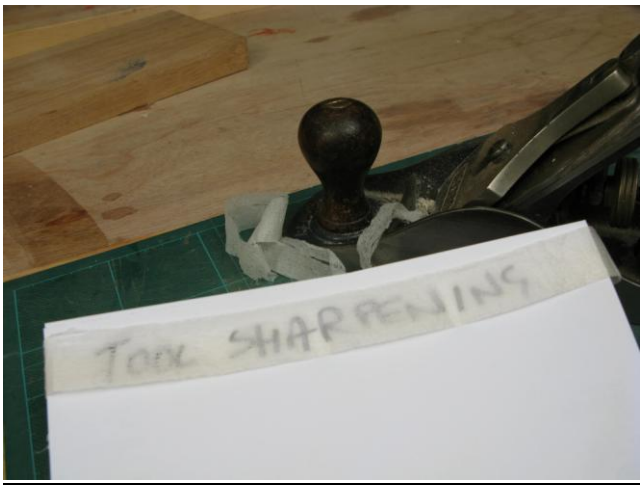
Tool Sharpening



Objectives

By the end of this session you will:

- Understand the importance of maintaining sharp tools
- Be able to tell when a tool needs sharpening
- Have experienced various grinding and honing media and understand their pros and cons
- Be able to regrind an edge using various grinding media
- Be able to hone an edge using various honing media and understand when to hone and when to grind

Introduction

Sharp tools are the very basis of fine furniture making, they allow greater control and finesse, they are less tiring to use and are also safer. In this handout we will cover the sharpening of edge tools, by which I mean those tools where a single edge is used for cutting ie planes, chisels and cabinet scrapers. We will not be dealing with saws.

The process of sharpening creates two flat mirror like surfaces that intersect at the optimum cutting angle with minimal rounding or distortion at the point. Any scratches in the surfaces are manifested as imperfections in the cutting edge.

How do I know when a tool needs sharpening

If a task you are performing seems to be hard work, you are having to push harder or the blade is not responding as you would hope, perhaps you are experiencing tear out when planing, there is a good

chance the tool needs sharpening. Look at the edge, are there minute indentations in it? Can you see light reflecting off the cutting edge? Lightly touch the edge with your finger (carefully!), with experience you will be able to feel the "bite" from a sharp edge and the blandness of a blunt edge.

It is not possible to specify how often a tool will require sharpening in a particular task as it depends on a number of factors such as the species of timber being worked and the quality of steel in the blade. Instead one should try to be sympathetic to the performance of ones tools and sharpen as often as they need it.

Grinding and Honing

The edge tools that I use are sharpened with two bevels. The primary bevel is created on a grinding wheel at 25 degrees, the secondary bevel is honed on a stone at 30 degrees. The primary bevel is renewed only occasionally while the secondary is attended to regularly.

Honing is a fairly slow way of removing metal to create an edge, but it gives a very fine edge. Grinding can remove metal quickly but the edge is not so good. So we grind at a slightly shallower angle creating a bevel the full thickness of the blade then hone at the optimum cutting angle, giving a narrow bevel that can be repeatedly renewed with less effort. The increased honing angle also means that the edge is better supported so it will remain sharp longer.

A tool should only be reground if the edge becomes damaged eg after hitting a nail, or when the secondary bevel has become so large or rounded that it is becoming difficult to hone.

A note on grit sizes

I will be talking a lot about abrasives, abrasives are usually graded by grit size which is defined by the number of holes per inch in a screen through which the abrasive can pass. So the greater the grit number the finer the abrasive. For fine polishing of edges and lapping, pastes and powders can be used, for these particle size is defined in microns, as an example 320 grit is 36.0 microns and 1200 grit is 6.5 microns.

Grinding

Grinding is basically the sharpening of an edge tool using a rotating abrasive wheel. There are a number of options available with their own pros and cons and cost implications.

Dry grinders

The best wheel for dry grinding before honing is 150mm 60 grit aluminium oxide (white), also useful is 120 grit which is finer, good for tools that are used straight from the wheel eg turning gouges. Powered dry grinders run at about 2900 rpm, so there is a danger of burning the metal, white wheels are relatively friable so they do not heat up the tool as much as other wheels

Another problem with dry grinders is that the tool rests are usually completely inadequate. I would recommend either purchasing a proprietary auxillary tool rest or making a simple one yourself. I would suggest a simple steel bar clamped in front of the wheels and register marks alongside the wheel to aid positioning of the tool (see picture). To establish the position of these marks offer up an already sharpened tool until the bevel rests correctly on the wheel and mark off the position on the register "plate". These marks may need to be renewed over a period as the wheel wears, but this is a slow process.

Occasionally the wheel may require dressing to flatten the edge and also break up any glazing. This is best achieved using a diamond dresser.

When sharpening offer the tool to the wheel in the correct position and move it slowly from side to side, do not use undue pressure. Have a pot of water available and dowse the tool in it regularly, larger tools require dousing less often than smaller as the larger mass of steel conducts the heat away. As the bevel is ground to its final point the tool will need dousing more often again because the heat is not conducted away so quickly. Towards the end of sharpening you may have to douse every 3 or 4 seconds.

Removing the tool and replacing it back on the rest in the same position can be aided by using the index finger as a stop against the tool rest, see picture (note water container ready for dousing).

NOTE: Eye protection should be worn at all times when using the dry grinder.

Whetstone grinder

The whetstone usually consists of a wide aluminium oxide wheel running at slow speed (around 90 rpm) in a water bath, thus preventing the burning of the tool. Usually the grinder is part of a sharpening system so it comes with good tool holding facilities, however they are usually quite expensive.

These grinders usually come with a full set of instructions on using the system, so I will not go into a detailed explanation here. In these systems the grinding angle can usually be set either by raising or lowering the tool rest or by adjusting the position of the blade in the jig. I have found that the latter option is preferable. By dressing the stone with a diamond dresser the edge can be made parallel with the tool bar, moving the tool bar may cause inaccurate realignment.

Do not let the wheel stand in the water reservoir when not in use as this may case it to swell and lead to uneven rotation.

Whichever system you use the important thing is to ensure that the tool can easily be offered up to the wheel at the correct angle.

Honing Media

Oil stones

In this country until about twenty years ago honing was usually done on some form of oil stone, be it carborundum or the legendary Arkansas or Washita stones. Unfortunately using the oil stone is also the most efficient procedure ever developed for transferring oil to a wood surface! This was one of the reasons for the move to water stones.

Water stones

The pro's and con's of water stones:

- They cut quickly
- They produce a good edge
- They wear easily so they need regular flattening

- The courser ones should be stored in water and kept wet in use, so they can be messy

Water stone's fast cut is achieved by the surface constantly being eroded away to expose new abrasive particles this is why they require flattening regularly.

Japanese stones can be either natural stone, or manmade abrasive particles in a bonding medium. I have experience of King and Ice Bear, both of which are good stones.

Norton water stones are fast cutting and also do not wear as fast as the Japanese stones, however they are more expensive.

My honing setup currently uses a Norton combination 220/1,000 a Norton 4,000 and a 10,000 Japanese stone. However this has developed by accidental evolution. An equally good setup would be any combination of 1,000 4,000 and 8,000 grits. I think the 10,000 may be a bit over the top!

Flattening water stones: this is achieved by rubbing the stone on a piece of 150 grit wet and dry paper on a piece of float glass. Lubricate the wet and dry with water. Obviously the stone can only be as flat as the surface it is rubbed against so check for contamination between the wet and dry and the glass. Some suggest just using surface tension to hold the paper to the glass, I find it better to stick the paper down using spray mount. An alternative method is to rub the stone on a course diamond stone (having checked the diamond stone for flatness).

It is worth getting into a routine to keep your stones flat. A quick rub on the flattening plate at the beginning of a sharpening session should maintain flatness. Flatness should be checked using a good straight edge.

<u>The scary sharp system</u>

I have not used this system regularly, but I can see it's advantages:

- There is little cost in the short term

- You don't have to worry about flatness
- Its not as messy as oil stones and water stones

However

- In the long term it would be more expensive
- It can be a chore changing the w&d when it wears out

The system uses wet and dry paper stuck to a piece of float glass using spray mount adhesive, check for contamination before sticking down. The glass ensures a perfectly flat surface, moving up the grits gives finer finishes. Grits 220,600,1000 and 2000 should be adequate. A final polished edge can be achieved using a polishing paste such as Autosol on a piece of MDF.

When the abrasive is worn out pull it off the glass, clean the glass with white spirit and stick a new piece on.

Diamond Stones

- They do not need flattening
- They cut quickly
- They can be used to sharpen hard materials such as tungsten carbide tips
- The edge can be uneven on the courser stones
- They are not cheap, but they last
- They do not go as fine as other stones, requiring the use of abrasive pastes

Diamond stones consist of carefully graded diamond particles bonded to a steel substrate. They can be lubricated with water or oil, many people use WD 40 as this prevents rusting.

Honing methods

Whatever honing media you use the procedure for honing can be the same. It will also be the same whether you are honing a plane blade or chisel (with a couple of exceptions). The object of honing is to intersect two flat surfaces at the optimum angle with as little rounding or interference to the intersection as possible. The choice is whether to use a honing jig or not?

Freehand honing

Freehand honing is the most efficient way to sharpen as there is no fiddling about setting up a jig, one could sharpen a plane blade in a minute (the more time spent sharpening – the less spent making!). However it does take some mastering.

1. Start with the course media, if it's water stones check for flatness. Apply the required lubricant for your chosen media.
2. Holding the blade between thumb and little and ring fingers with the other fingers on top, close to the end of the blade, offer it up to the stone and rock it back and forth until you feel it "sit" on the flat of the ground bevel.
3. Lift the angle of the blade a "smidgin" to establish the secondary bevel angle.

4. With the wrist locked in this position move the blade back and forth on the media, undue downward pressure is not required. Most of the movement should be from a rocking of the body rather than the movement of the arms.
5. Unless the blade is seriously blunt it should not take more than about six strokes to create a burr on the flat side of the blade. This can be felt by rubbing the finger lightly down the flat and off the end of the blade. Check the burr is the full width of the blade.
6. Go to the next grade up of your chosen media. Remove the burr by rubbing flat side down. It is important that the blade is kept perfectly flat on the stone when doing this. Except for a couple of exceptions to be mentioned later!
7. Turn the blade over and repeat 2-6. On the finer media the burr may not be detectable with the finger. We are seeking to polish the edge rather than remove a lot of metal. The result should be a uniform narrow bevel.

When working on the finer water stones and w&d do not press down on the forward stroke, the surfaces are fairly soft, a dig in may result if pressing on the forward stroke.

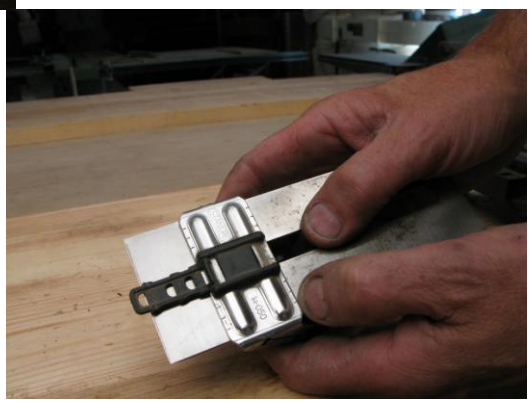
Some plane blades need to be sharpened with a slight curvature to the edge. This can be achieved by applying pressure either side of the blade during honing. At each stage hone as above, then take three or four strokes with pressure applied to one side of the blade then on the other. This is enough to establish a curvature of a few thou.

The exception mentioned above is "the ruler trick" popularised by David Charleworth. He realised that, for the polishing of the back of the plane blade on the finer media, it was not necessary to polish the whole of the flat. Instead he placed a 6" rule on the edge of the stone to slightly prop up the blade so that only the first millimetres or so is polished, thus saving time. The ruler trick should only be used on plane blades, it is important that chisel backs are perfectly flat to the very edge.

The biggest problem with honing freehand is maintaining the correct angle. This only comes with experience. To get a perfect edge right from the start you will need a honing guide.

Honing with a guide

The basic design of honing guides is very similar. A jig for holding the blade in the correct position for the required honing angle, mounted on a wheel that runs on the surface of the stone. Of the honing guides on the market I have experience of three:



- The Stanley honing guide (above). The main problem with this guide is getting the blade square. There is a useful fold down plastic registration tab which indicates the amount of blade projection required for different honing angles, however this only specifies three angles. It is one of the less expensive guides.
- The Eclipse (almost identical model also made by Axminster). The guide clamps to the edges of the blade, thus ensuring that it is held square, honing angle is controlled by measuring the projection from the guide. Only two measurements are specified, the rest you would have to work out for yourself.
- Veritas mk2. This is an all singing all dancing guide, but it's not cheap. Registration is achieved using a registration plate which is clamped to the front of the jig. This has presets for a multitude of different honing angles, many of which I am not sure I will ever use. Of particular use is settings for honing back bevels on plane blades (I will discuss back bevels later).

I will not go into detail about setting up honing guides as you can get this information from the instructions with your guide. A couple of warnings:

- When using guides that clamp from the top or bottom of the blade(Stanley and Veritas) ensure that you tighten the clamping screws evenly, otherwise the blade may be tilted in the jig. If you find the edge is not being honed square check this out.

- When using the Veritas the projection is set by placing the end of the blade up to a metal stop. Be careful not to push up tight to the stop else you may damage the blade edge.

The process of honing with a guide is similar to freehand honing except the blade is mounted in the guide. When pushing the blade back and forth hold the guide low down, this ensures even contact,
see picture

Some writers suggest that it is not possible to create a camber on a blade using a honing guide, particularly those with a wide wheel such as the Veritas. I have found that a slight camber can be achieved by varying the pressure on the corners of the blade in that same way as freehand honing.

<u>Effective pitch and back bevels</u>

Even with a perfectly set up plane with an exquisitely sharp blade you may find that you get tear out on particularly troublesome timbers eg ripples and burrs. The smoothness of cut on these difficult timbers is a product of the pitch of the blade ie the angle of the blade in relation to the timber surface. On a standard bench plane this is controlled by the angle of the frog, normally this is 45 degrees, although planes with a York pitch of 50 degrees are available. Even with a York pitch plane tear out can be a problem. A sneaky solution to this is to put a back bevel on the blade, to hone a very small bevel on the flat side of the blade, thus increasing the effective pitch (EP) of the plane.

The effective pitch is calculated as the angle of the frog plus the angle of the back bevel to the blade back:

Frog angle	45 °
Back bevel, say	10°

Effective pitch	55°

So the effective pitch on a standard plane could be greater than a normally set up York plane (50 degrees). The effective pitch required depends on the timber being planed, 55° to 60° would be good for most difficult timbers but up to 75° or 80° would be needed for real "stinkers"

So honing a back bevel can overcome tear out, but there are disadvantages:

- The greater the effective pitch the harder work it is planing as you need to push the plane harder to cut.
- It is difficult to remove the back bevel, the blade would have to be reground to below the bevel. The alternative is to hold spare blades specially for use on difficult timbers.
- The honing process is made more difficult as, instead of just honing the back flat on the stone you have to hone the back bevel. It is difficult to find the correct angle free hand this is where the Veritas guide comes in useful.

To hone a back bevel hone the blade in the usual way, working your way through the grades, but do not hone the back of the blade. Finally set up the blade in the honing guide. If you are creating the back bevel hone through the grades, just a few stokes on each. If the back bevel is already there just rub off the burr on the finest stone.


On block planes and other tools where the bevel is facing upwards in the plane a back bevel is of no use. The EP is defined as the angle of the blade in the plane plus the honing bevel, so for the 9 ½ block plane:

Blade angle	20°
Honing bevel	30°

Effective pitch	50°

So by increasing the honing angle the effective pitch of such planes can be increased.

Increasing the effective pitch takes the plane closer to a scraping action. Eventually you might as well use a proper scraper. In the next section we will look at sharpening scraper blades.

Finally, a note about positioning the chip breaker. After sharpening reposition the chip breaker so it sits about 1mm or less back from the edge of the blade. It is useful to polish the chip breaker occasionally.

Sharpening scraper blades

The action of a scraper is completely different to a plane. When sharpening a plane blade we are keen to remove the burr to leave a perfect edge. The action of a scraper relies on a well formed burr. The scraper is used with dragging action the edge of the burr cutting the shaving.

In use a scraper should produce fine shavings, if your scraper is making dust it needs sharpening.

Scrapers are of two types; card scrapers and scraper planes. Card scrapers are sharpened differently to scraper planes.

Sharpening a card scraper

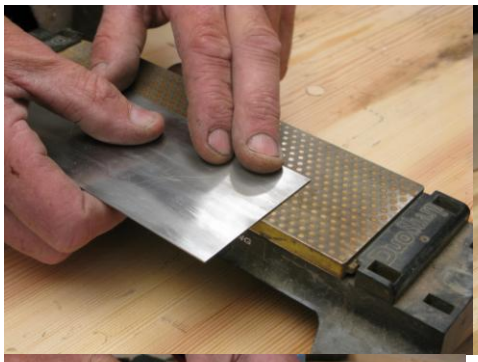
The card scraper in fact has four cutting edges , two on each long side, and would not normally be sharpened until all four are blunt. The procedure is to sharpen a seriously blunt scraper is:

1. Rub the card flat on a stone (about 4000 grit) to remove the previous burr.
2. With the scraper fixed in the vice carefully file away the edge using a mill file. Hold the file at an oblique angle to the edge but square to the face of the scraper and file along the line of the edge. You are aiming to remove any rounding created by forming the previous burr and also to create an edge square to both faces. You will know you are almost there when you can again feel a burr all along the edge on both sides.
3. Hone the edge , preferably on medium and fine diamond stones as softer stones may become grooved. The intention is to remove all the minute grooves created by the filing. The action is to hold the card vertical to the stone with the long edge in line with the long axis of the stone. When the edge is smooth, flip the card on its side and remove any burr created (picture 4).
4. With the card laid flat on the edge of the bench run the burnisher flat on the face, this is to work harden the square edge of the scraper and should be repeated on all four edges.
5. Finally the tricky bit. Place the scraper vertically in the vice and holding the burnisher about 5 degrees down from

horizontal draw it along the edge with a slight sideways dragging motion. Some downward pressure is required but not excessive. Repeat this about three times, increasing the angle slightly each time. You should now be able to feel a burr on the edge. Repeat on the other three edges.

Before using the burnisher check for any dirt or blemishes on it, rub with fine emery cloth or wet and dry if necessary. I usually lubricate it with a little water (spit!)

1.



2.

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3.

4.

5.

5.

The whole aim of the procedure before using the burnisher is to create a scratch free edge and surface so that the eventual burr is uniform. Any imperfections in the surfaces will show in the burr and be evident as slight ridges in the scraped wood surface.

It is possible to resharpen a scraper a number of times without having to file the edges. Simply flatten the burr as in step 5 and recreate it using step 6. Some people say that a second sharpening burr is better than the first.

Sharpening a scraper plane

The blades in scraper planes do not have square edges as card scrapers but are sharpened with a bevel varying from 45° to 25°. Scraper planes such a the Stanley no. 80 have thin mild steel blades while others , like the Lie Neilsen series, have thick hardened steel blades. I will deal here with the former.

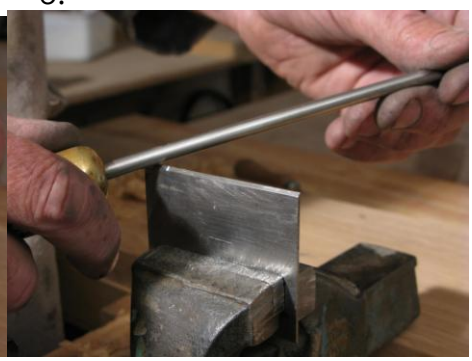
Each blade will have two edges to sharpen:

1. Flatten the burr by rubbing on a stone.
2. With the blade vertical in the vice file the bevel to remove any rounding, as in step one previously but at the bevel angle.
3. Hone the bevel to remove any filing marks. I have previously done this free hand, but I now understand the Veritas guide can cope with this blade. The bevel can vary from 45° to 25°, I use 45 degrees.
4. Hone the flat to remove the burr.
5. With the blade vertical in the vice run the burnisher over the edge at about 60 degrees to the face with a slight sideways dragging motion away from the bevel. Repeat this about three times increasing the angle slightly each time

2. 3. 4.

5.

5.



To refit the blade, slacken the clamping screws. Place the sole on a flat surface and insert the blade, bevel side up. With the blade resting on the flat surface tighten the clamping screws progressively so that pressure is even across the blade. Adjust the cut by tightening the adjusting screw to flex the blade.

Conclusion

This covers most of the sharpening processes for edge tools. I will repeat the main sharpening considerations:

- A sharp tool is more efficient, safer and gives a better finish. It should be a pleasure to use.
- Your intent in sharpening is to create as near perfect polished flat surfaces that intersect at an edge with no imperfections.
- Grinding is an efficient way of creating a new bevel but cannot provide a perfect edge.
- The tool can only be as flat as the stone it is honed on so a flat honing medium is the basis of sharp tools.