



ALL ABOUT HAND TOOLS

From the editors of *Popular Woodworking*
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Choosing Handplanes

Match the size to the job—that's the key.

BY TOM CASPAR



Handplanes come in a bewildering variety of sizes. Why are there so many? I'll help explain this mystery by dividing the field into four groups, in order of size: block planes, smoothing planes, jack planes, and leveling planes. I'll show you what the planes in each group are used for, and recommend two different starter sets.

Each group best serves a particular purpose. Smoothing planes, for example, are specifically designed to make wood as smooth as silk, ready for a finish. In general, length is the key to understanding a group. Picking a plane at random, you could use it for most any task, but pick a plane that's the correct length and you'll get the job done much faster, with better results.

BLOCK PLANES

Block planes are often associated with carpenters and do-it-yourselfers because they're inexpensive and small enough to fit in a toolbox or toolbelt. They have important roles in the woodshop, too. A high-quality block plane can do amazing work, and may become one of your favorite tools.

Types. Standard-angle block planes are the most common. Their blades are bedded at about 20°, with the bevel facing up. If the blade is sharpened at 25°, its effective cutting angle is 45°, which is similar to larger planes. In a low-angle block plane, the blade is bedded at about 12°, resulting in a much lower cutting angle. Pocket-sized planes have a standard bedding angle; what distinguishes these planes is their ultra-small size and light weight.

Uses. Block planes are well-suited for planing end grain or for fitting drawers and doors, where part of the assembly is end grain. Planing end grain requires more force than planing face grain and



STANDARD ANGLE

LOW ANGLE

POCKET-SIZE

puts more stress on the blade. Block plane blades chatter less because their bevels face up, not down, as is the case with most larger planes. Bevel up, the blade's tip has additional support from the plane's body. Planing end grain using a low-angle block plane requires less force than using a standard-angle block plane.

Block planes have more uses beyond planing end grain, though. They're very comfortable to hold in one hand for shaping parts and chamfering edges. A pocket plane is easy to carry around in your apron.



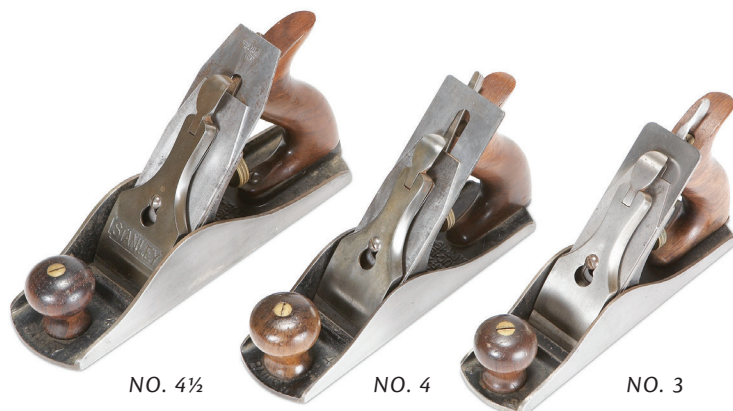
Block planes are designed for cutting end grain, such as the stile of this door-frame. Their compact size also makes them perfect for planing with one hand.

SMOOTHING PLANES

A smoothing plane is a serious hand-tool user's best friend. Set to cut a tissue-thin shaving, it can make a board feel smooth as silk. The wood's grain will pop in a way that you can't achieve through sanding alone.

Types. The No. 4 size is the type most commonly used, although the larger No. 4½ is gaining in popularity. The 4½ is heavier than the 4, and that added mass makes it easier to maintain momentum while planing difficult woods. A No. 4 blade is 2" wide, while a No. 4½ blade is 2 ¾" wide. A No. 3 smoothing plane is lighter and narrower than a No. 4. It's perfect for a user with less muscle power because its shavings are narrower. The blade of a No. 3 is 1¾" wide.

Uses. Smoothing planes prepare boards for finishing. Their relatively short length makes them ideal for planing a wide board or a glued-up top because they can follow slight irregularities in a board's surface



and still make a long, continuous thin shaving, the gold standard in smoothing work. Longer planes require a board to be flatter in order to make continuous shavings (flatter than need be, quite often), so these planes are less practical to use in preparing wood for finishing. Fine-tuning a smoothing plane can really pay off: on many woods, you can make a surface so smooth that little or no scraping or sanding is required.

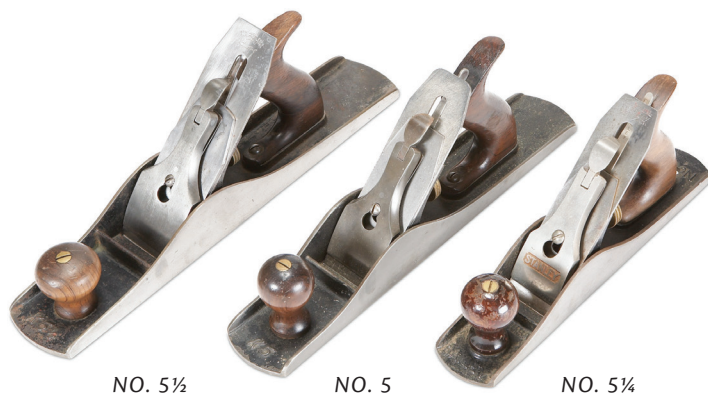


Smoothing planes take the place of power sanders. They're used for making a surface ultra-smooth and ready for finishing.

JACK PLANES

"He's a jack-of-all-trades, but master of none." That expression perfectly describes a jack plane, and helps explain the origin of its name. A jack plane is longer than a smoothing plane, so it's not as efficient in smoothing a large top because it takes more strokes to cut down to the low spots. It's shorter than a leveling plane, so it's more difficult to use in making an edge straight or truing a large surface. But it can smooth or level reasonably well.

Types. The classic jack plane is a No. 5. Its blade is 2" wide, the same as a No. 4, but its body is about 5" longer. A No. 5½ is longer, wider, and heavier than a No. 5. Like a No. 4½, this additional mass makes it easier to plane difficult woods. The No. 5¼ is shorter, narrower and lighter than a No. 5. It was designed for youngsters learning to work wood in shop classes, and is often referred to as a manual-training



plane or a junior jack.

Uses. You can smooth or level with a jack plane—it just takes a bit longer than using a more specialized smoothing or leveling plane. If you sharpen a jack plane's blade with a pronounced curve, this tool is perfect for hogging off a lot of wood fast, in any situation. A jack plane is also useful for evening joints, such as a table leg and rail, because this operation combines both leveling and smoothing.



Jack planes can both level and smooth a surface. They're useful for evening up one piece with another, such as this bread-board end on a tabletop.



LEVELING PLANES

Leveling planes are long, wide, and heavy. They have two specific purposes: straightening edges and flattening large surfaces. Accuracy is the goal in both situations, and that requires a plane with a long, flat sole.

Types. The leveling plane most often used these days is the No. 7, more commonly known as a jointer plane. As its name implies, a jointer is best suited for straightening edges prior to joining them together. A No. 6 plane is the same width as a No. 7, but about 4" shorter. The No. 6 is best suited for leveling the majority of a large surface (such as breadboard ends). It's commonly known as a fore plane (because it's used before a smoothing plane, which finishes the job) or a trying plane (because it makes a surface true and flat). A No. 8 plane is a behemoth: it's longer, wider, and heavier than a No. 7.

Uses. One plane, either a No. 6 or a No.



7, can be used for jointing and truing, although having both is ideal. If you have only one, it is best to have two blades. Jointing requires a blade that is sharpened dead straight across; truing is most efficiently done with a blade that's sharpened with a slight curve. A No. 8 is so large that it can be a bit unwieldy, but it's the perfect plane for jointing a long, wide edge, and useful for big jobs such as fitting an entryway door.



Leveling planes are used to make edges straight, such as these two boards, which'll be glued together. Leveling planes are also used to make large surfaces flat and true.

STARTER-SET RECOMMENDATIONS



BASIC TWO-PLANE SET

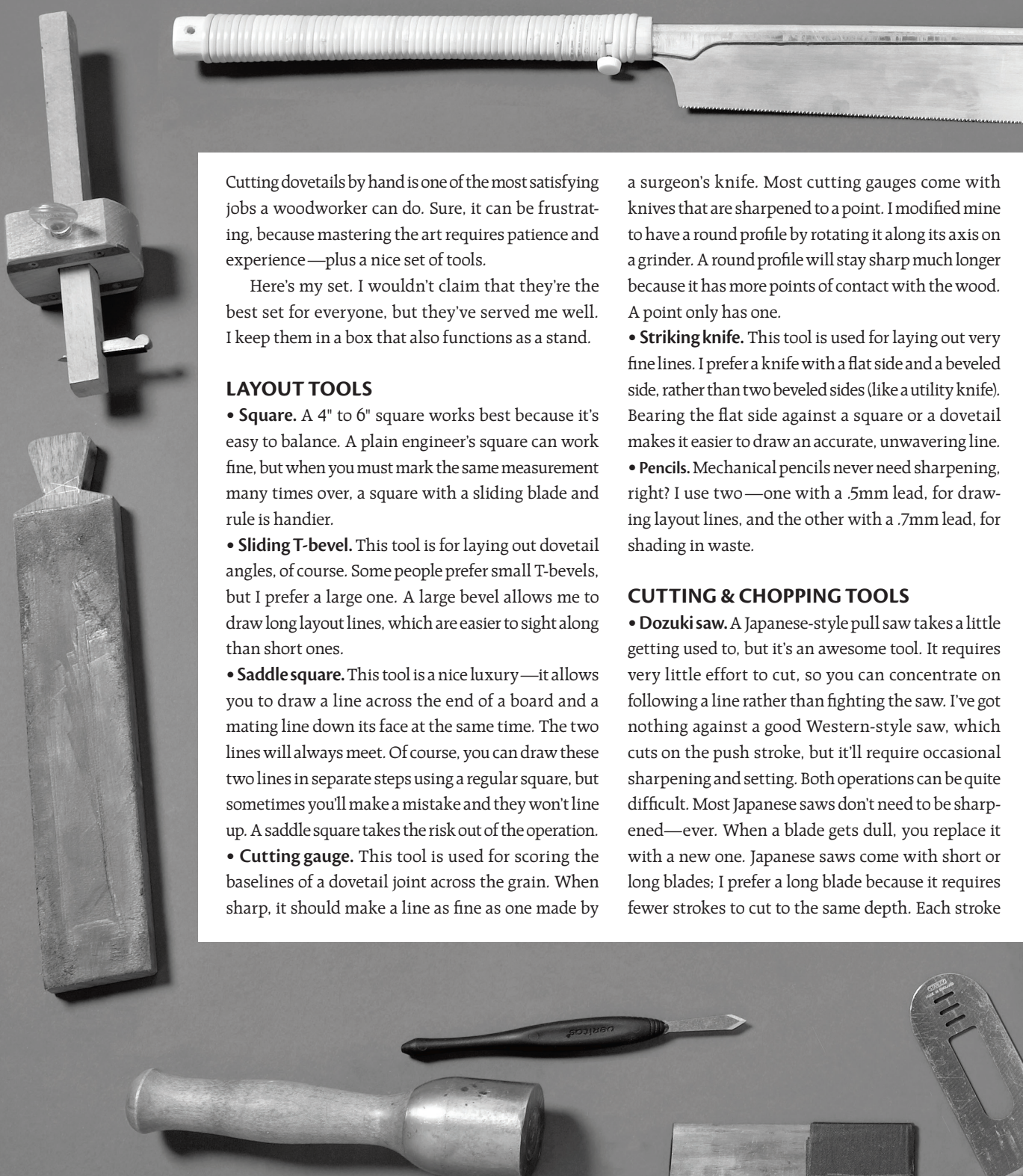
A No. 5 jack plane and a standard-angle block plane will serve you well in most situations. You'll find dozens of uses for the block plane, taking off a little bit here or there on your projects. With the jack, you can do everything a smaller or larger plane can do, such as straightening an edge, smoothing a surface, or evening up a joint. The job will just take a bit longer.



ADVANCED THREE-PLANE SET

This is a good starter set for a woodworker who wants to enjoy what handplanes can do. Each plane has a specialized purpose. The low angle block plane excels at cutting end grain; the leveling plane (which can be either a No. 6 or a No. 7) joints edges and flattens a large surface; the smoothing plane (either a No. 4 or a No. 4½) can make wood look so good that it hardly needs a finish.

Tools for Dovetailing



Cutting dovetails by hand is one of the most satisfying jobs a woodworker can do. Sure, it can be frustrating, because mastering the art requires patience and experience—plus a nice set of tools.

Here's my set. I wouldn't claim that they're the best set for everyone, but they've served me well. I keep them in a box that also functions as a stand.

LAYOUT TOOLS

- **Square.** A 4" to 6" square works best because it's easy to balance. A plain engineer's square can work fine, but when you must mark the same measurement many times over, a square with a sliding blade and rule is handier.
- **Sliding T-bevel.** This tool is for laying out dovetail angles, of course. Some people prefer small T-bevels, but I prefer a large one. A large bevel allows me to draw long layout lines, which are easier to sight along than short ones.
- **Saddle square.** This tool is a nice luxury—it allows you to draw a line across the end of a board and a mating line down its face at the same time. The two lines will always meet. Of course, you can draw these two lines in separate steps using a regular square, but sometimes you'll make a mistake and they won't line up. A saddle square takes the risk out of the operation.
- **Cutting gauge.** This tool is used for scoring the baselines of a dovetail joint across the grain. When sharp, it should make a line as fine as one made by

a surgeon's knife. Most cutting gauges come with knives that are sharpened to a point. I modified mine to have a round profile by rotating it along its axis on a grinder. A round profile will stay sharp much longer because it has more points of contact with the wood. A point only has one.

- **Striking knife.** This tool is used for laying out very fine lines. I prefer a knife with a flat side and a beveled side, rather than two beveled sides (like a utility knife). Bearing the flat side against a square or a dovetail makes it easier to draw an accurate, unwavering line.
- **Pencils.** Mechanical pencils never need sharpening, right? I use two—one with a .5mm lead, for drawing layout lines, and the other with a .7mm lead, for shading in waste.

CUTTING & CHOPPING TOOLS

- **Dozuki saw.** A Japanese-style pull saw takes a little getting used to, but it's an awesome tool. It requires very little effort to cut, so you can concentrate on following a line rather than fighting the saw. I've got nothing against a good Western-style saw, which cuts on the push stroke, but it'll require occasional sharpening and setting. Both operations can be quite difficult. Most Japanese saws don't need to be sharpened—ever. When a blade gets dull, you replace it with a new one. Japanese saws come with short or long blades; I prefer a long blade because it requires fewer strokes to cut to the same depth. Each stroke



Pointers on choosing, modifying and using my favorite set of tools.

BY TOM CASPAR

introduces the possibility of error, so the fewer strokes you make, the straighter your cut will be.

- **Copingsaw.** This saw is used to remove the bulk of the waste from a joint before the remainder is chopped away. A fancy model certainly isn't necessary, but you should use a high-quality blade with the appropriate number of teeth for the work at hand. I prefer a blade with 15 teeth per inch—not too fine, but not too aggressive, either.

- **Chisels.** I use two sets of chisels. One set has square sides, while the other has sides that taper to a sharp point. I use the first set for paring and hone them at 25°. (A low angle makes a chisel easier to push.) I use the second set for chopping and hone them at 30°. (The steeper the angle, the longer an edge will last.) The tapered edges of the second set allow me to get into angled corners, so I rarely have to use a skew chisel to clean out a dovetail. The tapers are angled at 12° and run back about ¾". I created the tapers by using a grinder.

- **Mallet.** I prefer a round mallet to one with a square head. Both will work fine, of course, but you have to pay more attention to how you hold a square mallet to avoid a glancing blow. A round mallet is more forgiving. I like a mallet with some heft—about 16 to 20 oz. The extra weight means you don't have to strike a chisel with so much force. Just dropping a heavier mallet on a chisel often does the job.

- **Strop.** Stropping a chisel renews its edge in just a

few seconds. Stropping is easiest when a chisel's edge is hollow-ground; you just balance the edge on heel and toe and go for it. I hone my dovetail chisels the same way, without a jig, to make them easier to strop.

- **Thin blades.** I use these blades for paring the sides of skinny sockets. One of the blades is just a block-plane iron; I made the other from a broken-off power hacksaw blade, wrapping tape around one end to make it more comfortable to hold.

- **Shims.** These are the set of playing cards below, in case you were wondering. Years ago, while in business, I made dovetails by the artisan's quick method of sawing and chopping to a line. These days, I slow down. I saw and chop away from a line, then pare to a line using a guide block and shims. The block is clamped right on the line. I place a few shims against the block and remove one after each shaving. My rule of thumb: the thinner the shaving, the more accurate the paring.

SOURCES

Lee Valley, leevalley.com 800-871-8158

Veritas Workshop Striking Knife, #05D20.05, \$10.95

Veritas Saddle Square, #05N56.01, \$14.50

Japanese Standard Dozuki Saw, #60T03.01, \$52.50

Veritas Journeyman's Brass Mallet (not pictured), #05E14.01, \$32.50

Calvo, Davidcalvo.com, 978-283-0231 1.5 lb. Bronze Wood Carver's Mallet (pictured), \$70.



Chipbreaker Theory & Use

BY KEES VAN
DER HEIDEN AND
WILBUR PAN

Most bench planes come equipped to eliminate tear-out.



Handplanes are great tools for creating a smooth, finish-ready surface on a board without the dust and noise from a sander. If the board is straight grained and the blade is sharp, it is easy to use a plane. But if the board has some figure, such as that commonly found in curly maple, figured cherry or knotty pine, there is a risk of tear-out.

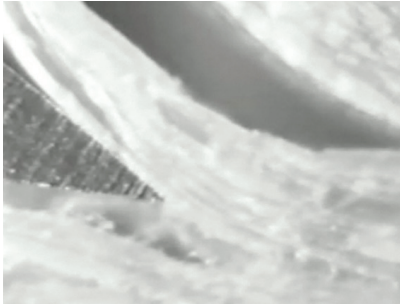
There are many strategies that can be used to reduce or eliminate handplane tear-out on tricky surfaces. A tighter mouth, a higher bed angle or, if you're using a bevel-up plane, a steep secondary bevel, are all ways one can attack the problem. But there is a device that comes standard on many bench planes that is equally effective: the chipbreaker.

The ability of the chipbreaker to reduce tear-out can be seen in the photo at left. The cherry board shown was deliberately planed against the grain with a Stanley No. 4, using a stock blade and chipbreaker.

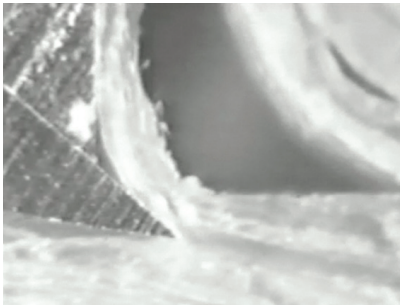
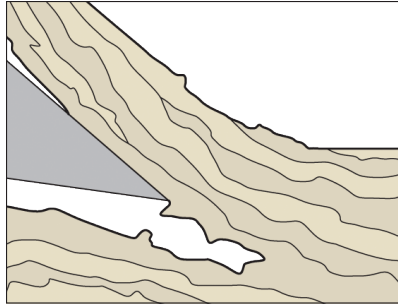
On the near side in the picture, tear-out can be seen, which is expected. On the far side of the board, tear-out is nearly nonexistent. The same plane and blade were used to produce both surfaces. The only difference is that the chipbreaker was set up properly when planing the far side.

CHIPBREAKER THEORY

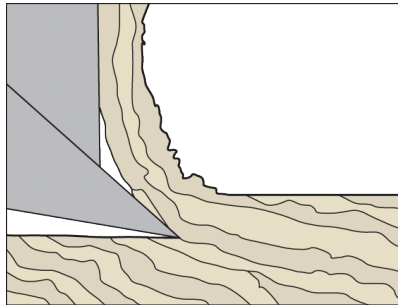
If a board is straight grained, planing is easy when you're going with the grain. But nearly all boards have areas where the grain reverses, so you're forced to plane against the grain. If the board is figured, the grain can switch back and forth over a short distance. In spots where the plane



Blow out. A still from the video by Yasunori Kawai and Chutaro Kato shows the mechanism of tear-out when planing against the grain. As the shaving comes up over the blade it levers up the fibers ahead of the cutting edge, which results in tear-out.



The bends. As the shaving comes up over the blade, it runs into the chipbreaker and bends over. The shaving loses structural integrity and cannot lever out wood ahead of the cutting edge, reducing tear-out. Here the chipbreaker is 0.02 mm ($1/128"$) from the cutting edge.



Tight is right. The chipbreaker needs to mate flat to the back of the plane blade in order for it to work. Otherwise, shavings lodge in the gap and interfere with the plane's function. An excellent way to check the fit is to hold the chipbreaker and the blade up to a light source.



is cutting against the grain, instead of cutting fibers, the blade acts as a wedge that splits them. Eventually these fibers will break and a small divot of wood comes off, which leaves an uneven surface that we know as tear-out.

In this situation, if there's a way to alter or break the fibers so there's no leverage to cause the divot of wood, tear-out can be reduced. Chipbreakers work by making the shaving deflect so the fibers in the shaving lose their integrity, either by bending or breaking. Therefore, the shaving loses the ability to pry the divot out of the board ahead of the plane blade, which reduces the tear-out.

CHIPBREAKER HISTORY

The oldest written evidence we found of a chipbreaker is from a 1767 advertisement by Philadelphia planemaker Samuel Caruthers. He describes the availability of "double-ironed planes, of a late construction, far exceeding any tooth planes or uprights whatsoever, for cross-grained or curled stuff." Those chipbreakers were probably imported from England, and were likely in use before this first written record.

Other references to and explanations of how the chipbreaker works have appeared in books and articles over time. But it wasn't until professors Yasunori Kawai and Chutaro Kato, at Yamagata University

in Japan, made a video that showed a chipbreaker in action on a microscopic level that we could see the exact mechanism of how it works to prevent tear-out.

In the video (available at vimeo.com/158558759), a sharpened plane blade with a microadjustable chipbreaker was filmed planing a board against the grain to see what factors impacted the performance. Kawai and Kato were able to show that the face of the chipbreaker did indeed bend the shaving over as the plane was advanced on the wood. The effect was greater the closer the chipbreaker was to the edge of the plane blade — distances on the order of 0.1-0.3 mm (about $1/128"$). In addition, the angle of the face of the chipbreaker changed the optimal distance that the chipbreaker needed to be from the edge of the blade. It appears that the bending of the shaving causes the shaving to be unable to lever out wood fibers ahead of the cutting edge, thus reducing tear-out.

CHIPBREAKER SETUP

Setting up a chipbreaker is a fairly straightforward procedure. The first step is to flatten the back of the plane blade and sharpen the blade as much as possible with your favorite sharpening regimen.

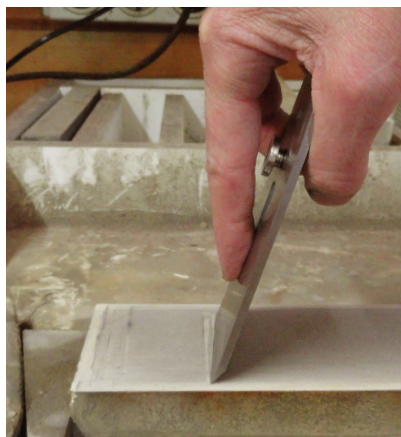
Next, the chipbreaker should be adjusted so it mates tightly to the back of the blade. (If there's a gap between the edge of the chipbreaker and the back of the blade, shavings will find their way under it and clog the mouth.) If the chipbreaker and plane blade are pressed together and held up to a light, no light should be visible between the two components.

If there's a gap, it's often because the edge of the chipbreaker isn't completely flat. If this is the case, flatten the mating surface of the chipbreaker the same way that you would the back of a plane blade. Luckily, the steel in a chipbreaker isn't usually hardened to the same degree as the plane blade, so flattening that surface should be relatively easy.

Finally, if you are using an aftermarket chipbreaker (one that doesn't have a



Get it tight. Flattening the edge of the chipbreaker is straightforward. In this photo, a standard Stanley chipbreaker is being flattened on a waterstone, although any sharpening medium can be used for this task.



Little by little. With an aftermarket chipbreaker, a small secondary bevel — created by holding the chipbreaker at about a 45° angle during the last step in your sharpening regimen — provides the “wall” against which the shaving bends. The angle doesn’t need to be exact and the bevel can be quite small.

hump like the Stanley), a secondary bevel of about 45° should be honed on the leading edge (the exact angle isn’t critical). The curve of the front edge of a stock Stanley chipbreaker provides this angle. This secondary bevel provides the wall that bends the shaving.

Set the chipbreaker on the back of the blade and tighten the chipbreaker screw with finger pressure only. The goal is to place the edge of the chipbreaker as close to the cutting edge of the plane blade as possible, in the range of $\frac{1}{64}$ " or less.

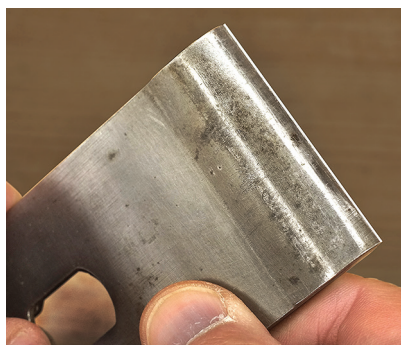
From a practical standpoint, this distance is not easily measurable in the workshop, but it can be achieved. Turn the blade assembly around until it reflects the light. Now push the chipbreaker forward to the edge and see how close it is by watching the reflection of light change in size. This will take some practice. When you’re happy with the result, tighten the screw.

Using the plane also provides feedback on the position of the chipbreaker. If you still get tear-out in reversing grain, the chipbreaker is likely positioned too far from the edge and not doing its job of bending the shaving before it tears the wood.

If the shavings are wrinkled, the chipbreaker might be positioned a little too

close to the edge; you also may feel more resistance when using the plane. Move the chipbreaker back to alleviate these issues. When the chipbreaker is in the right spot the shavings straighten out and you’ll have a surface relatively free from tear-out.

This technique isn’t only useful for smoothing planes, but also for jointer and jack planes. Because these planes are often set up with a cambered edge, it may not be possible to set the chipbreaker as close as you can on a smoothing plane. In this situation, tear-out may not be eliminated,



Show me the light. For the chipbreaker to work best, you need to put its edge $\frac{1}{64}$ "– $\frac{1}{128}$ " from the edge of the iron. Shine a light on the assembly and look at the reflection as you adjust the position. Despite the appearance of the reflection, this chipbreaker is less than $\frac{1}{64}$ " from the edge of the blade.

but it will reduce the depth of the tear-out, so it will be easier to clean up the damage with a smoothing plane afterward.

Try making adjustments on the location of the chipbreaker in your plane to see what works best in your shop, on the woods that you commonly use. Do some planing against the grain and feel how and where setting the chipbreaker in this manner gives you an advantage. It won’t take long to get the hang of using this approach to good effect.

DO YOU NEED A CHIPBREAKER?

Obviously, there are other ways to achieve a surface free from tear-out when planing a board. In fact, one of the first sequences of the Kawai and Kato video shows that a chipbreaker isn’t needed when planing against the grain, if taking a shaving that is sufficiently thin. As mentioned before, a tight mouth, a higher bed angle or a steep secondary bevel are all valid approaches. These methods all work by causing the plane shaving to fail before it can lever a chunk out of the wood ahead of the cutting edge.

All these approaches have their advantages, although many times the only way to take advantage of these features is to buy a new plane (or a high-angle frog if you can find one to fit your tool). The benefit of knowing how to set up and use a chipbreaker is that the vast majority of bench planes that woodworkers already own have a chipbreaker that is just waiting to be used. **PW**

Special thanks to Yasunori Kawai, professor, and Chutaro Kato, honorary professor, Faculty of Education, Art and Science, Yamagata University, for the use of material from their video in this article, to Mia Iwasaki for translation help, and to Bill Tindall, who facilitated the use of the video. Kees Van Der Heiden is a woodworker from the Netherlands. Wilbur Pan is a woodworker from New Jersey. Both geek out over hand tools.



Perfection by Hand

These jigs help you hand cut flawless mortise-and-tenon joints.

BY JEFF MILLER

Mortise-and-tenon joints tend to frustrate woodworkers far more than dovetails do. That's no mystery; they are genuinely harder to cut than dovetails. The large flat tenon cheeks and mortise walls need to be flat, smooth and parallel, the shoulders have to line up perfectly all the way around the tenon, and to get a fit that works, the tolerances are within a couple of thousandths of an inch.

About a year ago, I started fooling around with an idea to make hand-cut

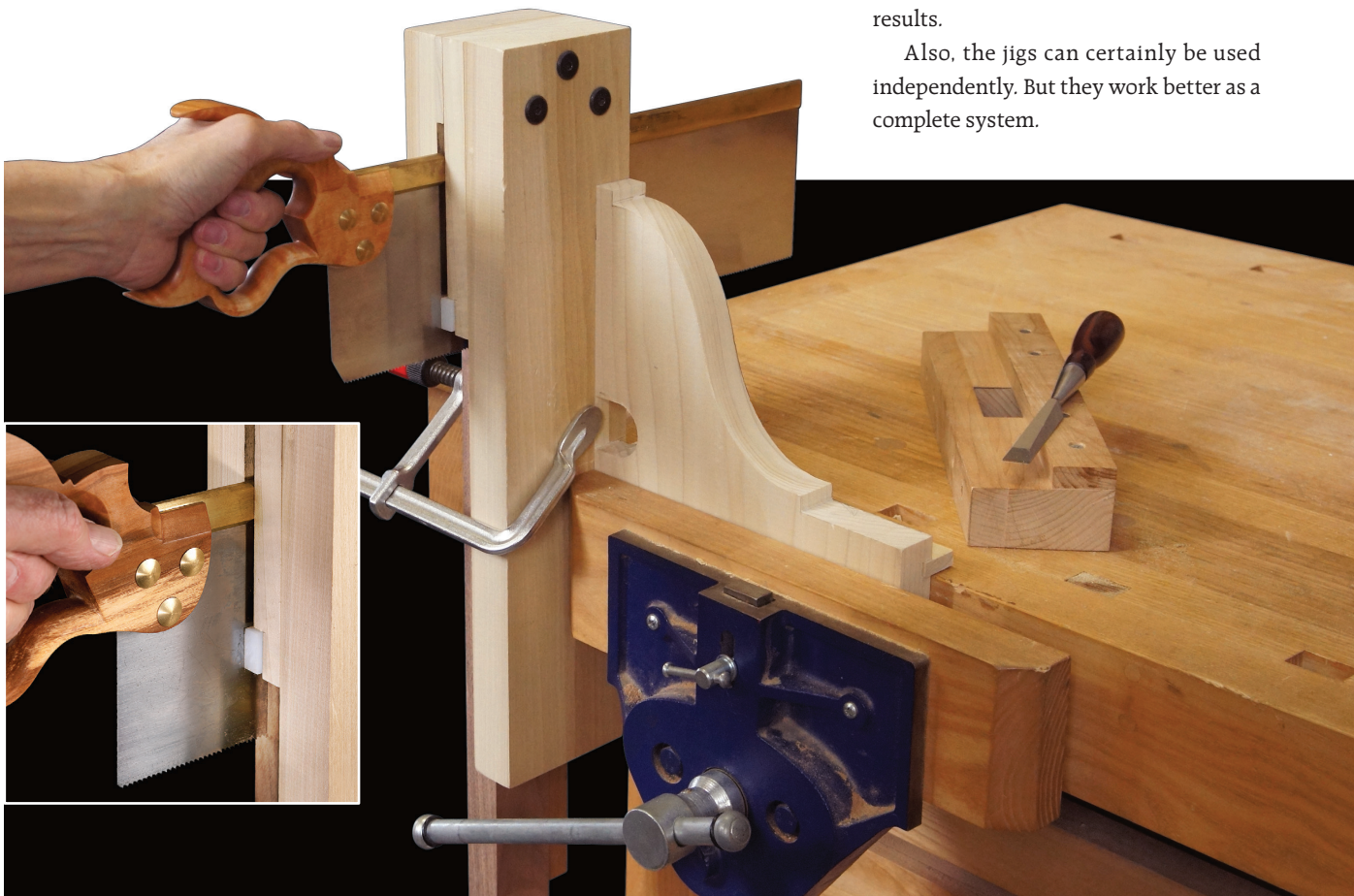
mortise-and-tenon joints a little easier. I came up with a pair of simple jigs that make it possible to cut—in conjunction with a good tenon saw and some mortise and paring chisels—accurate, repeatable joints by hand that rival those cut by machine. The jigs cut down on layout as well. And they make it easy to cut angled tenons. The final bonus is that the tenoning jig can actually help improve your saw technique.

That all may sound a bit like I'm ped-

dling snake oil, but the jigs are very simple in concept. There's a jig for paring mortise walls, and for paring tenons, a sort of an upright miter box combined with a system of spacers. There's no magic involved. There is, however, a fair bit of tweaking the jigs to tight tolerances.

Is it cheating? Maybe. But cheating in the same way that a shooting board is cheating: easy, accurate results on something you could conceivably do strictly by hand. And you still need good saw and good chisel technique to get the best results.

Also, the jigs can certainly be used independently. But they work better as a complete system.



THE MORTISE-PARING JIG

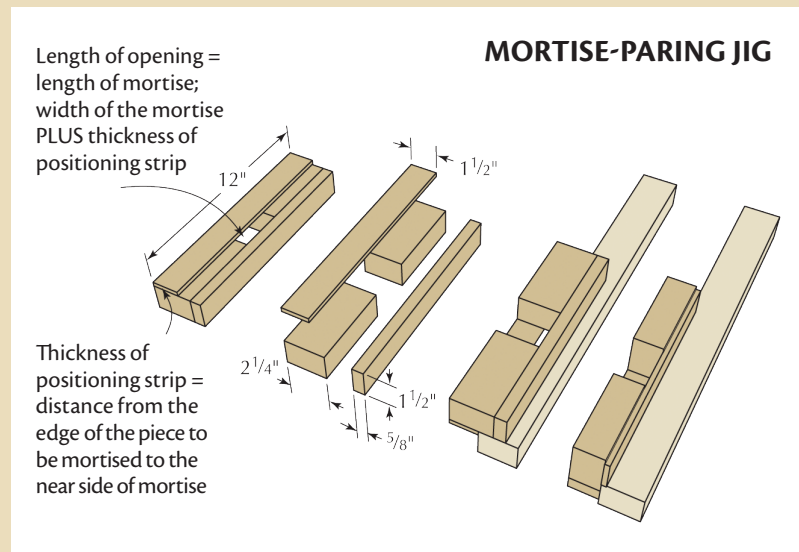
Chopping mortises with a mortise chisel is surprisingly fast and reasonably accurate, but for the best results, it helps to pare the side walls to clean them up. One of the easiest ways to do that and get straight, square results is to clamp a guide block to your workpiece to act as a reference for your chisel. This jig is actually a combination of chisel guides. With it, you can pare both sides of a specific-size mortise located a pre-determined distance from the edge of the workpiece. The jig references off only one edge of the workpiece for greater accuracy. And you don't need to chop by hand for the jig to work; it will clean up the sides of a mortise no matter how you cut it.

This might seem like a lot of work for a specific size joint, but the jig is very quick to make, and most of the time, you need to cut multiples of the same joint for your projects. Make up one for a table or chair, and it might well do for most other tables or chairs you build.

Once you've decided on the mortise location and size, you're ready to make the jig. The blank should be $1\frac{1}{2}$ " thick and 12" long, although it's helpful to have some extra length. Start by adding the distance from the mortise to the edge of the workpiece to $3\frac{1}{8}$ " (this assumes an $\frac{1}{8}$ " table saw blade; or you can calculate $2\frac{7}{8}$ " plus the width of two kerfs) to come up with the width of the jig blank.

Rip the blank into three strips: one equal in width to the distance from the mortise to the edge, one $\frac{5}{8}$ " wide and the other $2\frac{1}{4}$ " wide. The $2\frac{1}{4}$ " block should then be crosscut to two equal lengths. The pieces will be spaced equal to the length of the mortise (or longer, if you want to use the jig for various lengths of mortises). The simplest way to do this is to cut the block in half, then separate the two halves the desired amount. (You can trim off the ends later, and maybe even use the trimmed parts for another jig.) Clamp and screw the $\frac{5}{8}$ " strip to the separated $2\frac{1}{4}$ " blocks. Plane flush, if necessary.

Quick Jig for Paring Mortises



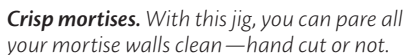
Mortise layout. Hold the positioning strip against your reference edge and scribe the far side and two ends of your mortise. Then flip the jig around and scribe the near side.

The placement of the remaining positioning strip will determine the exact size of the mortise. This strip lays flat on the $2\frac{1}{4}$ "-wide block faces, and the opening between the edge of this and the $\frac{5}{8}$ " strip should equal the width of the mortise plus the distance from the mortise to the edge of the workpiece. An easy way to come up with this dimension without measuring or fussing around is to take an offcut of the positioning strip and a similarly sized piece of scrap that is the same thickness as the tenon you want. Use the two pieces as spacers to align and space the positioning strip. Clamp everything carefully in place, then screw the strip to the $2\frac{1}{4}$ " blocks.

USING THE JIG

You can easily use this jig for the initial layout of the mortise. Hold the jig in place against your workpiece with the positioning strip against the reference edge, and scribe the far side and the two ends of the mortise. Then flip the jig around so the positioning strip is oriented vertically, and use the rest of the jig as a fence against the workpiece. Scribe the near side of the mortise along the positioning strip.

I usually chop a slightly narrower mortise inside these scribed lines, although you can also excavate it using other methods. Once the mortise has been roughed out, clamp the jig back into position with



I keep a dedicated chisel for this type of paring, which I ground to a 20° bevel and a 23° micro-bevel. It makes the paring easier, and seems to leave a cleaner side wall to the mortise. But the edge is fragile, and I never use this chisel for anything other than this work.

The core of the tenoning jig is the saw guide—a slot for the spine of the tenon saw constructed out of two saw guide blocks separated by a spacer (all made of wood), and a pair of ultra-high molecular weight (UHMW) plastic guides for the sawplate. The combination creates a guide that makes it hard to cut other than dead straight and square. The rest of the jig provides support for the workpiece and a way to clamp the jig firmly to a workbench.

guide are based specifically on your tenoning saw. Measure carefully the thickness of the saw's back and also the saw's overall height (the back plus the blade). The back measurement, with a little added clearance, provides the thickness for the jig's spacer. The overall height of the saw plus 2 1/8" will be the overall length of the inner and outer saw guide blocks.

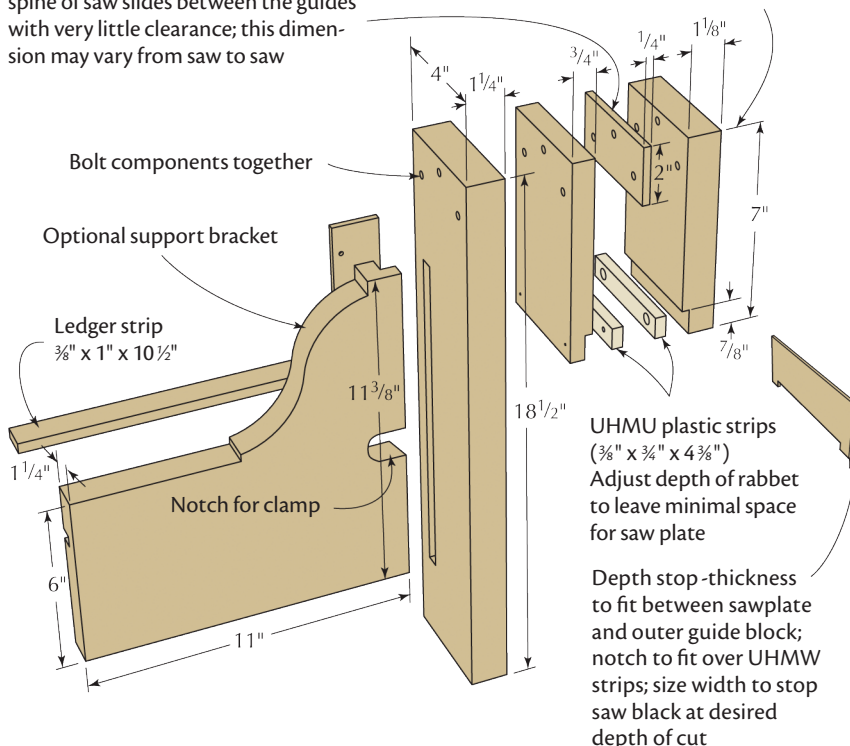
Eventually, you want to wind up with a spacer that is two to three thousandths of an inch thicker than the saw's back. This will provide just the right amount of clearance. But don't bother measuring this. You're better off just testing the spacer and adding shims to adjust to a sliding fit that's free of slop.

Getting to the point where you can accurately check the fit requires a bit more work, however. Clamping the parts together is certainly a possibility, but often, the results are not the same once you bolt together the parts. Drilling and bolting together is more reliable.

You can either stick the spacer, the guide blocks and the upright together with double-sided tape between them and drill, or make a simple alignment jig for

$\frac{1}{4}$ " spacer should be adjusted so that spine of saw slides between the guides with very little clearance; this dimension may vary from saw to saw

Length of guide blocks may vary based on saw's overall height; block is 2 1/8" longer than saw height.



the drill press to hold the parts in position (using tape here isn't a bad idea, either). Either way, it helps to have another section of spacer positioned at the bottom of the guide blocks to help stabilize everything. Drill the three $\frac{1}{4}$ " holes for the bolts through the stacked-up parts. Wide-flange connector bolts and nuts work well for this jig; these will require counterboring the holes for the nuts to 9 mm (or $\frac{3}{8}$ ") in the outer guide block. Bolt everything together, then check the fit of the saw back between the guide blocks. Adjust the fit with paper (a typical sheet of 20 lb. ink-jet paper is just under .004" thick), masking tape (generally about .005" thick, but somewhat compressible), or clear plastic packing tape (about .001" thick) until the saw can slide between the guides with a little bit of friction. A bit of wax on the guide blocks will make the saw slide better.

The UHMW strips aren't always sized accurately or evenly. You can correct that by handplaning them to an exact thickness with the simple jig shown on the next page (variations in the width won't matter).

You'll experience less flex in the plastic if you cut the strips to length before planing in the jig. The shavings are unusual, but the material planes well. Once the strips are the same thickness, it's time to work on the rabbets for the plastic strips. This is a somewhat tedious process of bolting things together, testing the fit, taking them apart and making adjustments; often many times over.

Measure the distance between your guide blocks. Subtract that amount from the thickness of two of your UHMW strips measured together (somewhere around $\frac{3}{4}$ ") and divide the result in two. That should be the starting point for the depth of the rabbets.

Disassemble the guide blocks and spacer assembly, and cut the rabbets across the bottoms of the blocks to the depth you just determined by $\frac{7}{8}$ " wide. Now put everything back together. There shouldn't be any space between the UHMW strips when you slide them into place. Sneak up on exactly the right amount of space for the sawplate by deepening the rab-

bets a little at a time. A router plane is perfect for this task, but you can choose whatever method allows you to take off small amounts while keeping the rabbets flat and parallel.

Once fit, the strips should ride against the saw plate without clearance. If you happen to make the rabbet too deep, you can always place shims behind the UHMW strips to bring them closer together. When you think you're close, drill and countersink the UHMW strips for the screws that attach the strips to the guide blocks. The screws securing the UHMW plastic to the inner guide block go through the block into the upright. Be sure all of the countersunk holes are deep enough to keep the screw heads well below the surface of the plastic. Put the jig together one more time to verify the fit and make any additional adjustments as needed.

The other important part to the core of the jig is the vertical fence at the back of the upright. The $\frac{1}{4}$ "-thick by $1\frac{1}{2}$ "- to $1\frac{3}{4}$ "-wide strip should be screwed into a $\frac{1}{4}$ "-deep by $\frac{1}{2}$ "- or $\frac{5}{8}$ "-wide rabbet. At this point, the jig is functional, and you could call it quits. But adding the support bracket makes it much easier to clamp to your workbench.

THE SUPPORT BRACKET

I designed the support bracket to work with most shoulder vises. A ledger strip let into the back of the bracket rests on the benchtop, and the width of the bracket makes it easy to clamp in most vises without racking. But this approach does not work with every workbench and vise setup. You may need to modify the support bracket to set up the jig at a comfortable sawing height and the most secure hold in your vise.

Cut a $\frac{1}{2}$ "-wide x $\frac{1}{2}$ "-deep dado in the upright, set $\frac{5}{16}$ " from the back edge, and a rabbet to leave a matching tongue on the edge of the support bracket. Cut a $\frac{3}{8}$ "-wide x $\frac{3}{8}$ "-deep dado for the ledger strip across the back of the support bracket, 4" up from the bottom (to allow for clearance for your vise screw). A cut-out just above this dado



TOP Drill with care. Position the parts to align the holes in all pieces. A leftover piece of spacer holds the work level.

LEFT Tape as shim. Masking tape can be used to make minor adjustments to thickness.



along the rabbeted edge will create better access for a clamp. Shape the bracket as desired, then glue and screw it into place. You should only glue about 1" of the end of the ledger strip closest to the upright to allow for cross-grain movement.

The tenoning jig is basically finished now, and you can take it out for a test-drive if you haven't already. But there are a few more components you should make to significantly enhance its capabilities.

Most important is a set of spacers for cutting various sizes of tenons automatically. Each spacer controls the workpiece location so that both cheeks of the tenon will be cut exactly the right distance apart. This approach allows you to reference off of one face of the workpiece—much more accurate. Make one cut with the spacer in place, then remove it and re-clamp the workpiece to make the second cut.

Each of the spacers needs to be the thickness of the desired tenon plus the width of your saw's kerf. Sizing the spacers accurately is key. Get as close as you can with careful milling. Then use packing tape, masking tape or paper in conjunction with tape to adjust for an exact fit to a mortise made with a paring jig. Once your spacer is adjusted to perfection, be sure to mark it.

One refinement that can improve the usability of the jig is a small rare earth magnet (in a magnet cup) recessed flush into the surface of the upright of the jig, and a magnet washer likewise recessed into the tenon spacers. While not necessary, it makes it easier to juggle things as you clamp the workpiece to the jig.

You'll also need to make spacers to adjust for the tenon location on the workpiece. These can be made as necessary for various thicknesses of work and tenon locations.

The last accessory you may find useful is a set of depth stops. These are simply strips of wood thin enough to fit freely between the sawplate and one of the guide blocks. Tabs at either end help keep the stop in place. A depth stop cut to a specific



LEFT Planing jig. Make a simple jig to plane the UHMW strips to the same thickness. The plane rides on ledges, which stop the cut at the desired thickness.

BELOW Fit to perfection. A router plane makes quick and precise work of the rabbets for the UHMW guide strips.



width will stop the saw from cutting any deeper once the saw's back reaches the top of the strip.

USING THE JIG

Hold the workpiece (and any spacers) in place against the rear fence and up against the bottom of the guide blocks. Clamp them securely to the upright. Slip your saw between the guides and begin sawing. Keep a light grip on the saw's handle and extend your forefinger. Align your forearm with the saw back, and cut smoothly and rhythmically until you reach the desired depth (or the depth stop). An even and steady touch will yield the best results.

Set up for the other tenon cheek by removing the tenon spacer (if you're using a second spacer to control location, leave that one in place) and re-clamp the workpiece. Saw to the shoulder line and unclamp. Cut the tenon shoulders using whatever method you prefer. Clamping a simple guide block with a 90° fence right over the scribed shoulder line can help you pare the shoulders or act as a saw guide. Saw the narrow shoulders close to the line,

then pare with a chisel that is wider than the tenon but not as wide as the workpiece.

Angled tenons? Simply make a wedge with the angle you want. Clamp the angled wedge in place in conjunction with the tenon spacer for one cheek, then remove the spacer just as you would for a straight tenon. A guide block with angled sides will help get the shoulder angles just right.

The tenon cheeks should be flat, straight and smooth. There are a number of things to check if you're having problems. Be sure the saw slides smoothly in the jig without any slop. Fine adjustments can be made by changing the bolt tension. Next, consider your saw. Better saws usually yield better results. Regardless, you might want to check the evenness of the set. Lightly and carefully stoning the sides of the teeth can take down slight variations in set that cause a rougher surface. Finally, look at your technique. The more relaxed and steady the cut, the better the results. **PW**

Jeff is a Chicago-based furniture maker and woodworking teacher.

Chisel Use

BY JIM STUARD



An easy guide to whether you should be pushing, paring or pounding your chisels in any given situation.

need to hit the chisel to get it to work right (the exception to this is, of course, mortising). Paring is a process of using the knife edge of a sharp chisel to slice small amounts of wood off. With a little technique and a sharp chisel, you can get into places inaccessible to a plane or knife.

Paring is basically the finest work you can do with a chisel. Some examples of paring include:

- Trimming the cheeks of a mortise to fit a tenon that's too large.
- In the absence of a shoulder plane, paring the tenon to fit the mortise.
- When you lay out a hinge mortise, after chopping the mortise sides, you basically have to pare the waste out to the edges of the hinge layout.
- If the space between dovetails is large enough (i.e. the pins) for a chisel, they can be pared, on their sides, to fit.

Before beginning, make sure your work is secured on your bench or in your vise. This will impart more of the force of your pushing into the work, thereby giving you more control of the cut. Paring requires pushing a chisel while it lies flat on a surface, slicing into the wood grain. This can be either with or across the grain. When you pare, you're

Back when I started as an apprentice cabinetmaker, a chisel was something to be beaten with a large hammer. That was before I learned how to properly sharpen and use these tools. Since then it's become apparent there are three distinct chisel operations that every woodworker should know: paring, light chopping and heavy mortise chopping.

There's a right way and a wrong way to make these cuts. This article will show you how to use your chisel with the least amount of effort, damage to the chisel and damage to your work.

Before I begin, there are a couple things to mention about safety. One nice thing about chisels is you don't have to wear hearing protection. But there are safety issues. Wear safety glasses when chopping or mortising, and I mean that. A chisel breaking can send pieces of metal flying,

possibly causing an eye injury.

Second, if you have any reservations about using the sharp end of a chisel while paring, consider using a Kevlar protective glove, which is routinely used by carvers. The glove will dull the impact of a slipped chisel and reduce your chance of injury. Finally, never use a chisel that's pointing toward your body. Always be mindful of the direction a chisel is going and where your hands are. This is the first thing to check before making a cut of any kind. The last thing you want to do on a Sunday afternoon is explain to an emergency room physician how you almost gave yourself a DIY appendectomy while working on Aunt Betty's blanket chest.

PARING

The one thing that amazes most beginning woodworkers is how seldom you really



generally not taking off large amounts of wood. Just gently slicing little shavings off.

To pare well, the chisel needs to have a flat face and a sharp edge. See the story at right on flattening for more about this. You can generally tell when your edge isn't cutting the way it should when paring end grain. If the grain starts to collapse and bend over from the chisel pushing through, the chisel needs sharpening. I won't go into a long diatribe on sharpening here, but suffice it to say that if your chisels are coming up dull, you either need to increase the frequency or quality of your sharpening.

LIGHT CHOPPING

At some time you'll have to do some chopping with a bench chisel. A half-blind dovetail joint is a good example of how to use chopping to remove wood. Other uses for chopping are defining a hinge mortise, low relief carving and through-dovetails.

When chopping, you can use the same force you would use when mortising – just not as often. Bevel-edged bench chisels shouldn't be used for mortising. They aren't designed for this purpose. Mortise chisels have a steeper cutting angle ground on them: 30° compared to 25° for bench chisels. Their blades are thicker with square flat sides to stand up to a pounding. Bench chisels are thinner and beveled on the sides to get into tight spaces.

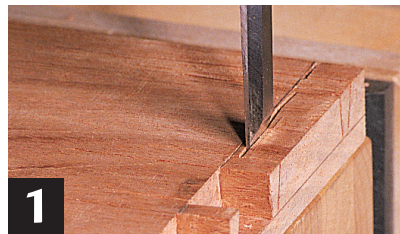
Most bench chisel chopping consists of light tapping of the chisel to define a cut line or remove a small amount of waste. Chopping is the most vigorous use that a bench chisel should see. Upon reading our reviews of 20 different bench chisels, only about half stood up to repeated medium/heavy chopping. If you plan on heavy use for your chisels, consult our review to get an idea of what to look for in a bench chisel.

Before beginning, make sure your work has a direct connection with the ground. That is, place the work directly over the leg of a bench or table. This imparts all the force of the blow directly into the cut and not into flexing your bench's top.



PARING: One Hand Steers, the Other Pushes

To do this properly, you need to use both hands on the chisel to get the most control. One hand is on the chisel blade as close as you can get to the edge. The other hand is firmly on the handle. How much you push down on the blade as you push forward determines the amount of wood removed. You can also angle the chisel into the wood to get a more aggressive cut. That's where having a flat face on your chisel is important.



LIGHT CHOPPING

1. After defining the pins with your dovetail saw, start chopping the waste out by chopping to a line approximately 1/2" away from the actual marked line. What happens when you chop with a chisel is the bevel will push the chisel toward the line as it's struck. You have to compensate for this by starting in a little from the line, then remove the waste.

2-3. Use a combination of paring and light chopping technique to remove the waste. The procedure is to chop a line, across the grain, then remove the waste by pushing into the end grain down to the cut line. Depending on the wood, you may or may not need to tap the chisel with a mallet. Re-cut another line and repeat till you get down to the marking gauge line.

4. To remove the rest of the waste up to the gauge line, start by pushing a series of angled cuts into the waste up to the line. Yes, Virginia, you can pare end grain but only with sharp tools. Proceed to pare or gently chop out the waste, cutting across the end grain. Some light paring is required to get into the corners along with a sharp, pointy knife.



IN DEFENSE OF A FLAT CHISEL FACE

Did you ever wonder why sharpening experts tell you that your chisel face has to be flat? Well, if your face isn't flat, one of two things will occur. If the chisel face is bowed you'll start digging into the wood; if the chisel face is bellied, you'll need to lift the chisel to get it to start cutting.

Either condition requires lapping. I like to use a coarse diamond stone, and then work up to a couple of finer grits. There's lots of other lapping equipment out there, but one of the cheapest alternatives is to use dark gray wetsanding paper (start with #150 grit and move up gradually to #400 or #600) on a flat surface. A thick piece of glass does nicely. Just soak the paper in water before use. Lay it down on the flat surface and the surface tension of the water will adhere it to the surface fairly well. Rub the chisel until it's flat at least two-thirds of the way up. This might take a while. Get as fine a polish on your chisel face as you can to eliminate catches or nicks. It also helps to finely sand the edges of the chisel face. If you pinch your finger between a piece of wood and the edge of the chisel, you'll stand less chance of scissoring a cut on your hand.

MORTISING

1. First, lay out a mortise and start by lightly chopping a series of lines, inside the layout lines, across the grain.
2. Next, using the bevel side of the chisel, remove the waste and repeat. After you get the first couple of layers knocked out, it's easier to just wail away and start taking large amounts of waste out of the mortise. When you get to the bottom of the mortise, start checking the depth with a combination square. When you get towards the finished depth, it's easier to just reach into the mortise with the chisel, bevel side down and pare out fine amounts of wood till you get to the finished depth. If necessary, use a wide bench chisel to pare the cheeks of the mortise.
3. Here's the finished results of using a mortising machine (left) and a hand cut mortise (right). The hand-chopped mortise is prettier, wouldn't you say?

MORTISING

I'm sure that back in the days when all mortising was done with manual labor, there were large muscular blokes all hammering and chopping away. This is certainly the woodworking equivalent of heavyweight boxing. The chisel and the wood both take an incredible pounding.

Mortising has one purpose: to make a square flat-sided hole in a piece of wood to receive a tenon. To that end, mortising chisels are the beefiest chisels you can buy. They have a steep grind (30°) and high flat sides to take a beating and guide the chisel while mortising. A bench chisel, with its thin profile, is likely to wander in your cut, ruining your mortise. Not to mention that if you hit a bench chisel as hard as you hit a mortising chisel, especially the small sizes

like $\frac{1}{2}$ " and $\frac{3}{8}$ ", they might actually fracture. Also, repeated pounding of a bench chisel will either roll or collapse the cutting edge.

If you own only one mortising chisel, I recommend a $\frac{3}{8}$ " tool. Tenons are typically half the thickness of your stock, and most stock is $\frac{3}{4}$ " thick. Make sure the mortising chisel you buy has a long handle because you're going to hit it pretty hard. If the handle is too short, it's your hand that will take the abuse.

Mortising has three parts. One, light tapping. This defines where the mortise will go and begins the mortise. Two, heavy pounding, which is what most of us think about when we talk about mortising. Three, paring. This is the only time you should use a bench chisel while mortising: to pare the sides of a mortise after chopping. **PW**



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