, I have never again longed for a machine to sharpen my hand tools.

⁶⁶ Those nasty things that are palmed off on unsuspecting customers in DIY markets.

⁶⁷ For this you need a surface grinding machine that produces flat surfaces with the aid of precise guides; these machines start at a weight of about 500 kg. What's more, while a surface grinding machine may be right for a one-time reworking of backs, it's no good for routine sharpening, because it removes far too much material.

8.3 By hand – sure, but freehand? Why not use a sharpening guide?

Many woodworkers, who sharpen their tools on bench stones or similar sharpening tools, use a guide or jig when sharpening. This is (usually) a small device with a wide roller that rolls on the whetstone. The blade is fastened to the sharpening guide, eg, by a knurled screw as shown in **Fig. 53**. The angle at which you grind or hone is set by the longitudinal position of the blade in the guide and kept precisely constant once you tighten the clamping screw (or similar).

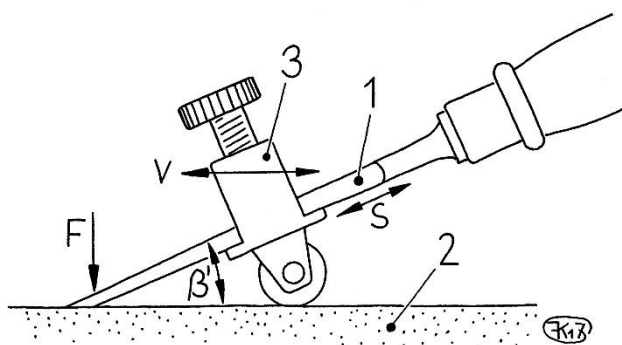


Fig. 53: Sharpening guide with roller

(simple example)

1: blade

2: whetstone

3: sharpening guide

v: grinding movement

F: downward force

s: longitudinal shift of blade (in guide)

for adjusting the angle

β' : angle of ground bevel

I too had one of these, but (after a brief honeymoon period) I found that it had many drawbacks. The angle adjustment was fiddly. Only part of the stone's surface was available for sharpening. The roller was very hard on the stone⁶⁸, causing possibly more wear than the sharpening itself. I couldn't produce curved cutting edges (with the guide I had!), nor was I able to sharpen my gouges. This left me with no alternative but to go back to my freehand methods.

Guides of different designs (eg, those that roll on the table) also have their downsides. One way or another, a sharpening guide will not eliminate all the problems you might encounter during sharpening. It's not surprising that a newcomer to sharpening will choose to work with a guide because he feels freehand sharpening is beyond him. But once you change to freehand sharpening, you can leave a lot of fuss and bother behind (just like the day you decided to shed the training wheels on your bike). I can recommend it.

8.4 Is there a video showing the sharpening techniques presented in this guide?

Yes, there is a video. In 2013 a three-part article of mine about sharpening was published in the periodical HolzWerken (nos. 41, 42, 43). At the same time three videos were made available online: <http://www.holzwerken.net/HolzWerkenTV> (category: tools)

This material has, however, not been brought up to date. And while a video of this nature can supplement a detailed guide, it cannot replace it.

8.5 What are the alternatives to synthetic water stones?

In **Chap. 5.2**, I described the stones that I use myself; these are without exception synthetic (Japanese) water stones. The choice here is virtually unlimited, but there are also many options⁶⁹ for anyone looking for something else. There is one key difference: all sharpening "stones" are subject to wear and must therefore be dressed, but you'll also find sharpening tools where this is not necessary.

- **Natural stones** (for use with water) are available from various sources. There is not only the legendary Belgian whetstone (a honing stone), but also other natural stones: from Thuringia, Slovakia, the famous Japanese natural stones, etc. etc. The use and handling of natural stones is a science in its own right, and you'll probably also encounter some myths. I have tested a number of natural stones, sometimes with high expectations, and every time I returned to my synthetic Japanese stones. I envy anyone who has a really good natural stone and is happy with it; I have stopped looking for a natural honing stone that matches my needs. Perhaps it is the case that during the creation of these stones mother nature wasn't quite as focussed on the requirements of tool sharpeners as are today's industrial manufacturers.

⁶⁸ The sensitivity of whetstones to stress induced by hard rolling is also made use of for the precise dressing of grinding disks ("crushing").

⁶⁹ You will also find really interesting comments on this topic (and on other sharpening issues) on Internet forums that deal with the art of wet shaving.

- **Oil stones** (where oil lubricates the sharpening process) were more common in the past. The famous Arkansas stone is a very hard, very fine and very slow natural honing stone that is used with oil (but water works as well!). Most oil stones are synthetic. One reason why I do not use oil stones is that I do not want to handle oil in my workshop (except where essential, for rust protection and lubrication). And I'm not just thinking of the sharpening process itself. Oil stones also dish⁷⁰ and must therefore be flattened again from time to time. How that would look in my workshop is simply too awful to contemplate.
- **Diamond-coated plates and sheets:** diamonds are the hardest abrasives, they effortlessly abrade not only hardened steel, but also carbides, ceramics and similar materials. Diamond-coated tools are virtually unusable for grinding steel on a machine at high cutting speeds, because at the resultant high temperatures the diamond (= carbon) wears away by diffusing into the blade. These high temperatures do not occur when grinding by hand so that working with diamond-coated sharpeners presents no problems.
The very expensive but durable diamonds are not embedded in a relatively soft bond; instead the uniformly distributed abrasives are securely and permanently held on the surface of the grinding tool, eg, by a layer of nickel (similar to the abrasive grit on sandpaper). This is the great benefit of diamond plates: they stay flat. And their great drawback: once they're dull it's all over, there's nothing to restore.
You can get flat, dimensionally stable metal plates (usually made of aluminium) with a diamond coating for roughing and grinding, but as far as I know none for really fine honing. Self-adhesive diamond-coated sheets (lapping film⁷¹) with an extremely fine grit are, however, available to glue onto a suitable base. It remains to be seen whether the elasticity of the sheet and adhesive layer does not result in sloping edges, as happens with polishing agents on leather (see below).
I do not use any diamond tools for sharpening. One reason may be that they were not commonly used at the time that I taught myself the art of sharpening. An experiment I made several years ago was not especially successful – the plate dulled disappointingly fast. All the same, if I wanted to further reduce the total effort involved in sharpening by hand, I would give diamond sharpening tools another chance.
- **Sandpaper on a flat base:** under the moniker “scary sharp” this is apparently quite popular among North American woodworkers. Sandpaper is glued onto a flat base, eg, a thick piece of sheet glass and then used like a whetstone or honing stone. Grinding is usually dry. I've tried it out. I ended up with properly sharp, but certainly not unusually sharp or even scarily sharp, cutting edges. You use an awful lot of sandpaper, the spray glue you need is expensive and has a disgusting smell. And the sandpaper and adhesive are elastic, this could be troublesome (see below). In my opinion this is a workaround, no more
- **Polishing agents on leather** (or possibly other soft bases, eg, wood) is considered by some sharpeners the ultimate approach to perfect sharpness. They can be used as a supplement to other sharpening tools. In fact, you will end up with an especially fine polish on the cutting edge. The drawback: under pressure the blade always sinks a bit into the soft leather; this means the edges of the contact area are worked on more, resulting inevitably in sloping edges of the surface. This change in the cutting edge geometry is not to my liking, while the polishing constitutes an additional process step. I think that an 8000 grit honing stone will in any case produce a sufficiently fine cutting edge for woodworking purposes. See also **Chap. 8.8**.
- **Loose abrasive grit** (powder or pastes on the basis of corundum, carborundum, diamond) can be used for lapping on dimensionally stable plates of soft steel or cast iron. This is an established procedure in precision metal processing, nowadays mostly with diamond grit. Suitable lapping plates of soft steel or cast iron are also available for sharpening tools. Diamond grit embeds itself into these plates, which is why they stay flat for a very long time. Lapping with other abrasives not only abrades the workpiece (here the blade that needs sharpening), but also inevitably the lapping plate whose flatness can no longer be assured. I experimented with using corundum suspensions for lapping on granite or glass plates (which would be replaced after losing their flatness), in the hope of perhaps completely replacing my expensive honing stones, which always need regular dressing. It worked quite well for microbevels and back bevels, but less so for backs (where it felt gravelly and scratchy). For the time being I have stayed with my honing stones.

⁷⁰ Yes, a hard Arkansas stone remains flat for a long time. But eventually it will no longer be flat. And then it must be dressed – and during dressing it will show you exactly how hard it is.

⁷¹ Regarding the designation: because the diamond grit is bonded in these abrasives the processing is referred to as honing rather than lapping according to German usage!

8.6 How can you save time when sharpening very thick blades?

This section covers western chisel and plane blades, Japanese ones are dealt with in **Chap. 8.12**.

Plane blades: thick blade, good blade?

The cutting edge of a plane blade should be as rigid as possible while cutting, ie, stay in place without discernible elastic give, without vibrating, or worse, chattering. A thick and therefore stiff plane blade will surely help to meet these requirements. On the other hand, you want to be able to sharpen the blade in double quick time. This is where a thinner blade is better – you have to remove less steel.

For satisfying both requirements – relatively high stiffness (through being thick) and relatively easy sharpenability – look to laminated chisel and plane blades, where a soft and therefore readily grindable substrate⁷² is welded to a thin and hard plating. This is the typical composition of Japanese blades – in the past, plane blades were also produced this way in Europe and North America. Today, however, the blades of western planes are hard throughout, whether the planes are made of wood or iron. This means, the thicker they are, the harder they are to sharpen.

I work almost exclusively with iron planes. On modern planes it is quite common to find blades 3 to 4 mm thick. The chunkiest plane blade that I ever had to sharpen belonged to a bevel up jointer plane from Lie-Nielsen: ¼ inch (6.35 mm) thick. This amount of steel will surely intimidate any piece of wood, but it's hardly necessary for it to function properly. And from the point of view of a hand sharpener it is more than irritating. On the other hand, you will be surprised at how thin the original blades of old Stanley planes are: sometimes under 2 mm. These are tools that joiners used day in, day out to make a living. It is of course possible that in the interests of faster sharpenability these blades were made rather too thin.

My yardstick for the necessary blade thickness for a bevel down plane is the Hock blade made of low-alloy O1 steel in my old Stanley Bailey #8: 2.4 mm; it works perfectly and sharpens easily.

Thick chisel blades

When it comes to chisel blades and their relatives, it is above all the mortise chisels that catch the eye with their extravagant dimensions. My 12 mm wide mortise chisel is 14 mm thick.

Faster sharpening of thick blades

All my thick blades have a fairly large, some even a very large, wedge angle. On such blades it is very easy to apply a somewhat flatter **relief bevel (Fig. 54)** with a faster roughing stone. This drastically reduces the area of bevel that you need to work on with the whetstone. The situation at the front of the ground bevel and the honed microbevel remains completely unchanged, the roughing stone never gets to those surfaces. The relief bevel is not worked on every time the blade is sharpened, just from time to time. Only once the bevel has become again annoyingly wide after several regrinds is it again the roughing stone's turn. For the plane blade in **Fig. 54 right**, the time seems to have come.

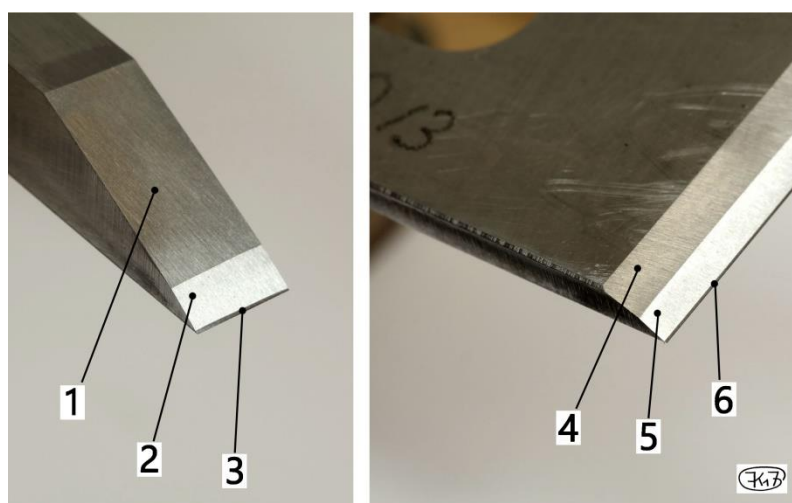


Fig. 54: blade with rough-ground relief bevel

left: mortise chisel 12 mm wide
right: blade for Veritas low angle plane, 3.3 mm thick

- 1: rough-ground relief bevel 25°
- 2: ground bevel 30°
- 3: honed microbevel 35°
- 4: rough-ground relief bevel 35°
- 5: ground bevel 45°
- 6: honed microbevel 50°

Are there drawbacks when using a blade with a rough-ground relief bevel?

A work-saving rough-ground relief bevel is always possible on chisels, firmer chisels and mortise chisels with large wedge angles; and on really thick blades it pays off in any case. Regarding the applicability on plane blades, one has to differentiate between bevel down and bevel up tools.

⁷² Remember: in the “elastic range”, ie, at low stresses as applicable here, soft steel is as stiff as hard steel. It's a fact, even if often the opposite is claimed!

Fig. 55 shows the blade with cutting force acting on the rake face near the cutting edge. Microbevel and back bevel are not shown here.

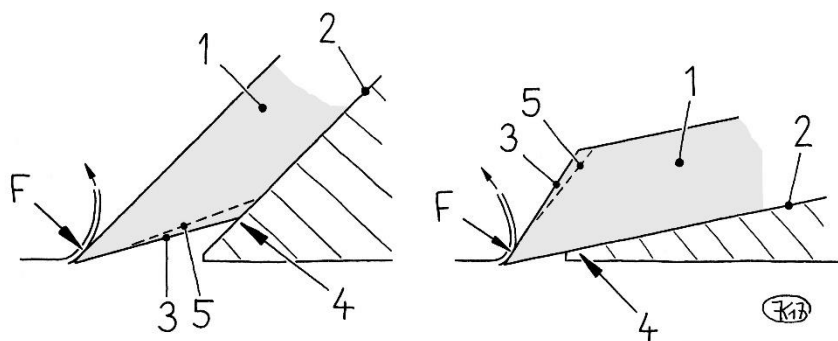


Fig. 55: Plane blades with relief bevels

left: plane, bevel down
right: plane, bevel up

- 1: blade
- 2: bed
- 3: ground bevel
- 4: lower blade support on bed
- 5: rough-ground relief bevel
- F: cutting force acting on the rake face

Plane with bevel down: the blade transmits the cutting force to the plane bed. The force is transmitted to the lower blade support at the point where the bevel starts. This point moves up when there is a relief bevel, the wedge gets longer and more elastic, the cutting edge is guided generally less rigidly. If you want to fashion a rough-ground relief bevel, then you must take care that you don't grind the wedge too slim, ie, not under 25°⁷³! My recommendation⁷⁴ (for a 45° bedding angle): rough-ground relief bevel 25°, ground bevel 30°, microbevel 35°.

Plane with bevel up: the lower support for the blade occurs at the front edge of the bed, the point to which once more the cutting force is transmitted (not to the very front edge of the bed, because the wedge forming the bed is thin and thus noticeably elastic). Nonetheless: the transmission path is very short and a relief bevel obviously does not change or affect the deformation behaviour of the blade bed system, or the effect is so small that you can ignore it. In any case, the wedge with the ground bevel now has a larger angle (at least 35° in my case). That is why a relief bevel is acceptable here and certainly does no harm, and all my blades for low angle planes have one.

8.7 What angles to chose for bevels, microbevels, back bevels?

This is how I do it. None of the values is a must, deviate from them as you see fit.

Pos	Tool	Bevel up/down	Bedding angle	Ground Bevel	Microbevel	Back bevel	Rough-ground relief bevel	Cambered cutting edge	Note
1	Chisel (general use)			25°	30° (35°) ⁷⁵		-	no	
2	Chisel (hand-guided)			25°	30°		-	no	
3	Mortise chisel			30°	35°		25°	no	
4	Carpenters' slick			30°	35°			no	
5	Carpenters' axe			30°	35°		-	no	
6	Bench plane blade, eg, Stanley (bevel down, thin blade)	d	45°	30°	35°	5°	-	yes	
7	Bench plane blade (bevel up, thick blade), various	u	12°	35°	40°	3°	25°	yes	
8	Pos (7) but for demanding wood	u	12°	45°	50°	3°	35°	yes	
9	Block plane blade Veritas /LN	u	12°	35°	40°	40°	25°	no	
10	Shooting plane blade Veritas	u	12°	30°	35°	35°	25°	no	PM V11

⁷³ 25° is the usual wedge angle on plane blades as supplied by the manufacturer.

⁷⁴ "Recommendation" because I myself have no bevel down plane with a thick blade.

⁷⁵ If necessary angle enlarged to 35° for processing problematic wood.

Pos	Tool		Bevel up/down	Bedding angle	Ground Bevel	Microbevel	Back bevel	Rough- ground relief bevel	Cambered cutting edge	Note
11	Shoulder plane blade	LN	u	20°	30°	35°	5°	-	no	
12	Shoulder plane blade	Veritas	u	15°	30°	35°	5°	-	no	
13	Router plane blade	Veritas	d	45°	30°	35°	5°	-	no	
14	Rabbet plane blade	Record	u	45°	30°	35°	5°	-	no	
15	Rabbet block plane blade	Juuma	u	12°	35°	40°	3°	25°	no	
16	Block plane blade	Stanley #102	u	24°	30°	35°	5°	-	no	
17	Dovetail plane	Ulmia	d	454°	30°	35°	5°	-	no	

Some time ago, after mulling it over for a long time, I decided to increase the wedge angle on all my Stanley bench planes: ground bevel/microbevel before 25°/30°, now 30°/35° (always with 5° back bevel) to increase the resilience of the cutting edge.

On my low angle planes with 12° bedding angle (and only on such planes is this unproblematic) I can vary the cutting angle by using different wedge angles: for routine work I use a ground bevel of 35°, a microbevel of 40° and back bevel 3°. For trickier timber (with a risk of tear-out) I use blades with a ground bevel 45°, microbevel 50°, back bevel 3° for low angle smoothing and jointer planes; this results in a wedge angle of 53° and a cutting angle of 62°! This works exceptionally well. The smaller angles on the shooting plane with a PM V11 blade are an experiment to see whether satisfactory edge holding properties can be obtained (current verdict: yes).

The frequently heard comment that planes with 12° bedding angle and 25° wedge angle (and thus only a 37° cutting angle) are especially suited for working on end-grain timber, is not correct as it stands. A blade with a 25° wedge angle may well be suited for planing lime wood, for many common types of timber, let alone end grain, the cutting edge will fail.

8.8 Can one go over the top with sharpening? And how often is often enough?

The sharpness of blades has been shrouded in myths and legends since time immemorial; back then it wasn't about tools but about instruments for killing. Wayland the Smith, it is said, demonstrated the sharpness of a sword by letting a tuft of wool drift in water against the cutting edge. And in "Bodyguard" a gossamer-thin silk scarf was parted cleanly in two when it floated down on a sword.

There are people who believe this. In reality it is impossible, but there are many more gross examples when it comes to matters of faith.

Back to our hand tools. For a woodworker a blade is sharp, if with little effort it is able to cut wafer-thin shavings (not to mention thicker ones). It is the quality of the cutting edge that decides whether this is possible.

The basic requirement for proper sharpness is a sufficiently fine honing stone. The finer the stone, the closer the cutting edge will approach the ideal ("zero radius of curvature", see **Chap. 2.2.1**), provided the sharpening method is good, and the sharpener is skilled and careful. What is a sensible limit?

With a honing stone J6000 grit or finer you will always be able to produce a decent cutting edge. I hone all my plane and chisels without exception with 8000 grit stones. Until about two years ago this was a rather soft polishing⁷⁶ 8000 grit stone. Today I mostly use a significantly harder 8000 grit non-polishing stone (see also **Chap. 5.2.2**). This way I achieve a sharpness that satisfies all reasonable requirements and that in some cases seems like a bit of an overkill, for example, on a blade which I use for cutting mortises. However, I keep them in good nick (through the use of microbevels and optionally back bevels) without any special effort. That is why I do not differentiate between tools, but sharpen all my chisel and plane blades in the same way and to the same level of quality.

I'm sure I've not yet achieved the ultimate in sharpness on my blades. With more time and possibly more expensive stones and some quite special tricks you could get a bit more out of it. But what's the point? Wood is an abrasive material and even after just a few strokes with a plane the magic is gone. One thing is clear: a freshly sharpened cutting edge is the exception, most woodwork is performed with a cutting edge that is already more or less dulled.

⁷⁶ For special features of polishing stones see **Chap. 5.2.1**

Because the sharpness of a tool always diminishes in use, it doesn't make all that much difference to its sharpness whether you push your skills to the limit when honing. **Far more important is not to put off the next sharpening session for too long.** What always helps is a sharpening centre ready to go into action at any time. Once you set one up, you'll find you sharpen your tools as it becomes necessary, instead of putting off the job.

When you're busy on a project you clearly want to keep the time you spend sharpening as brief as possible. How short this can be in practice depends entirely on the type of work. If I'm looking for perfect results – for instance, when smoothing a difficult surface – I won't wait for the blade to become even discernibly dull. Instead, I'll resharpen the blade after just a few minutes. In less critical cases, eg, when cutting mortises in soft wood, I find I can work for hours before I think of resharpening. Each project has different requirements.

8.9 How do you flatten grinding and honing stones, if you don't have any clinkers or don't want to use them in the first place?

Naturally there are alternatives to the method shown in **Chap. 6** of dressing stones on flat lapped clinkers. Here is a selection:

- **Dressing stones on wet sandpaper:** The reference surface is a suitably flat, hard and waterproof plate, eg, a thick sheet of glass or granite window seat⁷⁷. On the wetted plate you place a sheet of medium fine wet sandpaper (don't forget to remove the price label on the reverse side of the paper!) and dress the stone on the wet surface. This is quick and the result is impeccable. I used this method for years. Drawbacks are that the sandpaper dulls quickly, so that consumption of sandpaper is frighteningly high if you dress your stones frequently.
A variant of this method involves replacing the sandpaper with a self-adhesive diamond-coated film; but now we are talking about a significantly larger initial cost.
- **Dressing stones on a ceramic block:** on offer are large, grooved, hard ceramic blocks for dressing whetstones and honing stones. For me a trial run didn't turn out well: the tested dressing block deviated by several tenths of a millimetre from flatness (this is far too much!); besides, it was so coarse that it completely spoiled my honing stone. If neither of these two problems existed, one key question would remain – what do you do when the dressing block itself (the reference surface!) becomes dished through use as it inevitably will?
- **Dressing on cast or steel plates with loose abrasive grains:** plates and grinding powder are available on the market. I don't doubt that this method works, though I've never tried it myself. It would be interesting to ascertain how long a plate like this – exposed to grindings and corrosion – would remain flat.
- **Dressing on diamond plates.** You can get diamond-coated plates, thick and flat, and as such eminently suited for dressing whetstones and honing stones. In the size you would need they range from expensive to very expensive. They'll work well enough, they'll surely also stay flat and you'd hope that they'll keep for a very long time. I've never tried them out, because I'm satisfied with my clinkers.
- **Rubbing grinding and honing stones against each other:** this is sometimes recommended and it happened to be the method I tried first. In fact, it is a very poor method, because you lack a reference surface! Two (possibly) hollow stones may in this way become somewhat flatter than they were before. But if you end up with one stone with a slightly concave surface, then the other is correspondingly convex. That's exactly what one doesn't want and what's more, this process also chews up your expensive honing stone

8.10 How do you refurbish blades that are in a bad state?

Old or misused blades can usually be restored to full working order.

Often you will first need to remove rust. I do this with a rotating brush in a stationary drilling machine, at high rpm, applying a lot of pressure, if necessary. In less severe cases I use a brass wire brush, in more severe cases I use a brush with synthetic bristles with embedded grit. This gets rid of a rust film and also of more serious corrosion. I chose not to use any chemical means of rust removal, but that is not to say that I have a fundamental objection to this method.

A blade prepared in this way must now be provided with a flawless back and a flawless bevel, in arbitrary order.

⁷⁷ Modern sheet glass (float glass) is reliably flat, thanks to the method of its manufacture; sawn window seats or tiles made of stone should be checked with a good ruler.

8.10.1 Restoring the back of a blade

Restoring a back can be very time-consuming. If its condition is not too poor, I tend to use the same whetstone that I use for sharpening. But there are limits. The material removal that can be achieved with a J800 or J1000 grit bench stone on a large area on a hard workpiece – here the back of a chisel or plane blade – is ridiculously small. Such a stone can only remove a minor unevenness, scratches or very flat nicks. It will not handle more extensive jobs within an acceptable time. In such a case it is best to use a grinding tool with a greater removal rate either ahead of or instead of the whetstone (see below: Options for removing material at a faster rate.....).

If the back slopes too much at the cutting edge, because the previous owner worked from both sides while “sharpening”, it may be a good idea and helpful to significantly shorten the blade at the cutting edge (for method: see below, keyword: bench grinder).

An example of restoring a back in poor condition:



Fig. 56: Flattening a back

(old English chisel, 19 mm wide)

above: initial state with scars and traces of past grinding attempts by a previous owner

bottom: finish ground

Stone: Shapton 1000

Duration: approx. 60 minutes, with about half the time spent on the improvement from the 3rd to the 4th photo

The stone was dressed some 10 times during flattening

Note: the flattening process also removed all scars in the vicinity of the cutting edge!

When working on wide backs (wide chisel blades, plane blades) it is helpful to press the blade down on the grinding tool with extra force using a block of wood or cork (piece of a sanding block).

Finally check (as described in Chap. 3.4.1) “on the stone” whether the now beautifully bright back is really flat.

I would prefer not to flatten an even poorer back or the back of a much wider blade on a whetstone; you need something more aggressive.

Options for removing material at a faster rate when flattening backs

- You can start proceedings with a coarser stone (roughing stone), this is my choice. A good roughing stone is significantly faster than a whetstone. But you’ll need to dress the stone very frequently, otherwise it **does more harm than good**.
- You can use a flat diamond grinding plate or a diamond grinding film glued to suitable base. My experience is mixed: it worked, but the pleasure didn’t last, because the plate was soon dull and it was no faster than a decent roughing stone. A lasting benefit of such a plate is that it stays flat.
- You can glue a sheet of sandpaper (eg, 80 grit) onto a thick plate of glass, part of a granite window seat or any other level and rigid base (or lay wet sandpaper on it) and then use it like a whetstone. This works well as long as the paper is fresh and sharp. Unfortunately, it dulls very quickly, sandpaper consumption rockets and with it the costs. It won’t be perfectly flat either, the sandpaper’s elasticity creates more or less sloping edges, just like a polishing leather.

When I was still building up my stock of tools and often had the opportunity to flatten crooked backs, I also experimented with a stationary belt grinder. Without much success, because while the backs ended up brightly polished, they were not really flat.

8.10.2 Restoring the bevel

A bevel can have various faults that may prevent normal sharpening:

- **Wedge angle much too small or much too large:** an angle that is too small is not a disaster. It is enough to grind a narrow new bevel at the correct angle at the cutting edge (remnants of the old bevel will survive). Functionally this is adequate and the new bevel will get wider with each sharpening. An angle that is too large, on the other hand, means that the blade must be completely reground to the correct angle, this takes a lot more effort.
- **Skew cutting edge:** this must be improved by grinding. Chisel blades should have a cutting edge at right angles to the side, by eye. Plane blades should have a cutting edge whose perpendicularity should stand up to scrutiny with an angle gauge (see **Chap. 3.2 Fig. 23**)
- The blade needs to be shortened (to remove part of the back that is beyond repair): this is mostly a job for a bench grinder.

Using a bench grinder on the bevel

I hesitate to write this, but truth must out: I put my dry bench grinder to work when a lot of material has to be removed regrinding a bevel. I exercise extreme caution to avoid as far as possible any over-heating of the steel:

- I use a coarse stone which I dress first⁷⁸ so that it is sharp and grinding generates relatively little heat.
- I draw the blade that I'm working on once from left to right along the stone (not to and fro!), applying just a little pressure, and then I dip it immediately and with one movement into a water container standing to the right of the bench grinder. This takes time, but is a must.
- I do not grind the blade until I have a sharp cutting edge, but only until I've produced about a 1 mm thick edge where I want to fashion the eventual cutting edge.

The bevel is subsequently ground on bench stones. And will never see the bench grinder again.

Is the blade too soft at the cutting edge?

It can happen that the cutting edge of a restored blade will fail because it bends when subjected to high stresses. If this happens, although experience tells you that the wedge angle is large enough⁷⁹, then the blade is too soft at the cutting edge. If it is an old blade of unknown provenance, it can be assumed that a previous owner damaged the blade thermally by grinding it at too high a temperature. Grinding the bevel down another 1 or 2 mm will, with a bit of luck, remove the damaged zone, after which the blade will be fine again.

8.11 Why do you need a cambered cutting edge on plane blades?

A straight plane blade precisely honed and adjusted cuts a uniformly thick shaving over its entire width. This is as it should be for shoulder, rabbet, block, dovetail and edge planes (and likely a few more). It's different for bench planes (anything between a smoothing and a jointer plane). Their job is to work on surfaces. If these surfaces are wider than the plane, you will need to make several plane strokes one next to the other. Plane blades with an exactly straight cutting edge will then leave sharp-edged steps between the plane strokes – if you are aiming for a perfect surface, it is irritating to see and feel these steps. You can, of course, refinish the surface with a scraper, but this won't result in the quality surface a plane can achieve.

The cutting edge of a blade in a smoothing plane, designed to produce flawless surfaces (without the need for finishing touches), should therefore not be straight but very slightly cambered, ie, curved with a protruding middle section.

A surface finished by a plane with such a blade has a profile consisting of extremely flat curves. With transitions between plane strokes that can hardly be seen or felt; it is a pleasure to see and touch.

⁷⁸ There are "dressing devices" for this, mine is a fractured diamond-studded dressing disk used in gear manufacture.

⁷⁹ For wedge angles see **Chap. 8.7**.



Fig. 57: Shaving produced by a smoothing plane whose blade has a cambered cutting edge

The shaving should have the full width for a chip thickness typical for that plane, but run out left and right with thickness zero. For a reduced shaving thickness the shaving will be narrower than the blade as shown in the photo.

Ideally the narrower chip should show as being symmetrical about the midpoint of the blade. This could have been corrected by the plane's lateral adjustment.

(Veritas bevel up plane)

In practice another benefit of the cambered cutting edge is just as important: when you true the edge of a board you can optionally remove more material either on the left or right side by planing with a lateral offset; this is an easy way of achieving rectangularity.

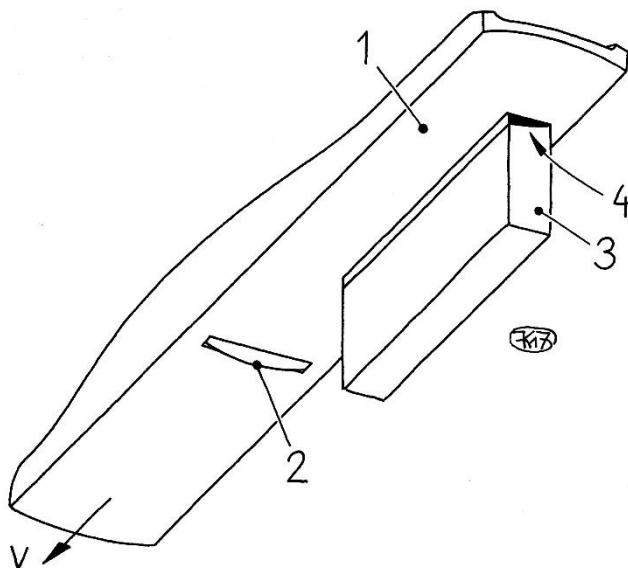


Fig. 58: Blade with cambered cutting edge in a jointer plane

- 1: Sole of the jointer plane
- 2: cambered cutting edge of the blade
- 3: workpiece (board)
- 4: triangular shaving cross section on the workpiece
- v: planing movement

On all bench plane blades from smoothing to jointing planes the cambered cutting edge is always an advantage.

The camber of the cutting edge and the triangular form of the shaving cross section are here greatly exaggerated!

What's the recommended amount of camber on the blade's cutting edge?

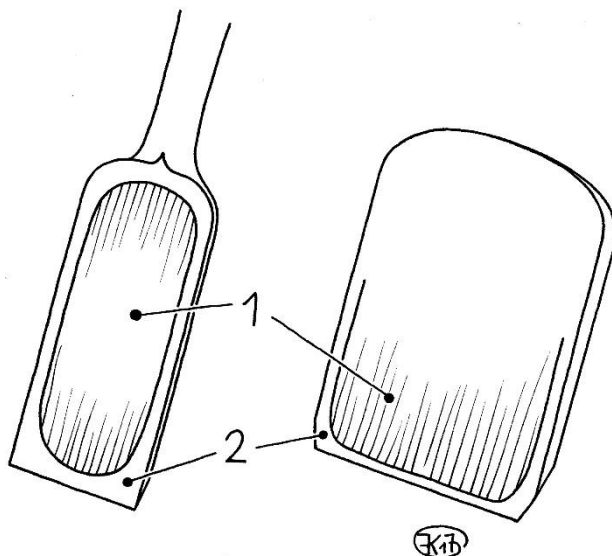
With the blade fitted, the corners of the cutting edge must stand above the middle of the blade, measured vertically to the plane sole, by the shaving thickness. On a blade bedded at an angle, the correction is referred to the back of the blade and is correspondingly greater: at a bedding angle of 45° the corners of the cutting edges should be eased back by about one and a half times the thickness of the shaving, for the blade of a low angle plane with 12° bedding angle by a fivefold amount. The thickness of the final shavings you produce with a smoothing plane are at most five hundredths of a millimetre, when truing with the jointer plane at most two tenths of a millimetre. The correction of the cutting edge form should be correspondingly small, you'll hardly see it on the finished sharpened blade.

8.12 What to consider when sharpening Japanese blades

Japanese chisel and plane blades represent a truly unique tool culture and are often of an impressive puristic quality.

Traditional Japanese chisel blades differ clearly from western ones: blades are shorter and thicker and have a relative long shaft. They are also nearly always made of laminated steel, ie, the blades have a substrate of soft steel that is forge-welded over its whole surface to a thin plating of very hard tool steel. Nor is the back of the blades flat throughout, but ground slightly hollow, with a narrow flat edge (the **ura**) forming a closed ring.

Fig. 59: Japanese blades with hollow-ground back and ura



left: Japanese chisel blade
right: Japanese plane blade
1: hollow-ground concavity
2: ura

The design and form of these blades have definite advantages when it comes to sharpening them:

Grinding the bevel is relatively easy (despite the thickness of the blade), because the bevel surface consists largely of soft substrate. When honing the ring-shaped ura (instead of a flat back) you have to remove only a little material and coarser grit cannot get stuck beneath it. That's why you can get the job done quickly, effortlessly and to a high standard. It also helps that the ura is at an angle to the longitudinal axis of the shaft and protrudes a little above it, ie, it is "undercut"⁸⁰ and is short. On a flat whetstone the whole ura can be worked without any problems and it will stay permanently flat⁸¹.

For these reasons, Japanese chisel blades are not difficult to sharpen despite their thickness and very hard plating.

Traditional Japanese plane blades all have quite similar features: short and thick, slightly wedge-shaped, laminated and with hollow-ground backs. The ura here is U-shaped.

The fact that it is relatively easy to produce a perfectly honed back and thus also a flawless cutting edge is a real benefit, and in my opinion the main reason why many users attribute superior cutting edge behaviour to Japanese blades. Producing a comparable cutting edge quality on western **chisel blades** with their full-sized flat backs is far more difficult. On **plane blades**, in contrast, the drawback of a flat back can be bypassed through the use of a back bevel; if you sharpen your western plane blades in this way it really takes little effort to achieve cutting edge quality that will not be inferior to that of Japanese blades.

How to sharpen Japanese blades

Japanese chisel blades: these I sharpen⁸² like their western equivalents, with a flat back. And I add a microbevel to the bevel, everything quite normal.

Japanese plane blades: I have never owned a Japanese plane and only once(!) did I sharpen a Japanese plane blade. My attempt to emulate Odate⁸³ (in whose book you can see how the short blades without additional aids can be held by hand) failed. It failed because material removal on the soft substrate was greater than on the hard plating and the ground wedge angle became ever smaller. As I do with other plane blades, I then ground with a long holder and created a microbevel. No back bevel, because the ura of Japanese plane blades is especially good to hone as is. I ended up with a very sharp blade. I can say with confidence that this worked well enough, despite my minimal experience.

⁸⁰ Some blades must be reworked a bit at the transition point between ura and neck.

⁸¹ This is different with the long backs of European blades, see Chap. 3.4.4 and Chap. 8.18.

⁸² Or rather: sharpened, because of my once ample stock of Japanese blades only one is left; I have changed to European blades because I prefer their slimmer form.

⁸³ Toshio Odate: *Japanese Woodworking Tools*

8.13 What about the grit grade specifications according to FEPA or JIS?

This section covers only grinding tools using “conventional” abrasives such as corundum, but not diamonds or CBN!

Abrasives are produced industrially as bulk material from grains of different size. The **grit size** is specified in μm (micrometre, ie, a thousandth of a millimetre). For technical applications abrasives are classified (sorted) according to grit size, you end up with grit fractions having roughly the same size. Their fineness (and also that of stones produced from them) is specified as **grit grade**. This code number specifies the number of meshes per inch of the wire sieve that was used for the classification of the grit. A grit grade of 60 means that the grit just managed to pass a sieve with 60 meshes per inch, but not the next finer sieve. Grit grade 200: the same story with 200 meshes per inch. Thus the bigger the number, the smaller the grit size.

The classification of very fine abrasives uses a different method that does away with sieves, but retains the grit grade specification. In Europe this is standardized, the relevant organization is **FEPA** and you should expect the specification of the grit grade to be prefixed by F. Example: 180 grit grade according to FEPA is given as **F180**, and this grit grade is assigned to a grit size of $70 \mu\text{m}$ (\pm a permissible tolerance).

Japan has a completely different, independent artisan tradition and its own industrial norms⁸⁴. There too code numbers are used: the bigger the number, the finer the grain. The Japanese standards organization is called **JIS** and their grit grade specifications are prefixed by a J. A grit grade of 180 grit according to JIS is therefore specified as **J180**.

Unfortunately, the assignment of grit size to grit grade in the two systems is only identical or very similar for relatively coarse fractions; for finer ones the deviations are very large⁸⁵: to illustrate this point look at just one comparison of a coarse and a very fine abrasive:

FEPA		JIS	
Grit size	Grit grade	Grit size	Grit grade
129 $\mu\text{m} \pm$	F100	125 $\mu\text{m} \pm$	J100
1,2 $\mu\text{m} \pm$	F2000	1,2 $\mu\text{m} \pm$	J8000

The Internet lists extensive comparison tables that often also go into further detail; you will also see that there are several other norm systems.

In short: the grit grade specification of a whetstone must always be seen in conjunction with the norm to which it refers. For Japanese stones it is clear – they are always specified according to JIS, even if this is not expressly stated. For stones from Europe one can assume that the grain specification is according to FEPA. But keep your eyes open, it may be a relabelled stone originally manufactured in Japan!

All the above refers to loose abrasives and rigid grinding tools (stones and disks). For sandpaper and sanding belts there is a special European norm: FEPA P. 280 grit on sandpaper is denoted by P280.

For natural stone there is no specification of the grit grade. It would be impossible, because the grit obviously wasn't classified according to any particular norm. A popular workaround is to specify the grit grade of a synthetic stone that generates a comparable grinding pattern.

Now it is certainly not the case that the specification of the grit grade unambiguously defines the behaviour of a stone. Apart from the grit size, the type of the grit and bond also determine the behaviour of the stone. Two “1000 grit stones” of different provenance can therefore behave quite differently and also leave you with a totally different grinding pattern.

8.14 How much time should sharpening take?

Since sharpening is not an end in itself, but an interruption of what you really want to do, namely working on wood, it's a job you want to get done quickly. These are roughly the times I need for grinding and honing:

- A normally dulled chisel blade of medium thickness with microbevel: about 2 minutes
- A 50 mm plane blade (Veritas, about 3.2 mm thick, with microbevel and back bevel, cutting edge cambered, with rough-ground relief bevel): about 5 minutes.

⁸⁴ And of course US Americans also have their own norms, as do the Russians, etc. etc.

⁸⁵ Possibly Japanese sieves are constructed differently...

8.15 Can you resharpen blades with just a honing stone?

This is assuming that you are using an 8000 grit honing stone; you may have a different experience honing with a coarser stone.

Sharpening means getting rid of wear and often also signs of damage at the cutting edge. Minor signs of wear can be removed with a fine honing stone, but not damage.

If a blade with a microbevel (and possibly a back bevel) has become dull, it is usually possible to resharpen it with a honing stone in double quick time, because you can focus your attention on the spot where the blade is showing wear. But this will work once only; a second time it will be laborious.

Does this save on sharpening time? Ultimately not. The microbevel gets wider and you will have to grind away all the more when next you sharpen the blade.

8.16 What can you do to prevent scratches on the back?

Once you've added a back bevel to a plane blade your worries about a scratched back are over. Because this isn't possible on chisel blades, you have to take a lot of care to avoid a scratched back. The thing to eliminate as far as possible is contaminating the honing stone with coarser grit. This is what you can do:

- Store the whetstone and honing stone well apart from each other. Under no circumstance must these two stones lie on top of each other or in the same slurry!
- Always rinse the honing stone thoroughly after dressing (that's when it comes in contact with coarser grit). You don't need running water for this: I rinse in a water container (**Fig. 40**) in which I clean not only all my stones but also any blades that I want to sharpen or have already sharpened. Coarser grit quickly sinks to the bottom; the water at the top may not be crystal clear, but is certainly free of any coarser grit. For the stones I use a little brush.
- Never turn the honing stone over to use the other side without first dressing and rinsing this side⁸⁶. The stone is likely contaminated with coarser grit on the underside.
- Do not operate any machines (bench grinders, belt grinders, sanding disk and similar) that can propel coarse grit into the air immediately next to your sharpening centre.

8.17 Why are the backs of brand new blades often not flat enough?

Modern grinding machines for metal processing work very precisely. By comparison, the flatness requirements for backs (they need to be good enough to be sharpened without problems) are really quite modest. Nonetheless the requirements are often not met by brand new machine-ground blades. How is this possible?

Crooked backs

After hardening the blades will be distorted and not free of hardening stresses (see also **Chap. 7.3**). For grinding they are clamped or mounted on a magnetic clamping plate, where clamping forces result in further distortion. And then they are finish-ground – both sides in the case of plane blades, all around in the case of chisels.

Removing a layer of material from a workpiece that is subject to internal stresses changes the stress equilibrium and to compensate for this stress the part will assume a new shape (distort) as soon as it can. This is exactly what happens: the machine-ground areas remain flat as long as the part is clamped. Once the clamping force is removed, the part loses shape and the back becomes crooked again – if you're out of luck, too crooked for it to be sharpened properly.

A "flatness deviation zero⁸⁷" cannot really be obtained by grinding such thin workpieces. What does matter is for the manufacturer to accept that a decent flatness of the back is an important quality feature (I suspect this is not the case everywhere). By optimizing the hardening and grinding processes the residual flatness deviation of the back can then be kept reliably low enough so as not to matter. The extra effort, if it exists at all, is modest.

⁸⁶ On all my stones I use just one side (I have used a waterproof felt pen to mark a "U" on the out-of-bounds underside.

⁸⁷ This is strictly not possible, but if there is no measurable deviation, it's what people like to call it.

Back with sloping edges

Another deviation from the ideal shape of the back are sloping edges. They come about due to the infuriating habit of some manufacturers of polishing their chisel blades, including the back, for cosmetic reasons (after they have been ground flat). Polishing tools are soft, which is why the back ends up more or less with sloping edges, even in the front at the cutting edge. To sharpen such a blade properly the woodworker has to laboriously grind down the back until it is flat right up to the cutting edge. Really annoying!⁸⁸

Cheap plane blades that were ground on a contact grinding machine⁸⁹ belong in a chamber of horrors. This may result in a wonderfully uniform grinding pattern – but with blatantly sloping edges. Flattening such blades by hand is nearly impossible. Anyone manufacturing and marketing such a product is clueless or malicious, perhaps even both.

Perfect: lapped backs!

Let's stop all this complaining and turn to something positive for a change: flat-lapping is an ideal process for fine finishing thin, hardened workpieces and for flattening them precisely and reliably. Held down only by a weight (not fixed by clamping), the parts float in a spiral pattern over a large, slowly rotating cast iron plate. A lapping fluid (oil with abrasives) is added. What you get are high-precision flat surfaces, ie, without appreciable flatness deviation and without sloping edges. Lapped surfaces can be recognized by the fact that they are matt (**Fig. 60** left) without the typical structure of parallel score marks caused by grinding. The only manufacturer (to my knowledge) who laps the backs of his blades is Veritas in Canada. I take this opportunity to express my respect and admiration for this.



Fig. 60: An outstanding job! Lapped spokeshave blades

(Veritas, brand new)

left: back, lapped

right: reverse side, ground on a surface grinding machine with a cup wheel.

A back of this kind needs no reworking. Of course, when you sharpen the blade you will have to hone the back or the back bevel, as on any other plane blade.

8.18 Can the back of a chisel blade stay permanently flat?

I described in **Chap. 3.4.4** that the backs of my chisel blades gradually lose their flatness and the blade its good sharpenability through repeated honing and then have to be refinished on a whetstone. This happens despite my best efforts to keep the honing stone flat!

How is it possible that a back that is honed on a flat whetstone does not stay flat? For a better understanding consider first of all how the honing⁹⁰ of flat-ground surfaces works:

The workpiece (here the blade with back that needs to be flattened) is moved to and fro on the tool (here the honing stone) while pressure is applied. It is guided only by the surface of the stone and is free to find its own way. This is described in **Chap. 6.3** for the dressing of whetstones on a clinker in **Fig. 50**, and basically the same applies when a back is honed on a whetstone.

⁸⁸ Just imagine: here a (cost-intensive) process, viz. polishing, is performed that clearly impairs the quality of use of the tool! What about asking those responsible to sharpen the tools manufactured this way with their own hands?

⁸⁹ This is a grinding machine that instead of a grinding disk has an elastic roller over which a grinding belt runs. Contact grinding machines create an optically perfect grinding pattern, eg, on decorative elements made of rustproof steel, and even if the workpiece has geometric irregularities – the soft roller adapts to changing shapes. A crooked surface reground on such a machine stays crooked. A flat surface becomes crooked.

⁹⁰ Honing is similar to lapping, but with bonded grit; the tool is thus a grinding stone.

Several conditions must be met for a precise flat surface to be produced on the workpiece:

- The stone must be flat.
- No part of the workpiece protruding above the surface that is to be honed flat must come into contact with the honing stone, because otherwise the unconstrained surface contact would literally be overturned.
- **The workpiece (lying on top) must be able to overhang the tool at times all around** and it follows that the tool must be able to protrude in any direction at all times. This means the flat surface on the workpiece must have an edge all around and the workpiece must be able to move in correspondingly long strokes.

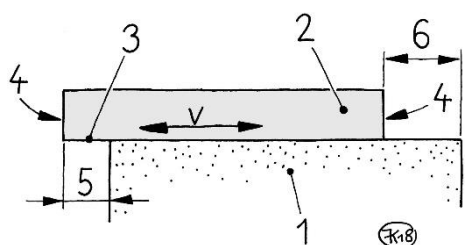


Fig. 61: Overhang/protrusion while flat-honing

- 1: tool (whetstone)
- 2: workpiece
- 3: flat surface (to be honed flat) on workpiece
- 4: workpiece edges
- 5: overhang
- 6: protrusion
- v: honing movement (only hinted at here; in fact, the movement sweeps across the whole surface!)

Ordinary chisel blades are relatively long, this helps you to work accurately and may also assist freehand sharpening⁹¹. European chisel blades are long, relatively thin and slightly wedge-shaped. The mostly round neck is short:



Fig. 62: European-style chisel

- 1: blade
- 2: neck
- 3: back

This is the familiar blade design, it certainly suits me.

What is problematic regarding the sharpenability is the layout of the back. This is simply a flat surface starting at the cutting edge and ending at a step, mostly at the point where the blade changes to a neck. A long back is not necessary for the blade to fulfil its function (just look at how the Japanese do it). Honing the full extent of the back would thus be laborious and in any case not possible because of the step⁹². What is missing in this case is an edge that denotes the end of the surface to be honed, there is no way you can achieve the overhang/protrusion required for precise honing.

In practical terms this is what happens: sometimes you hone a bit further along the blade and sometimes not quite far enough – not a method that you would expect to deliver a really precise result.

One solution: undercutting by regrinding

Undercutting means: the surface to be honed is shortened to the necessary length; it is further provided with a defined edge and you also have to make sure that in its vicinity there is nothing that projects above it. The practical implementation is that the rear zone of the back of the chisel blade is ground down by a few tenths of a millimetre.

⁹¹ I've already voiced my restrained reservations about stubby blades in **Chap. 2.4.1...**

⁹² You cannot hone flat a surface that ends against a step because the step inhibits the honing movement.

The outline is now such that a collision-free projection of a flat honing stone beyond the rear edge of the flat back of at least about 20 mm is possible:

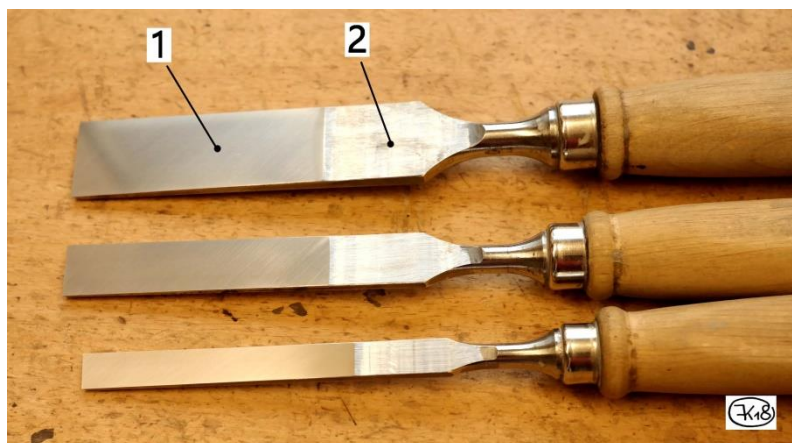
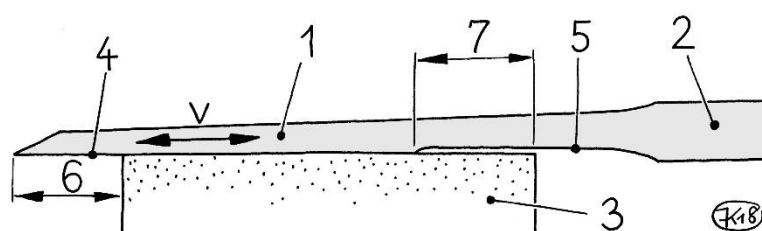


Fig. 63: Chisel blades with undercut back

above: reground standard blades

1: flat area, honed

2: undercut area



below: blade with undercut back on a honing stone

1: blade

2: neck

3: honing stone

4: flat area

5: undercut area

6: overhang

7: projection

v: honing movement

Result:

The undercut backs of these blades (they are the same whose changed shape I detected using a straightedge) were ground flat and honed. Ever since they have been remarkably easy to sharpen. The grinding pattern of the back is wonderfully uniform, it looks nearly as if it's been lapped (once you ignore the inevitable slight scratches). When honing the back, material is removed immediately at the front cutting edge. There is no reason why the flatness should deteriorate over time as it did previously. Perfect! I really like the blades this way, just beautiful tools for light, precise workmanship.

After this more than positive result, I modified all my chisels and firmer chisels (except mortise chisels) this way and I would recommend it to all who use chisel blades for precision work and who are accustomed to sharpen them to high standard. You can of course tune your blades privately in any way you like, the commercial exploitation of this idea is however not generally permissible⁹³.

9 The finishing touch

My thanks to everyone who has arrived with me at this end point, be it through chance, after some cursory browsing or after an in-depth study of this guide. I deeply appreciate the attention that you have paid to my efforts.

With the publication of this sharpening guide I hope to make a small contribution to the greater idea that hand tools will again experience the appreciation and wider use that they deserve.

I wish all my readers success and pleasure when using their tools – and when sharpening them, because that's a part of it.

Friedrich Kollenrott

⁹³ German Utility Model 20 2018 001 428