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layout tools & Tricks

Measuring & Marking Tips 6
Ensure precise project layouts — every time — with this series of simple tricks.

Choosing a Marking Knife 8
Marking knives are more accurate than pencils. Here's how to pick the right one.

Marking Gauge Tricks 10
With these time-tested shop secrets, you can use a marking gauge like a pro.

Classic Try Squares 12
Make your own classic squares with basic materials and a few hours in the shop.

Heirloom Brass Compass 16
This shop-built compass is sure to be both a useful tool and a treasured heirloom.

Precision Layout Gauges 20
Complete your shop-made tool collection with a pair of accurate marking gauges.

hands-on Joinery

Perfect Mortises & Tenons 26
Master this classic woodworking joint by adding these strategies to your technique.

Tools for Accurate Miters 28
A couple of simple shop jigs are all it takes to create gap-free miters every time.

Hand-Cut Tenons 32
Refine your hand tool skills by learning how to cut large tenons with a hand saw.

Shooting Board 34
This traditional tool works with a hand plane to fine-tune miters for a perfect fit.

Shop-Built Mallets 38
Mallets are always handy around the shop. They're even better when built by hand.

SHOP SAFETY IS YOUR RESPONSIBILITY

Using hand or power tools improperly can result in serious injury or death. Do not operate any tool until you read the manual and understand how to operate the tool safely. Always use all appropriate safety equipment as well as the guards that come with your tools and equipment and read the manuals that accompany them. In some of the illustrations in this book, the guards and safety equipment have been removed only to provide a better view of the operation. Do not attempt any procedure without using all appropriate safety equipment or without ensuring that all guards are in place. Cruz Bay Publishing, Inc. assumes no responsibility for any injury, damage, or loss suffered as a result of your use of the material, plans, or illustrations contained in this book.

cleaner Cuts

Secrets for Sawing Straight 46
Make accurate cuts second nature by perfecting a few hand saw techniques.

Chisel Tips & Tricks 48
Chisels are key to clean cuts and smooth results. Here's how to use them.

Sandpaper Sharpening 50
Sharp hand tools are easy with this technique that uses common sandpaper.

Pull Saw Miter Box 52
Pair up your saw with this handy jig, and perfect miters are within easy reach.

Paring & Skew Chisel Set 56
Enhance your tool collection with a few specialty chisels that you make yourself.

smoothing & Shaping

The Essential Block Plane 64
A few simple strategies will have you fine-tuning project parts in no time.

Making Flat Panels 66
Master the art of creating glued-up, solid-wood panels from individual boards.

Rasps & Files 68
Smoothing and shaping irregularly shaped parts becomes easy with these tools.

Infill Block Planes 70
These shop-made heirloom tools' great looks are surpassed by their functionality.

Custom Spokeshaves 78
With this simple weekend project, you can create your own handy spokeshaves.

clamping & Assembly

Clamping & Assembly 84
The assembly process is when projects begin to take shape. Here's what to know.

The Versatile Handscrew 88
These traditional clamps still have a lot of uses in the modern woodshop.

Square Assemblies 90
Clamping assemblies is one thing, but keeping them square requires special skills.

5 Shop-Made Clamps 92
Round out your clamps with these useful additions you can make in the shop.

contents

layout tools & Tricks

All woodworking projects begin as ordinary boards. It's the accuracy of the layouts that gets things started on the right foot. These shop-tested tools and strategies will help you along the way.

9 MEASURING & MARKING TIPS 6

CHOOSING A MARKING KNIFE.....8

MARKING GAUGE TRICKS 10

CLASSIC TRY SQUARES 12

HEIRLOOM BRASS COMPASS 16

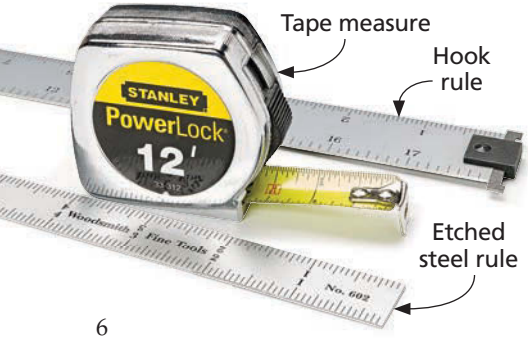
PRECISION LAYOUT GAUGES.....20

9 shop-tested Measuring & Marking Tips

The tape measure and steel rule are the fundamental measuring tools for every project in my shop. And using them seems like it should be second nature.

Yet it's amazing how many errors are introduced this early in the woodworking process. The key to success is to incorporate some sound principles into how you measure and mark — and then use them each and every time you reach for your measuring and marking tools. Here are the tips that I try to keep in mind.

Top Tools. Here are a just a few of the helpful measuring tools that you'll want to keep handy in your shop.



[1] CHOOSE THE RIGHT TOOLS

As with most things, you get what you pay for when it comes to measuring tools. The tape measure should be a brand you can trust. Also, you can probably get by with a smaller 10' or 12' tape for the shop, rather than a 25' model that a carpenter might use. For steel rules, choose an etched option instead of one that is stamped or painted. They're typically more accurate (photo at left).

[2] USE THE SAME TOOLS

When you get busy working in the shop, there's a tendency to reach for whatever measuring tool is handy when setting up a cut. However, I make an effort to use the same tape measure or rule for all the parts in the same project, particularly mating parts. Markings on tape measures and rules can vary from brand to brand and even tool to tool, so using the same tool can take some possibility for error out of the process.

[3] LET YOUR TAPE SHIFT

Speaking of introducing errors to projects, one commonly misunderstood fact about tape measures has to do with the little bit of "play" you may notice in the hook at the end of the tape. Contrary to popular belief, this isn't a design flaw in the tape measure that's adding errors to your projects. Rather, this built-in wiggle allows the tape to adjust to make an accurate outside measurement or inside measurement.

It all depends on where you place the hook of the tape measure for the measurement at hand. Essentially, the shift is intended to match the thickness of the hook, so it either adds or subtracts itself from the dimensions shown

based on whether you push or pull on it for a particular measurement.

[4] SIMPLIFY CENTERS

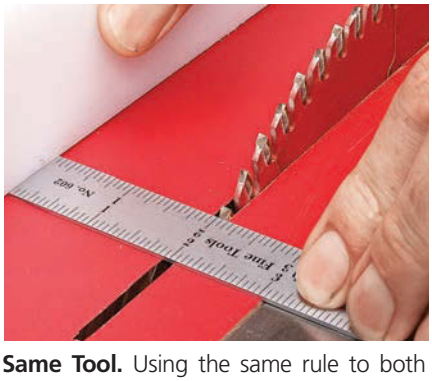
The main photo on the opposite page shows a simple tip I've been using for years. To find the center of a piece, don't fuss around with calculating half of an odd dimension. Instead, simply tilt the tape measure or rule until the opposite end or edge of the workpiece lines up with a whole number (such as 8"). Then you can mark the center much more easily (right at 4" in this example).

[5] TRY A HOOK RULE

In my shop, I've come to rely on a hook rule for project part layout (near right photo, above). The reason is simple: With a standard rule, you're still often guessing as to whether or not you are truly lined up with the end or edge of the board. The hook rule takes this guesswork out of the equation by letting you hook right to the end or edge of the piece.

[6] TURN IT ON EDGE

Since a hook rule is placed on its edge, it also allows you to mark more precisely by aligning the pencil with the marking on the rule itself. This is more exact than marking with a rule on its face, which could introduce slight errors due to the thickness of the rule. So when extreme precision is needed, such as for mortise or tenon dimensions, I'll also turn a standard rule on edge when marking.



Same Tool. Using the same rule to both measure the part (above) and set up the tool (below) is a good way to stay accurate.

Hook an Edge. Hook rules help take the guesswork out of placing a rule on the end or edge of a workpiece before marking it.

[7] TAKE TWO MEASUREMENTS

When measuring inside a drawer or cabinet, the tendency is to bend the tape into a corner, which can create inaccuracy. Instead, I like to measure to a fixed dimension (like 10"), and then measure back to that from the other side (photos at right). Then simply add the two numbers together to get the total dimension. This results in a more accurate measurement.

[8] USE THE RULE ON THE TOOL

When you're getting ready to make a cut, use the same measuring device to both mark the workpiece and to set up the tool itself for the cut.

Where to Mark. For table saw cuts, mark the bottom end or edge of the workpiece, since this is what contacts the blade first.

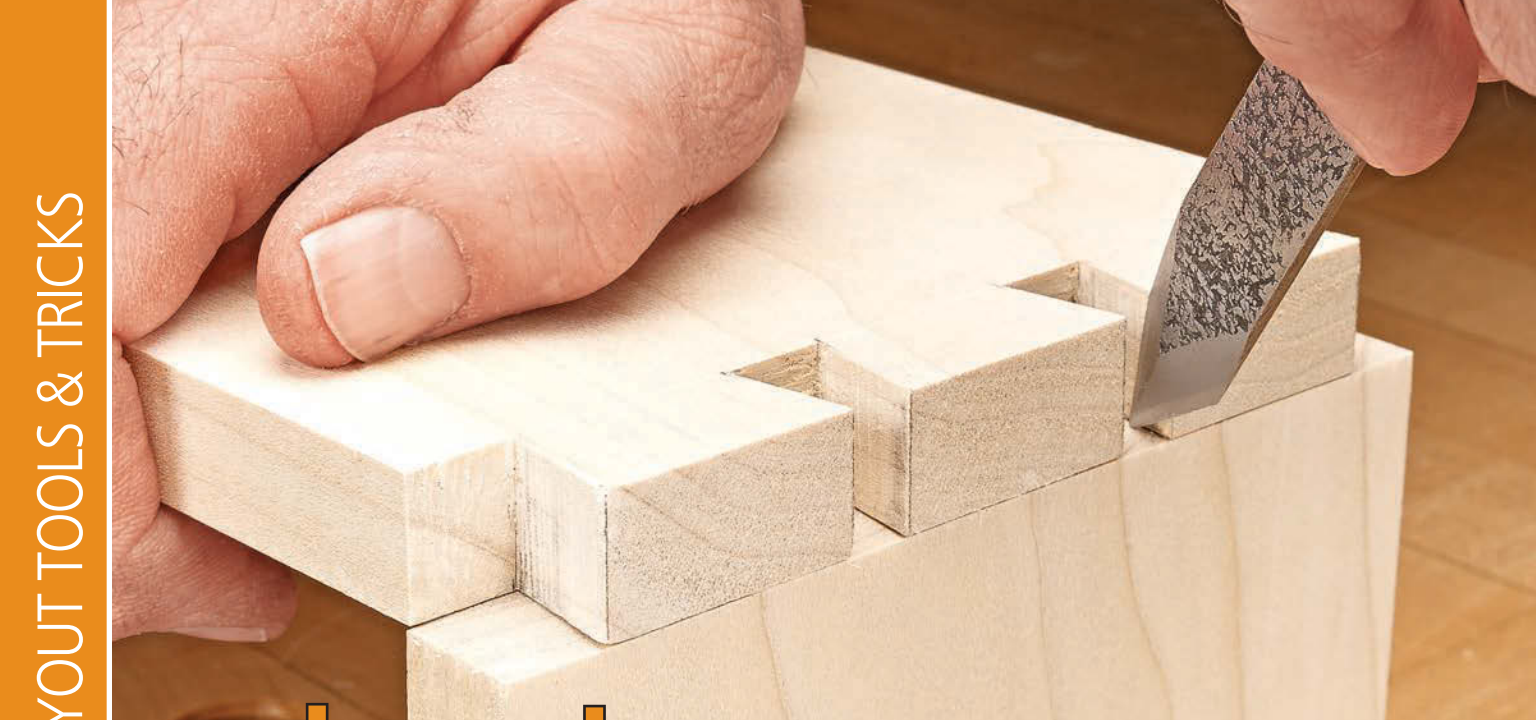
Two Steps. For accurate inside dimensions, mark a fixed point (above), and then measure back to it from the other direction (below).

For example, I'll always use my steel rule to set the distance from the table saw blade to the rip fence (below left).

[9] THE RIGHT PLACE

Finally, think about where to measure and mark a workpiece based on the tool you'll be using to cut it. For example, if it's a miter saw cut, you should measure and mark the face of the board to line up with the blade. At the table saw, it's the front leading edge or end that you'll want to measure and mark (photos below).

Face Cuts. On the miter saw, you'll be cutting the top face of the workpiece first. So this is the area to mark when setting up the cut.



choosing a Marking Knife

When your goal is dead-on accuracy, put away your carpenter's pencil and pick up a good marking knife instead.

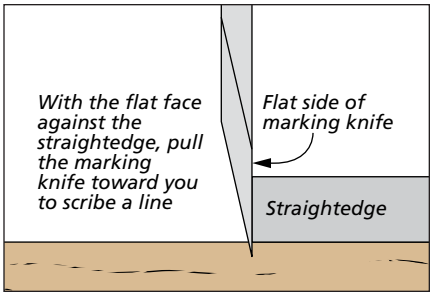
Knife Options. Both Western and Japanese-style marking knives are available with either a single- or double-bevel blade.

Measuring and marking project parts and joinery locations accurately is a fundamental skill. But how you mark a workpiece can vary, depending on the kind of work that needs to be done.

For power tool operations, you can use a pencil mark to line up a blade to cut on the correct side of the line. But more often than not, it's just a matter of setting a fence and making the cut.

When you're marking a position that will need further refinement with hand tools, like a mortise location, I prefer to use a marking knife (sometimes called a striking knife). Not only is the thin line of a knife more precise, but it offers a groove to position the blade of a chisel (top right photo on the facing page).

MARKING KNIFE. Not every knife is right for marking precise lines. For example, a pocket knife isn't a good choice. It's beveled on both faces so the actual cutting edge isn't flush with either face. In order



to scribe a line when using a square or rule as a guide, you want a flat face against the straightedge. The illustration above shows the correct position, allowing the bevel to force the knife against the straightedge.

KNIFE TYPES. The margin photo shows a few different types of marking knives. While all of them have a flat back, the cutting edges of the knives are either single or double-beveled. That is, they have either one or two sharpened edges.

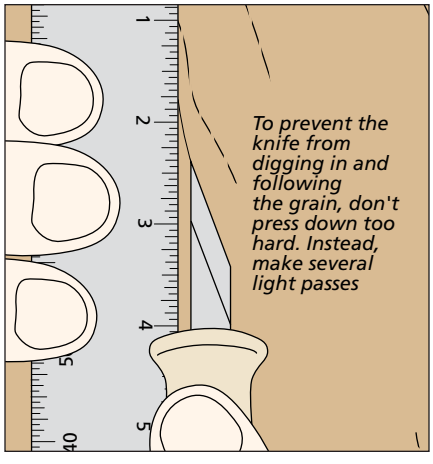
Keeping the flat face against a rule or square limits a single-bevel knife to cutting

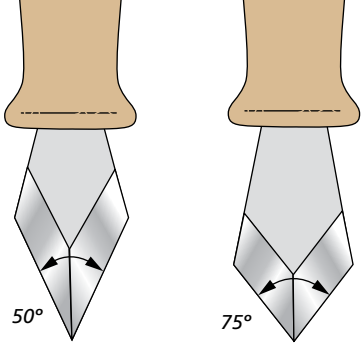
on only one side of the straightedge. For this reason, they are often paired, left and right, to give you some versatility.

Another option is the spear-point knife that is beveled on both sides of the tip. This knife can be used on either side simply by turning it over. I prefer this single-knife solution for its ease of use.

PREFERENCES. An important thing to consider when selecting a knife is how you grip and hold it. Do you prefer to hold it low to the surface or more upright? You can determine this by practicing with a pocket or carving knife.

Your preference will determine the choice of angle on the blade. It's common to find spear-point knives with angles ranging from 45° to 75°. If you like to hold the blade low, then the lower-angled knives will suit your style. No matter what your preference, however, you'll need to make sure the knife you choose can fit into tight spaces, like hand-cut dovetails. Some knives are made from thicker steel and simply won't fit between closely spaced tails.





Angle. The different angles available for double-bevel knives accommodate your preferences for marking a workpiece.

Accuracy. A groove scribed by a marking knife allows you to position the blade of a chisel for an extremely accurate paring cut.

STEEL. Like just about any cutting tool, you'll find marking knives made from different kinds of steel. Inexpensive Western knives are usually made from O-1 tool steel, but some high-end knife makers use other types, as well.

Japanese marking knives are available in high-carbon, white, or blue steel. These hard steels are forge welded to a softer steel, as is the custom for Japanese edge tools like plane irons and chisels.

The steel plays a big role in the cost of the knife. But in my view, expensive steel does not improve performance. And it's not likely you'll use up an entire blade in a lifetime of woodworking. Both O-1 and white steel are more than adequate for the task, easy to sharpen, and offer good value for the money.

USING THE KNIFE. A marking knife is generally used with another tool, typically a square or a rule to scribe a straight line. The line doesn't need to be deep, just deep enough to score the surface. As I said earlier, you simply rest the flat face against the tool and pull the knife toward you. Keeping the blade sharp ensures you end up with a clean, crisp line. If it's dull, you'll wind up with tearout when cutting across the grain.

It's cutting with the grain that can be a problem. In this case, the tip has a tendency to follow the grain rather than the straightedge, especially if you're pressing down hard. Here it's best to make a few lighter passes to establish the line, then increase the pressure for a final mark.

BOTTOM LINE. No matter what kind of work you do, there's a knife for you. Once you get used to using a marking knife, you're sure to keep one close at hand — right next to a sharp pencil.

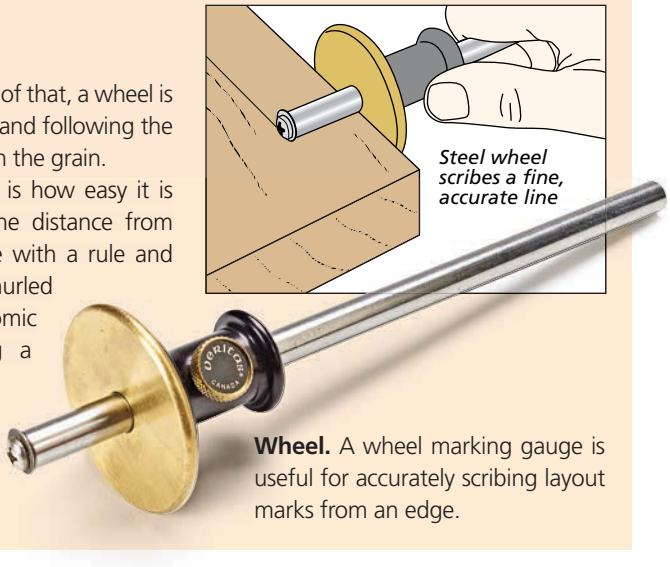
Wheel Marking Gauge

Once you get used to using scribed lines instead of pencil marks, you'll also want to consider a wheel marking gauge for joinery work. With it, you can make dead-on layout marks for mortises, inlay channels, or any other lines that are measured from an edge.

Marking gauges have been in use for centuries, but using a hardened steel wheel instead of a metal pin or even a blade can be a big step forward. The advantage of the wheel is that it not only cuts a clean line, but it won't tear the grain like a pointed metal scriber when cutting across the grain. On top of that, a wheel is not prone to digging in and following the wood when cutting with the grain.

But what I like most is how easy it is to use. You can set the distance from the wheel to the fence with a rule and lock it in using the knurled knob. Then, the ergonomic design makes scribing a line a breeze.

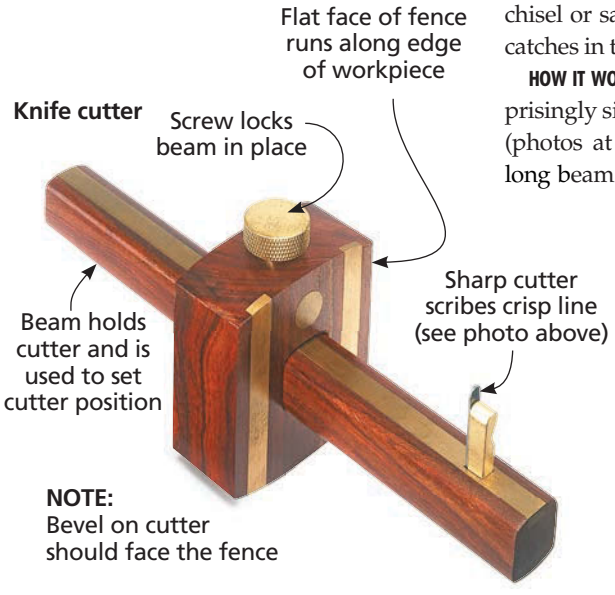
The basic model shown in the photo at right is available from *Lee Valley* (05N33.21).



Wheel. A wheel marking gauge is useful for accurately scribing layout marks from an edge.

marking gauge Tips & Tricks

Discover the best ways to get more from this traditional tool.



Accurately laying out joints and other details gives my project a headstart. So it goes without saying that some of my most important tools are the layout tools. One that I reach for time and again is my marking gauge.

The main benefit of a marking gauge is that it scribes a fine line. This mark is more precise than a pencil line. When you work to a scribed line, the result is tighter-fitting assemblies. Another benefit a scribed line offers is that it can be used as a starting point for another tool like a chisel or saw blade. The edge of the tool catches in the line for accurate placement.

HOW IT WORKS. A marking gauge is a surprisingly simple tool with just a few parts (photos at left). A cutter is housed in a long beam. The beam is held in place by the fence that slides along the reference edge of a workpiece. The position of the fence determines the location of the line.

CUTTER. I want to focus on the cutter for a moment. Marking gauges come with one of two types of cutters, as shown in the left margin. The most common is a sharpened pin. In this configuration, the pin is the least effective as a layout tool. The problem is the pin tends to scratch a jagged line. (You can see an easy fix for this in the box on the next page.)

The next type of cutter looks more like a knife blade. It has a flat back and a beveled end. This version is sometimes called a "cutting gauge." This type of cutter marks a fine, crisp line. Unfortunately, a knife-blade cutter has a tendency to follow the grain if you aren't paying close attention.

Joinery Tool. Mark a line from each edge to create a perfectly centered mortise that matches the size of a hollow mortise chisel.

Accurate Setup. A scribed line makes an ideal alignment mark for setting up the table saw.

Smooth Cuts. Use a marking gauge to score plywood for tearout-free rabbets (inset).

The remedy is to make a light pass to establish the line. Then make a second, deeper line for the final mark.

USING A MARKING GAUGE. Traditionally, a marking gauge was used to lay out hand-cut joints. However, the tool is just as handy when using power tools. Just take a look at these applications.

FIND THE CENTER. One common task is locating the center of a workpiece. Measuring can be hit or miss. Instead, I use the marking gauge to make marks from alternating sides of a workpiece. You can see this in the main photo on the facing page. When the marks meet, you know you've found the exact middle.

MORTISE MASTERY. I also use my marking gauge for laying out centered mortises for a hollow chisel mortising machine (lower right photos on the facing page). I fine-tune the setting so that the layout marks match the size of the hollow chisel exactly.

SET-UP GAUGE. Setting the rip fence on the table saw is another opportunity to put a marking gauge to use. The scribed line a marking gauge creates turns a workpiece into a precise set-up gauge. I can align the saw blade with the line without measuring, as you can see in the upper left photo and inset.

ELIMINATE TEAROUT. The scribing action of a marking gauge crosses the line between layout and actually cutting a joint. For example, cutting a rabbet on the end of plywood can result in nasty tearout. The upper right photos show how a marking gauge scores the face veneer to create a clean joint shoulder.

A marking gauge isn't a dusty relic of bygone times. In fact, it can be a multipurpose tool you'll turn to often.

Marking Gauge: Quick Tips

Besides the specific tasks mentioned above, there are a couple other marking gauge tips I want to pass along.

First, if you have a pin-style gauge, you can modify the pin to scribe cleaner lines. All you need to do is file a flat bevel on the end, as shown in the left photo below.

The beam on most marking gauges is about 8" long. To increase the capacity, I made an auxiliary beam about 14" long. I also drilled the end to accept a pencil for rough layout work on larger pieces.

Finally, trying to adjust a marking gauge in small amounts can be frustrating. Loosening the screw on top often results in the beam sliding more than you want. Instead, I hold the fence and tap the beam on my workbench (right photos).

Bevel. File a bevel on the pin cutter to scribe crisp lines.

Pencil. A long beam and pencil come in handy for rough layout work.

Tap, Tap. To fine-tune the setting of the marking gauge, lightly tap one end or the other on your workbench.

classic Try Squares

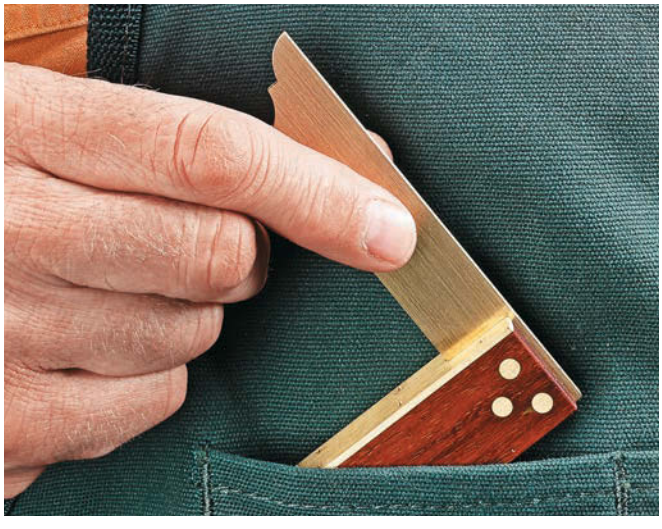
All it takes to make a set of precision layout tools is a few wood and metal parts, a relaxing afternoon in the shop, and the techniques presented here.

Try squares, like the ones shown here, are one of the simplest layout tools around. But despite this simplicity, they play crucial roles in my shop. Primarily, they help me determine if something is perfectly square. This could be two parts in a project assembly or the end of a board. I even use my square to make sure the saw blade is perpendicular to the table.

Another key task is laying out joinery across several parts, as shown in the photo above. You can also use it to accurately transfer a layout mark around all four sides of a workpiece.

Although these are precision tools, try squares are surprisingly straightforward to make in the shop. There are just three basic parts held together by screws and rivets. In fact, with just a few hours of easy effort, you can have a pair of heirloom tools that work as great as they look.

The construction of each square is identical. The dimensions for both the small and large square are provided on the facing page. Just follow the step-by-step photos on pages 14 and 15 to make your own classic tools.



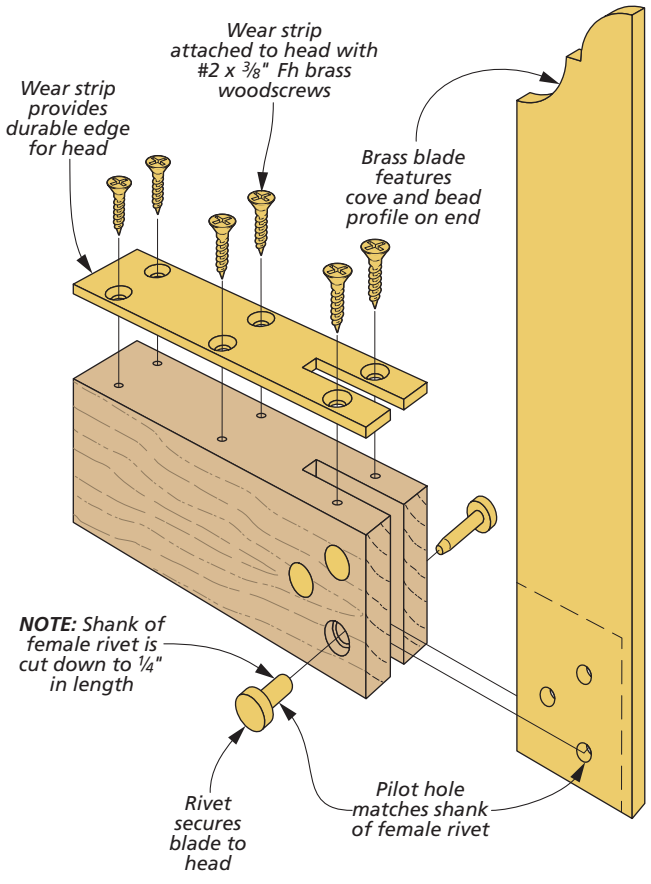
Pocket-Sized. The compact size of the smaller square means you can always keep it close at hand in a shop apron.

Construction Details

OVERALL DIMENSIONS:

Large Square: 4¼"W x 9/16"T x 7"L

Small Square: 2 9/16"W x 9/16"T x 4¼"L



GO 2 Online Extras

For a table saw push block helpful in building the squares, go to:

WoodsmithSpecials.com

making the Square

Making a try square isn't complicated, as you'll soon see. What it does require is attention to detail in a few key areas.

THE BLADE

The starting point for making the squares is the brass blade. I chose flat bar stock that matched the width and thickness I was looking for. Note that the width of each blade is slightly different. (You can find where to purchase the brass in Sources on page 98.)

CUT TO LENGTH. I cut the blade to length at the table saw, as shown in the upper right photo. While it may seem surprising to cut metal at the table saw, the carbide teeth on an ordinary saw blade work just fine on soft metals like brass and aluminum. And a few short cuts won't dull the blade.

Lay Out the Profile. Make a photocopy of the blade pattern from the previous page as a guide. Then lay out the profile at the end of the blade with a scribe.

Cut the Blade. A standard, carbide-tipped table saw blade can easily cut the brass bar stock to final length.

SMOOTH & FLAT. From there, I spent some time smoothing the blade. I applied a strip of self-adhesive sandpaper to the saw table. Take it easy here. Your goal is to simply remove any tarnish and create an even appearance.

You can see in the inset photo that the rip fence is set alongside the sandpaper. It serves as a guide to keep the scratch pattern made by the sandpaper in perfectly straight lines. Sand the blade up to 400-grit.

TRADITIONAL PROFILE. The profile I shaped on the end adds a little visual interest. It's a good idea to use a scribe to trace the profile (near left photo). This leaves a crisp line to work toward.

Shaping the profile is shown in the lower three photos. First, remove the bulk of the waste with a hack saw. You can get surprisingly close to the lines.

Smooth the Faces. Use the rip fence as a guide to establish a straight scratch pattern.

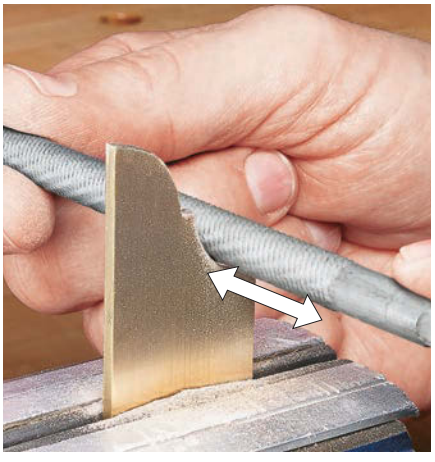
I used files to smooth out the cut edges. A round file tackles the concave portion and a flat file makes quick work of the convex "bead." You'll need to finish up with some sanding. Like before, the sanding scratches should flow along the length of the blade.

THE HEAD

The other main part of the square is the head. It's a hardwood block with a solid brass wear strip. The strip provides a smooth, durable surface to ride against the workpiece.

WEAR STRIP. The wear strip is attached to the block with small, brass screws. The tricky part is keeping these small

Shape the Profile. I used a hack saw to quickly remove most of the waste from the end of the blade.



Refine the Shape. Smooth saw marks with round and flat files. Gradually work your way to the layout marks.

Smoothing Edges. Sand the edges up to 400 grit. The strokes should be along the edge, not across it.

parts aligned. The solution has two parts. First, start with a slightly oversize wear strip. This way, you don't need to fuss with a perfect alignment.

The second part is to use super glue to temporarily attach the wear strip. This prevents it from shifting while you drill holes and drive the screws for a permanent connection to the head.

In order to drill consistent holes and countersinks, I used the drill press, as in the upper right photo. Once the screws are in place, you can file and sand the screws and wear strip flush.

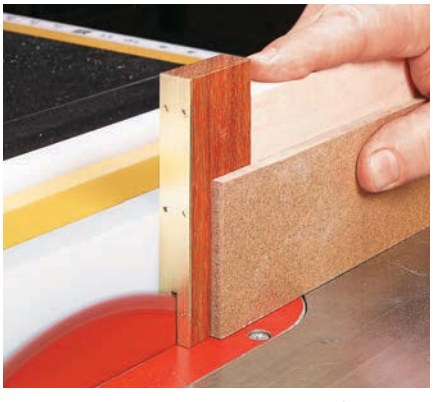
SLOT. The blade is housed in a slot cut across the end of the head. I did this at the table saw (left photo below). The key is centering the blade on the thickness of the head. Then to add safety and control during the cut, I made a push block to guide the part. You can find the details for the push block at *WoodsmithSpecials.com*.

Glue It On. To keep the wear strip from shifting, use super glue to temporarily secure it to the handle.

Drill & Countersink. At the drill press, drill the pilot holes and countersinks for the small screws that anchor the wear strip.

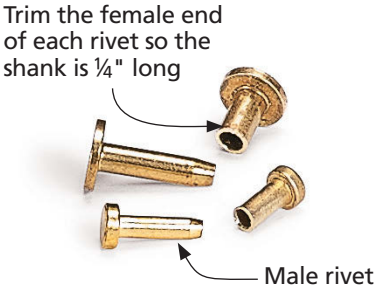
ADDING RIVETS. The blade is secured to the body with three rivets. Before you drill the holes for the rivets, you want to make sure the blade is secure and square in the head. Here again, you can apply super glue to the blade first. Then install it in the body using a square corner as a form until the glue dries. Once the glue is set, mark and drill the holes for the rivets. You need to trim the female part of the rivet to ¼" long so it can seat in the head, as shown in the right margin.

A few taps with a hammer fixes the rivets. After sanding and a coat of oil, the try square is ready for use. In the end, you have a tool that will last a lifetime.



Cut a Slot. A simple push block (available as an "Online Extra") guides the head to create the blade slot at the table saw.

Make It Square. Glue the blade into the head using the square corner of a scrap panel as a reference guide.



Rivet Holes. Drill pilot holes for the rivet shank. Then drill shallow counterbores so head is slightly proud.

Peen the Rivets. Using the anvil on the back of a bench vise, seat the rivets to permanently secure the blade.

Final Sanding. Apply sandpaper to the saw table to smooth the faces and level the rivets with the fence as a guide.

heirloom Brass Compass

Sharpen your shop skills by making this custom designed layout tool. You'll even learn simple techniques for working with brass along the way.

Every once in a while, I like to expand my horizons when it comes to shop projects. This compass is the perfect example. Made entirely from brass and steel, this layout tool is sure to be the perfect addition to any shop. Plus, you'll pick up some new skills by working with materials you may not often use.

If the thought of working with brass and steel seems intimidating, don't worry. There's really not a whole lot of difference from working with wood. The metals I selected for this project are easily machinable with common woodworking tools you probably already have in your shop.

The brass can be cut on a band saw with a standard wood-cutting blade. (I used a $\frac{3}{16}$" blade with 10-tpi.) A hacksaw works well to cut the steel. Some files and a stationary disc sander are great for cleaning up the cut edges.

The only real difference to working with metals is that instead of using glue to hold parts together, you'll use solder. If you've ever sweated a copper pipe fitting, you'll find the process much the same. There are just a few "specialty" items you'll need (photo at left). I'll talk more about the soldering procedure in a bit.

CUTTING THE PARTS. You'll find a full-size pattern for the six main parts of the compass on page 19. The patterns can be copied, cut out, and glued to the flat brass stock with a little spray adhesive. (The tip of the pivot leg is glued to a steel blank.) As shown in Figure 1 on the next page, you'll then move to the band saw to cut out the parts. Take your time with this process. The closer you get to the layout lines, the less filing and sanding you'll need to do later on.

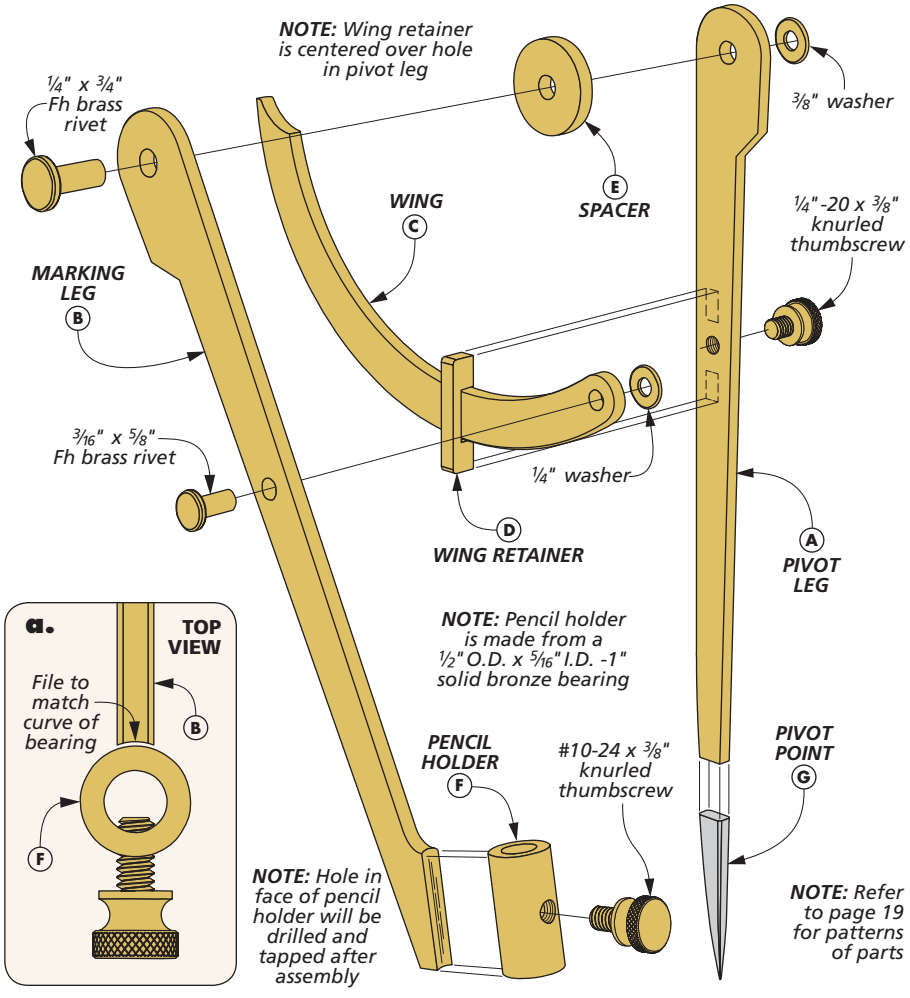
And one more note about cutting these parts: You'll want to leave the bottom of the pivot leg a little wide for now. The final shaping will be done after the pivot point is soldered in place. (The same applies to the upper end of the steel point.)

FILE & SAND. After cutting out the parts, now is the time to break out the files and sanding supplies. For the areas that require quite a bit of material removal, I started with a coarse file and transitioned to a smooth file before switching to sandpaper. A three-sided taper file and a round file are also useful tools to have on hand. In addition, a combination disc and belt sander makes quick work of smoothing the edges. For the wing, I installed a sanding drum in my drill press.

The marking leg of the compass will eventually have a bronze bearing soldered to the flat area near the bottom of the leg. This bearing is the pencil holder. I used a round file to make a shallow, concave depression on the leg to match the shape of the bearing (detail 'a', at right).

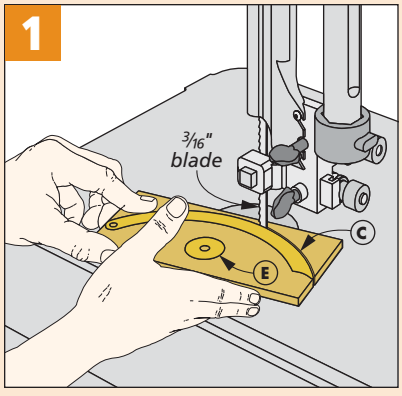
LAY OUT & DRILL HOLES. With the main parts of the compass in shape and sanded smooth, some holes are needed in a few of the parts for assembly and operation. (Check the patterns on page 19 for sizes and locations.) All these holes are easy to make at the drill press (Figure 2). Don't forget the hole in the spacer and the wing, as well.

TAP THE LOWER HOLE. The lower hole in the pivot leg houses a knurled thumbscrew.

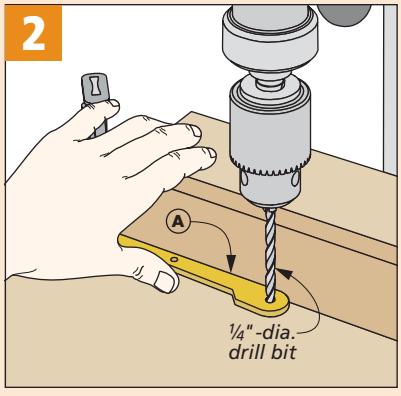


The thumbscrew locks the wing in place against the retainer while in use. Use the proper size tap to cut threads in this hole as shown in Figure 3, below. At this point, all of the parts needed to make the compass are cut to shape with the edges filed and sanded smooth. Turn to the next page where you'll start putting some heat to the project and bringing things together.

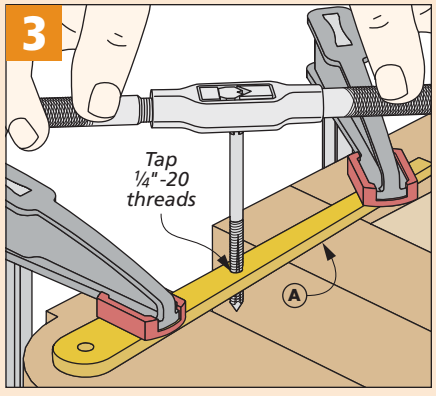
How-To: Cut & Shape Brass Parts



Cut out the Parts. A wood-cutting blade in the band saw slices through the machinable brass with ease.



Drill Multiple Holes. Lay out and drill all of the holes in the pivot and marking legs, as well as the wing.



Tap Hole in Pivot Leg. The lower hole of the pivot leg needs threads tapped to accommodate a thumbscrew.

solder & shape Brass & Steel

Soldering. A pair of vise grips help hold the marking leg at the correct angle while you solder it to the bronze bearing. A couple of fire bricks protect the worksurface.

Now the process will start to feel a little bit like a science experiment. As you can see from the photos on this page, there are three components that need to be joined together using a soldering process. More specifically, you'll be using a silver-soldering method (also called silver-brazing). This simply means that the solder has a high silver content and melts at a higher temperature than regular solder, thus creating a very strong joint. This method is needed because of the thickness of the parts being used.

Sources (page 98) has information on where to find the items you'll need for silver-soldering. In addition to solder, you'll need to pick up a flux specifically made for use with silver solder. Also, because of the higher melting temperature of silver solder, a bottle of MAPP gas (also called MAP-Pro) is needed. For safety reasons, I recommend getting a torch head with a trigger start. This style ignites by squeezing the trigger, and more important, extinguishes when the trigger is released.

BRING THE HEAT. With all of the supplies gathered, you can now prepare the parts for silver-soldering. The key to a strong joint lies in four simple steps. First, make sure you have tight-fitting joints between the parts to be soldered. While the solder will fill a slight gap, anything wider than about the thickness of a playing card could result in a weak joint. Second, clean the parts of dirt and oils. Sandpaper does a great job for this.

How-To: Solder Parts & Add Final Details

Wing Retainer. The wing retainer is soldered in place first. It sits on the pivot leg so no clamps are required.

Add the Steel Tip. With the parts butted against each other, solder the steel tip to the end of the pivot leg.

Shape the Point. After everything has cooled, use a file to do the final shaping where the steel tip meets the pivot leg.

Sand the Parts. A piece of adhesive-backed sandpaper on a flat board provides a good surface for sanding.

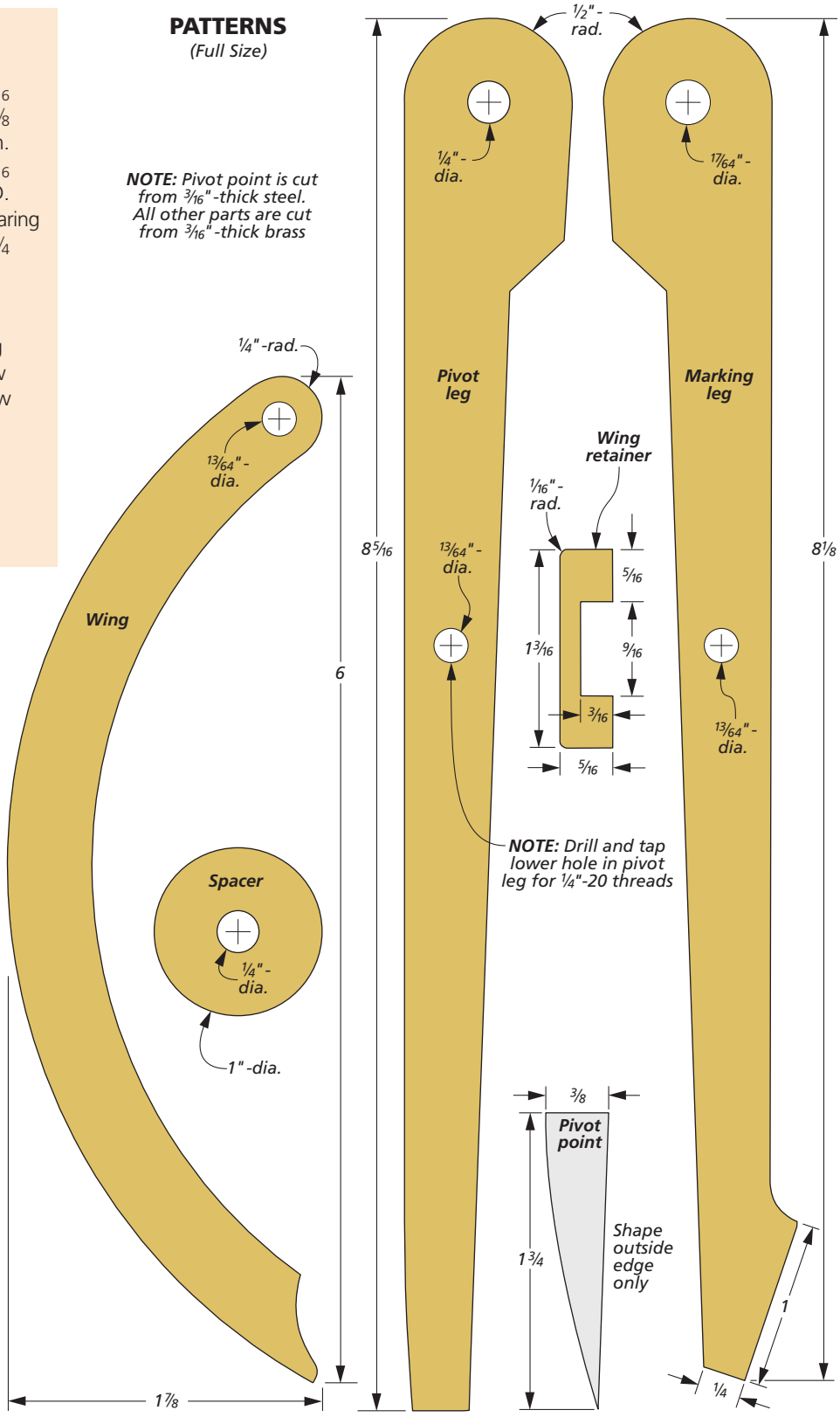
Drill & Tap. After drilling a hole in the side of the pencil holder, use the proper size tap to cut the threads.

Peen Rivet over Washer. Gently peen the soft rivet over the face of the washer to secure the legs together.

MATERIALS & SUPPLIES

A	Pivot Leg (1)	3/16" brass - 1 x 8 5/16
B	Marking Leg (1)	3/16" brass - 1 x 8 1/8
C	Wing (1)	3/16" brass - 2 x 6 rgh.
D	Wing Retainer (1)	3/16" brass - 5/16 x 13/16
E	Spacer (1)	3/16" brass - 1"O.D. x 1/4"I.D.
F	Pencil Hldr. (1)	1/2"O.D. x 5/16"I.D. - 1" bearing
G	Pivot Point (1)	3/16" O1 steel - 3/8 x 1 3/4

- (1) 3/16" x 1" - 24" Machinable 360 Brass
- (1) 3/16" x 2" - 6" Machinable 360 Brass
- (1) 3/16" x 1" - 6" O1 Tool Steel
- (1) 1/2"O.D. x 5/16"I.D. - 1" Bronze Bearing
- (1) 1/4"-20 x 3/8"-dia. Knurled Thumbscrew
- (1) #10-24 x 3/8"-dia. Knurled Thumbscrew
- (1) 1/4"-dia. x 3/4"-long Brass Fh Rivet
- (1) 3/16"-dia. x 5/8"-long Brass Fh Rivet
- (1) 1/4" Brass Washer
- (1) 3/16" Brass Washer
- (1) Brass Colored Solder - 6 Ft.



Third, immediately after the parts are cleaned they should be coated with flux. The flux further cleans the metal and prevents oxides from forming while the soldering takes place. And finally, apply plenty of heat and be patient. The idea is to get the metal hot enough so it (and not the flame) melts the solder. The hot metal will pull the solder into the joint by capillary action.

Start by joining the wing retainer and steel tip to the pivot leg. The bronze bearing (pencil holder) then gets attached to the marking leg (Main photo and Photos 1 and 2, previous page.)

FINAL SHAPING & CLEAN UP. After everything has cooled, you can complete the final shaping of the pivot leg where the steel tip meets the brass. A file and vise works well for this, as shown in Photo 3 on the previous page.

The parts will also be discolored and unattractive after the soldering process. But with a little elbow grease they'll clean right up. I used a piece of adhesive-backed sandpaper on a flat surface to brighten the brass and give the parts a consistent scratch pattern. Working up to 400-grit gave the parts a nice look.

All that's left before the compass can be assembled is to drill and tap a hole on the pencil holder for a thumbscrew. This is the same process you used on the pivot leg earlier (Photo 5).

ASSEMBLY TIME. A brass rivet holds the compass together. Sandwich the spacer between the marking leg and the pivot leg. Put the rivet through the hole and place a brass washer on the other end of the rivet. Gently peen the end of the rivet over the washer, ensuring the parts still move freely (Photo 6, previous page). Attach the wing to the marking leg in a similar fashion (no spacer this time).

Finally, insert a pencil in the pencil holder and secure it with the thumbscrew. This quality tool is now ready to go to work in the shop.

2 precision Layout Gauges

Exotic wood and solid brass come together in a pair of handy layout tools.

Layout is one of the first tasks in any woodworking project. The two shop-made layout gauges you see in the photo above can help make that task easier and more accurate.

The two gauges work as a team to handle both straight and curved layout work (photos at right). The pencil point fits into small countersunk holes in the end of each adjustable brass bar for making quick, accurate layouts.

They're a great way to use up small pieces of scrap you just couldn't throw away. Plus, you can start on them in the morning and be using them on a new project in the afternoon.

LAYERS & SMALL PARTS. Each gauge consists of a top that attaches to a body with a pair of brass thumbscrews. You can see how things fit together in Figure 2, page 23. The thumbscrews

Straight Lines. Adjust the gauge bar, then set the tip of your pencil in place to draw even layout lines quickly and easily along any straight edge.

Curves. Easily follow an outside curve (right) or a changing inside curve (inset).

fit into threaded inserts installed in the body and pinch the brass gauge bars to lock in your measurement. Adding a cap to each of the tops provides a finished look.

OVERSIZED BLANKS. Because all these pieces are rather small to work with safely, it's best to start with oversized blanks. This way, you can complete most of the tasks on workpieces that are easier and safer to manage. Plus, it makes it easy to build both gauges at the same time (Figure 1).

PATTERNS. Once you have the blanks sized, the next step is to lay out the location of the holes for the threaded inserts, the dadoes for the gauge bars, and the overall shape of each of the pieces. An easy way to do this is to use the patterns shown at right.

You'll need two of the lower right pattern, one for the top blank, and a second one for the cap blank. Spray adhesive makes quick work of attaching the patterns.

IDENTICAL DRILLING. Even with the patterns, drilling the holes identically in mating pieces can be a challenge. To ensure accurate and consistent alignment, I used my drill press fence and positioned a stop block to drill the first stopped hole for the insert hole at the outer edge (lower left photo).

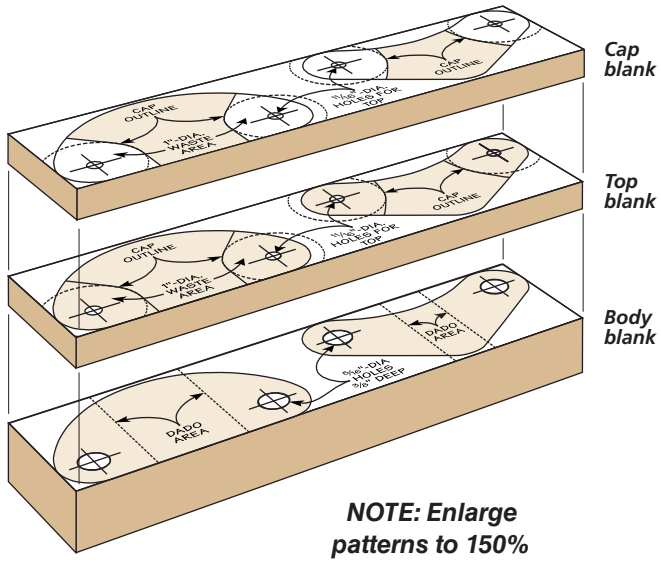
To drill the hole for the other insert, just slip in a spacer (center photo below). Then, simply repeat the steps to drill the holes for the inserts at the opposite end of the blank. After swapping out drill bits, you can use the same steps to drill mating holes in the top blank.

1 FIGURE

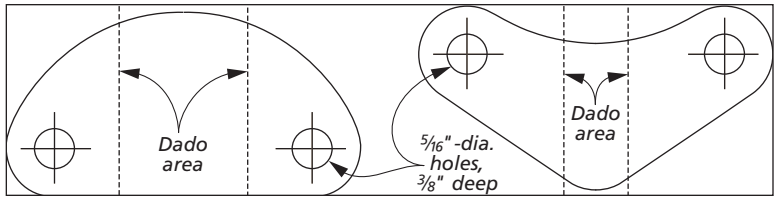
NOTE: Attach pattern to each blank with spray adhesive

NOTE: Body blank is ½" thick, top and cap blanks are ¼" thick. All blanks are 1½" x 6"

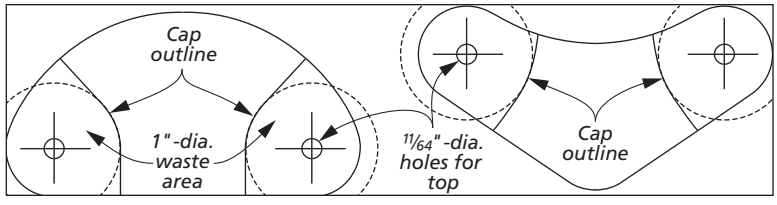
NOTE: Insert holes are sized to match outside diameter of insert for easy installation and drilled ⅜" deep for a flush fit with the face of the blank



NOTE: Enlarge patterns to 150%



Body Blank. Use this pattern to locate the holes for the threaded inserts, as well as the dadoes for the brass bars that are added later.



Top/Cap Blanks. This pattern guides the work on both the top and cap blanks, along with the final shaping of the marking gauges.

This procedure keeps the top aligned with the body for final shaping. And you can rest assured that the top and body will stay aligned during use. You can use this same setup later to begin shaping the caps, so don't make any changes. For now, you can turn the page and focus your attention on cutting the dadoes for the brass gauge bars.

Setup. After setting the fence and stop, drill the stopped hole at the outside edge of the body blank for the threaded insert.

Reposition. A 2" spacer repositions the blank for the other insert hole. Repeat the procedure for the other end of the blank.

Top Holes. Use the same setup to drill perfectly aligned holes for the thumbscrews that hold the top in place.

completing the Gauges

Locating the holes in each blank is the most critical part of building the layout gauges. With that step complete, you can start on the last few steps: creating dadoes for the brass gauge bars, adding a cap to the top, and final shaping.

CUTTING THE DADOES. The brass gauge bars used to guide a pencil during layout work fit into dadoes cut into the body of each gauge. As you can see in the upper photo, I used a dado blade in the table saw to cut these shallow dadoes.

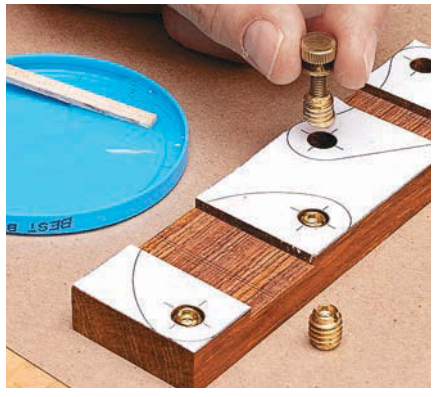
The goal here is a smooth, sliding fit. So before you cut the dadoes, be sure to have your brass bar stock in hand. This way, you can check the width of the dado and sneak up on a perfect fit, like you see in the photo at right.

You'll also want to make sure that the dadoes are shallow enough so that the bars stick up above the surface slightly (about 1/32"). This way, when the knobs are tightened, the top pinches the bars to lock them in position.

Each dado is centered between the two holes you drilled earlier for the threaded inserts. You don't need to be perfect here, it won't affect the use of the gauge. Just be sure to size the dado for the straightline gauge to accept two bars. You'll only need to cut a dado for a single bar in the body of the curved gauge. The two bars in the straightline gauge allow you to keep a pair of commonly used measurements always at the ready or use the gauge for laying out a mortise or groove along the edge of a workpiece.

Dadoes. Cut centered dadoes to match the width of the gauge bars.

Shallow Dadoes. The gauge bars should project slightly above the dado and slide smoothly back and forth within it.

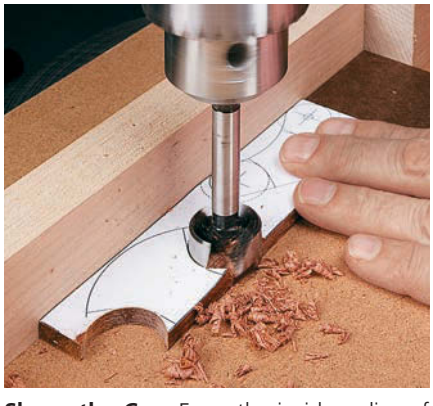


Install the Inserts. Use epoxy to secure the threaded inserts into the stopped holes drilled in the gauge body.

INSTALL THE INSERTS. With the dadoes complete, you're ready to install the threaded inserts. When I drilled the holes for the inserts, I sized them to match the outside diameter of the threads. This way, installing them won't crack the body. But you will need to use epoxy to hold them in place (lower right photo above).

SHAPING THE CAPS. While the epoxy sets, you can work on the caps. They're added to each top to provide a finished look to the gauge. Plus, it makes each gauge more comfortable to hold during use. Although you could head straight to the band saw and cut each cap to final shape I started with my drill press.

Using the same setup as before, drill out the inside curved edge of each cap

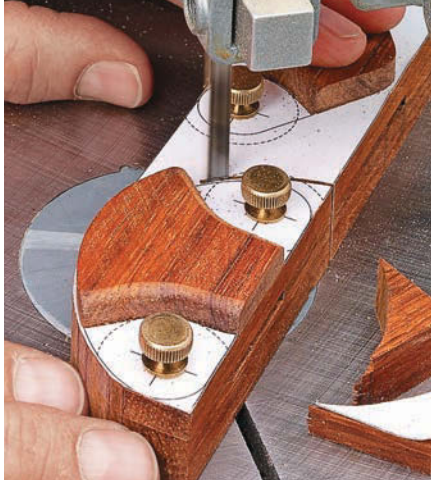


Shape the Cap. Form the inside radius of the cap first, then trim the remaining waste away at the band saw.

Locating the Cap. Use each cap as a guide to score the pattern, then remove those pattern pieces from the top.

Attach the Cap. The removed pattern provides a reference for gluing and clamping the cap in the correct location.

Assemble the Blanks. Join the top plate (and caps) to the body blank using the knurled brass thumbscrews.



Shape the Gauges. Using the pattern as a guide, trim each gauge to rough shape at the band saw.

Final Shaping. All it takes is a few minutes of sanding to complete the final shaping and smoothing of each gauge.

(lower left photo on the opposite page). This way, you only had to make a couple easy straight cuts to complete the inside curves. After cutting the outside edges to final shape, sand a small roundover on the top, inside edge of each cap to provide a little finger clearance.

ATTACH CAP. With the caps shaped, they're ready to be attached to the top blank. To make it easy to align the caps and glue them in place, I removed some of the paper pattern on the top. You can see how I did this in the center and right photos at the bottom of the opposite page.

FINAL SHAPING. Your next task is to make sure the outside shape of each gauge is smooth and even. For this, you can set the top blank in place and use the knobs to secure it to the body, as shown in the photo at the upper left.

Now all you need to do is a little work at the band saw to remove most of the waste (center photo above). Then, some hand sanding takes care of smoothing out the final shape (upper right photo). Once this is done, remove the rest of the pattern. Any adhesive residue can be wiped off with a rag and some lacquer thinner.

BRASS GAUGE BARS. The layout gauges are really coming together at this point, but you still need a way to accurately guide the pencil during use. For that, you'll need to make a set of brass gauge bars. You'll find all the information for making them in Figure 2 and the margin drawing at right.

To "trap" the pencil in the gauge bar during use, I drilled some small holes near the ends of each bar. The bars for the straightline gauge have a single hole at one end, but you'll need to drill a hole at each end of the bar for the curved gauge.

To complete the bars, I drilled countersinks for clearance around each hole and then rounded the ends with a file. After completing the layout gauges, you'll find they're easy to set up (lower right photo). So don't be surprised if they end up being a couple of layout tools you reach for every day.

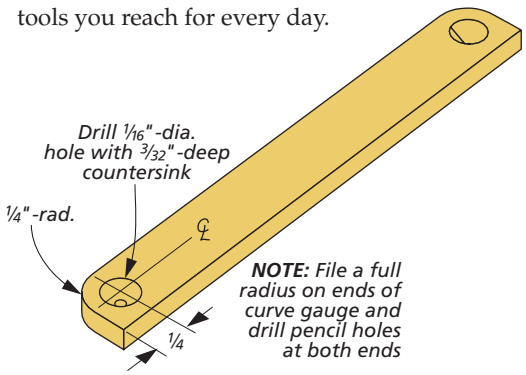
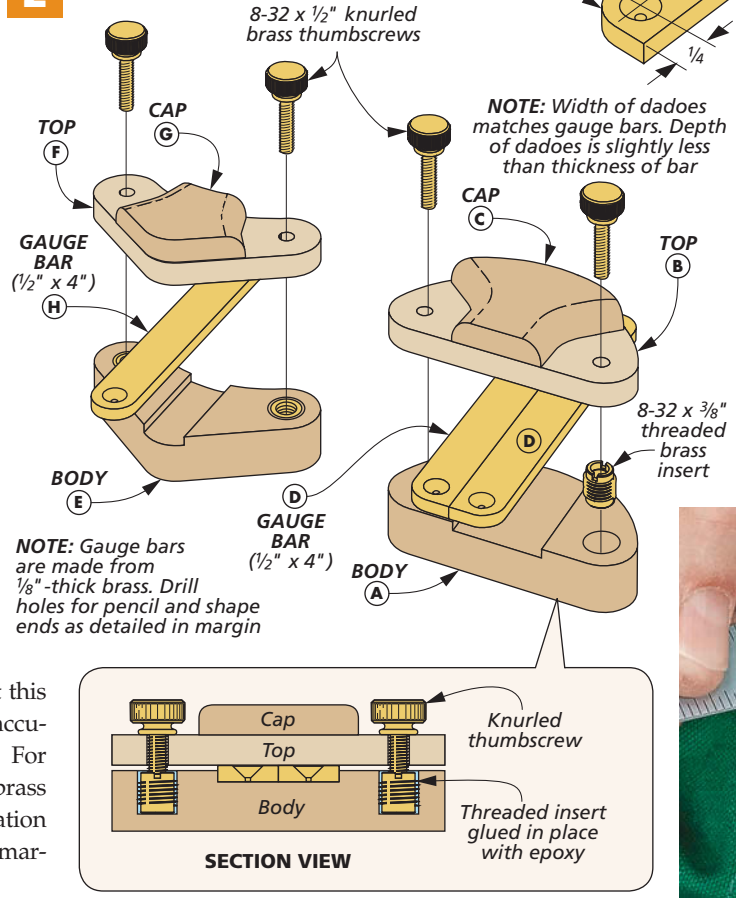


FIGURE 2



Easy Setup. To set a layout gauge, rest a ruler against the body and adjust a gauge bar to match the desired measurement.

hands-on Joinery

What makes your project parts go together — and stay together — is the creation of accurate, proper fitting joinery. The skills and tools that can take your joinery from good to great are within easy reach.

PERFECT MORTISES & TENONS.....26

TOOLS FOR ACCURATE MITERS 28

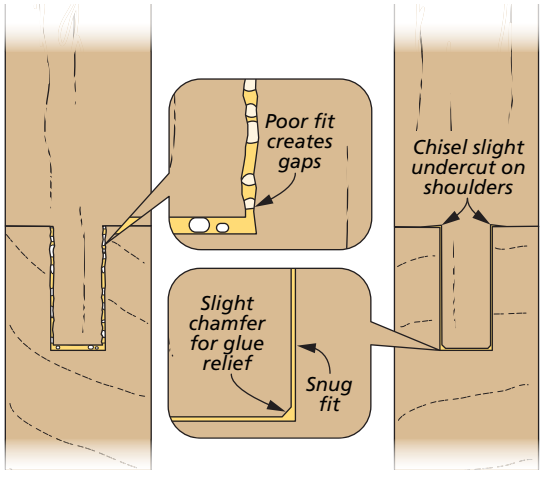
HAND-CUT TENONS 32

SHOOTING BOARD 34

SHOP-BUILT MALLETS.....38

perfecting a Mortise & Tenon Joint

Cutting joinery with power tools works great. But fine-tuning the fit with a chisel and a hand plane kicks your craftsmanship up to the next level.



Good vs. Bad Joinery. The joint on the left has poorly mated surfaces, resulting in a weak bond. On the right, flat glue surfaces create a stronger bond.

Learning to make solid mortise and tenon joinery is a fundamental woodworking skill. And with the power tools in most woodworking shops, it's not a difficult joint to make. You just drill out most of the waste for a mortise and clean up the sides of the mortise with a sharp chisel. After that, it's just a matter of cutting a matching tenon on the table saw using either a dado blade or a tenoning jig.

Before going any further, it's worth taking a closer look at the joint. As you can see in the drawing at left, a mortise with uneven walls combined with a tenon that still has saw marks makes for a joint that has two unmatched components and a lot of surface that never comes in contact.

No matter how strong your glue is, it can't save a joint like this. The second drawing shows a tight-fitting mortise and tenon joint. The smooth walls of the mortise and the flattened face of the tenon provide plenty of surface contact for the glue to do its job. So, the question is, how can you turn the rough-sawn tenons and drilled-out mortises into a tight-fitting joint.

The answer is in learning how to use a couple of hand tools effectively. The first tool is a chisel, or in this instance, a couple of chisels.

With a chisel, you can pare away the ridges left by the overlapping drilled holes and make a smooth surface. The second tool you'll need is a shoulder plane like the one in the main photo on the facing page.

MORTISES

The first step to getting smooth walls is to pare away the ridges left by drilling out the waste. Keeping the chisel straight as you do this can be a challenge. By clamping a shop-made guide next to the mortise and clamping the workpiece to a bench, you can use the guide to keep the chisel vertical (photo at right).

TECHNIQUES. I usually make the first few chisel cuts with the aid of a mallet. This is the quickest way to remove waste. After getting rid of the biggest parts, paring cuts will finish up the mortise.

You'll need to find a position that allows you to use your weight to your advantage. For most of us, this means leaning over the workpiece a little bit so your paring cuts are forceful enough to shave away the waste. That's the important task for now, just getting things smooth on the sides of the mortise.

When you have achieved that, make a final stroke down the side. One stroke guarantees that there aren't any steps, or notches in the mortise. Use the same technique (with a narrower chisel) on the ends of the mortises.

TENONS

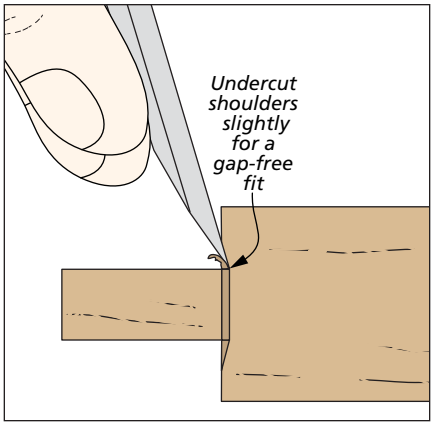
The same problems arise after cutting tenons, especially if you use a dado blade to make the cuts. You can see the ridges on the surface of the cheeks that prevent a good glue bond. Fortunately, the solution is pretty simple.

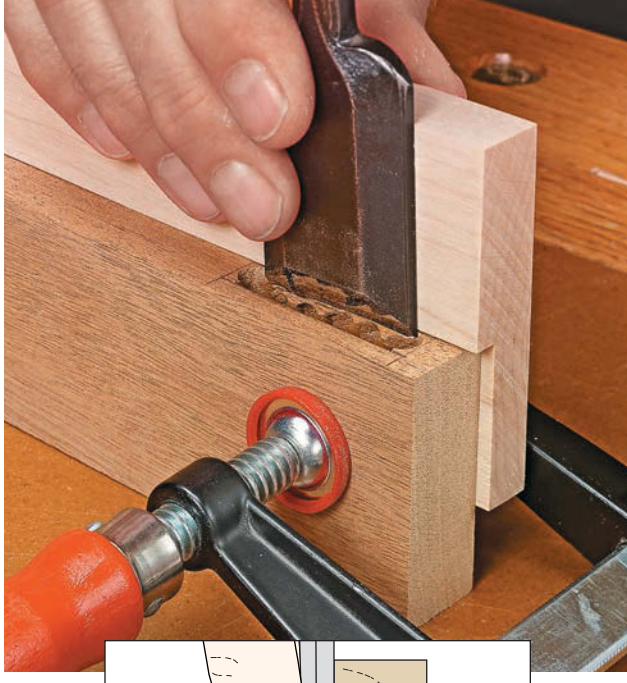
SHOULDER PLANE. To say that a shoulder plane was made for the task of refining joinery is an understatement. The name actually comes from its role in trimming the shoulders of the tenon. One thing that distinguishes a shoulder plane from most others is that the blade is just a hair wider than the plane body. This allows you to cut right up to the corner of a joint.

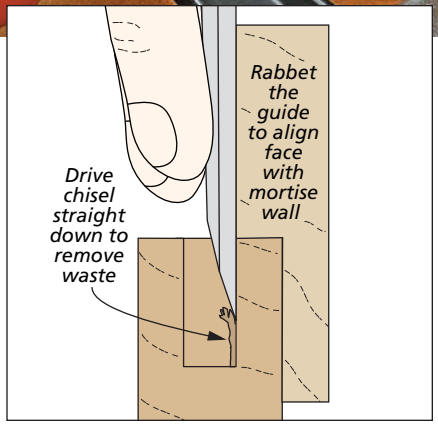
On many shoulder planes, the mouth is also adjustable. This lets you size the opening to suit the task at hand. Open it up a bit for rough work, or bring it close to the blade for fine work. The top photo at left shows how you can use the shoulder plane to smooth the cheeks. The bottom photo shows the plane in use cleaning up a stepped shoulder, which is a small rise from being slightly off the mark at the table saw.

TECHNIQUES. For both tasks, the first step is to secure the workpiece in a vise or clamp it to the bench. With the workpiece secured, there are a just few things to keep in mind.

Plane It Smooth. A shoulder plane makes quick work of removing saw marks on cheeks and stepped shoulders.







Chisel Guide. A simple guide block helps you keep the paring cuts square.

First, set the blade for a shallow cut. You want to take off very thin, wispy shavings as you go. Practice on a test piece using the same stock as your project.

The second thing to watch out for is tearing out the edges of the workpiece as you finish the cut. If the wood fibers are unsupported, you'll need to plane just over halfway, then complete the cut from the opposite edge.

UNDERCUTTING. Another trick for getting a tight joint line is to slightly undercut the shoulders. The idea is to remove a tiny bit of material that could prevent the joint from closing when it's glued up (drawing at left).

With these hand tools and the right techniques for using them, you're well on your way to producing first-class mortise and tenon joints every time.

tools for Accurate Miters

By using this pair of simple shop-made accessories along with your hand planes, creating gap-free miter joints is easier than ever before.

Even experienced woodworkers can struggle when it comes to fitting perfect miters. Whether it's molding that wraps around a cabinet, a small box with mitered corners, or a picture frame, getting gap-free joints can sometimes be a frustrating trial-and-error process.

In spite of all the care and time it takes to set up a miter saw or table saw, getting perfect miter joints can still be a challenge. For me, the revelation was learning to blend the use of power tools with some hand work. The key is learning to use a couple of traditional tools and techniques craftsmen used over 100 years ago. The tools include a hand plane, the miter jack shown in the photo above, and the miter shooting board (page 30).

THE TRADITIONAL METHOD. In the past, craftsmen didn't have the luxury of power saws for cutting joinery. Their tool of choice was an old-fashioned miter box with a back saw. But this hand-cut joinery was just the first step. The woodworker would then reach for his hand plane to fine-tune the cut edge for a perfect match to its mating workpiece. For mitered frames and casing around windows and doors, he might have used a miter jack,

Position the Workpiece. When you clamp the workpiece in the miter jack, leave it slightly proud for trimming.

similar to the one shown at right, to help guide his hand plane to get a perfectly smooth surface for a tight joint.

WIDE JAWS. As you can see in the photo at right, the miter jack is made with wide, angled jaws that secure the workpiece. The fixed and movable jaws are cut at 45° to provide a guide surface for the sole of the hand plane. The press screw allows you to tightly clamp the workpiece between the two jaws. You can get detailed plans for building the miter jack online at *WoodsmithSpecials.com*.

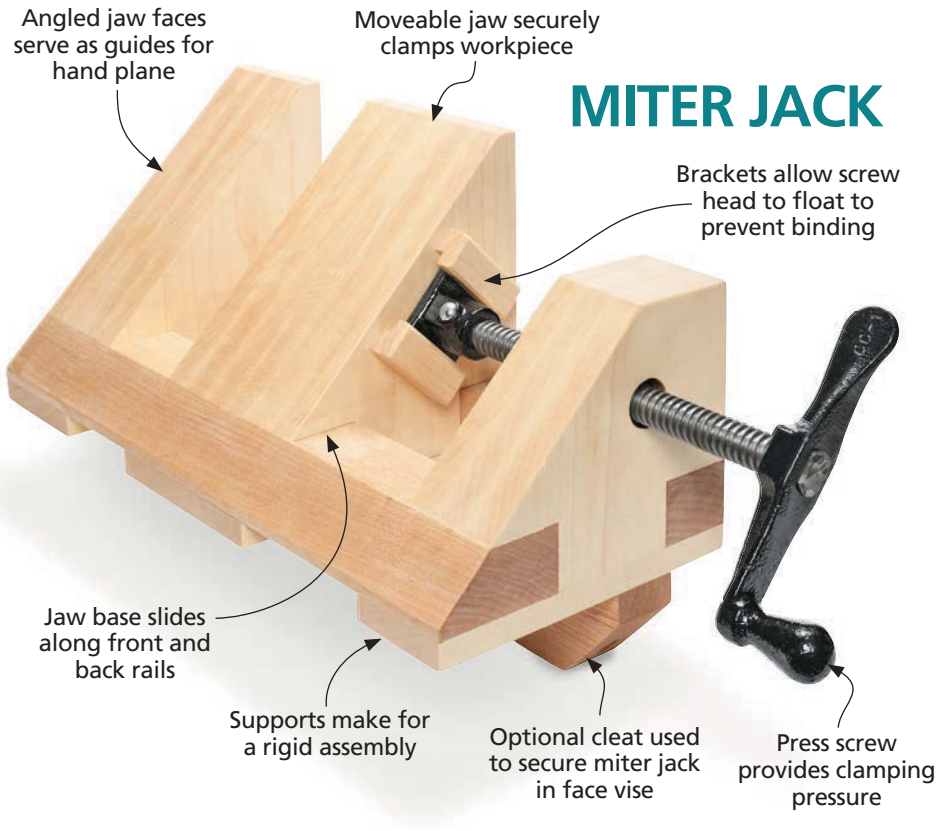
SETUP. Setting up the miter jack for use is pretty easy. The optional cleat allows you to clamp it in the face vise of your workbench. When locating the cleat you'll need to make sure the path of the plane is unobstructed. If your bench has a tail vise and dog holes, you can skip the cleat and simply clamp the miter jack between a pair of bench dogs.

PLANE CHOICE. Before I explain the technique of using the miter jack, I want to talk about the hand plane. You can use any hand plane as long as the iron is razor-sharp.

But I like to use a plane with a low cutting angle. To find out why, turn to page 31. The *Veritas* low-angle jack plane shown in the photos is a good choice.

A block plane is perfectly suited for smaller moldings. Whatever your choice of planes, it should be long enough to span across both jaws with the workpiece clamped in place.

TECHNIQUE. When clamping the workpiece in the miter jack, the mitered end should sit slightly proud of the jaw faces. (The photo on the bottom of the opposite page shows this exaggerated for clarity.)

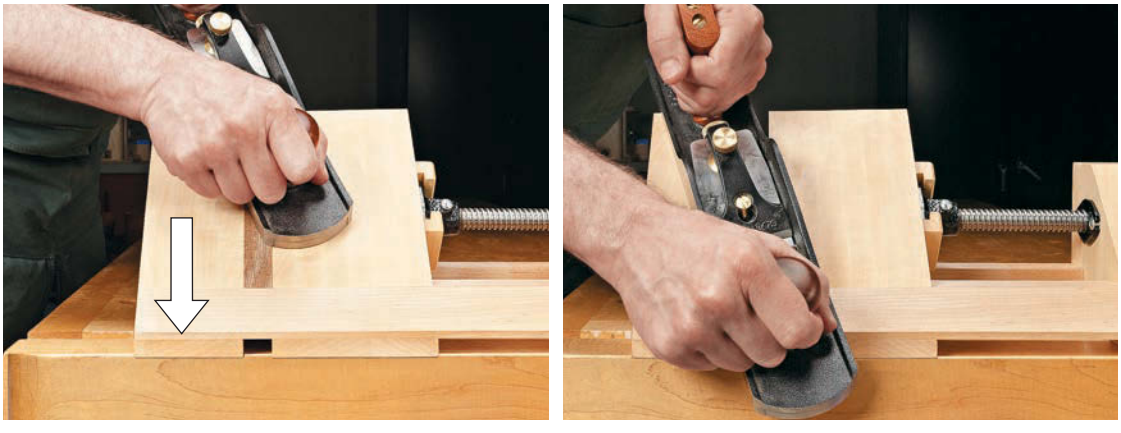


This way, the plane trims the workpiece without cutting into the jaws.

With the plane iron set to take a very light cut, start trimming the mitered end. I do this by starting the cut with the plane at the top of the miter jack and the iron centered on the workpiece (left photo below). I like to skew the plane to ensure the front and rear of the sole are riding on the faces of the jaws. Then make a pass across and down the workpiece, as shown in the right photo below. You're aiming to make the end grain as smooth as glass.

It takes a little practice to learn how to control the plane for a consistent cut across the end of the workpiece. And you'll learn when to stop planing before cutting into the surface of the jaws. The key to smooth, square cuts is to let the faces of the jaws guide the hand plane as you make repetitive cuts across the piece.

TEST FIT. After truing up the miter, check the fit of the joint on your project. If it needs a little more tweaking, clamp the workpiece back in the miter jack to fine-tune the fit. I'll talk later about some tips and techniques for creating seamless joints.



Several Passes. Starting at the top edge of the workpiece (left photo), make a full pass across the end grain (right photo). After a few light passes, check the fit of the workpiece. Then repeat the process if necessary.

GO 2 Online Extras

To find detailed plans for the miter jack and donkey's ear, go to:

WoodsmithSpecials.com

trim miters with a **Donkey's Ear**

The accessory shown above is a modern adaptation of a miter shooting board, sometimes called a "donkey's ear." It's designed for trimming the ends of wide miters, like those on a small box or the molding that wraps around a cabinet. My version is made from Baltic birch plywood for strength, straightness, and stability. The photo at the top of the opposite page points out the important features. To get plans for the donkey's ear, go online to *WoodsmithSpecials.com*.

Setting Up the Cut. Using the sole of the plane as a stop, slide the workpiece up until it contacts the plane. Then you can trim the end.

Shooting the Miter. With a sharp iron set to take a fine cut, make several passes to clean up the miter.

ANGLED SHOOTING BOARD. The donkey's ear is a close cousin of the shooting board. The difference is that the bed supports the workpiece at 45° so that the plane's iron can trim the miter. But the technique for using it is the same as for a shooting board. The plane is laid on its side and pushed to slice the end grain, as you can see above.

TECHNIQUE. The photos at left show you how to get started when positioning the workpiece for the cut. I use the sole of the hand plane as a stop. To do this, slide the plane up against the edge of the bed of the donkey's ear. Then place the workpiece against the cleat and slide it up until it contacts the plane's sole.

A LIGHT CUT. When making end-grain cuts like this, I set the plane to take a fine shaving. It requires less effort to slice through the wood fibers.

The first time you use the donkey's ear, the plane's iron will cut away a small section of the bed and a thin section from the end of the cleat. This is normal and isn't a cause for concern.

GENERAL TIPS & TRICKS

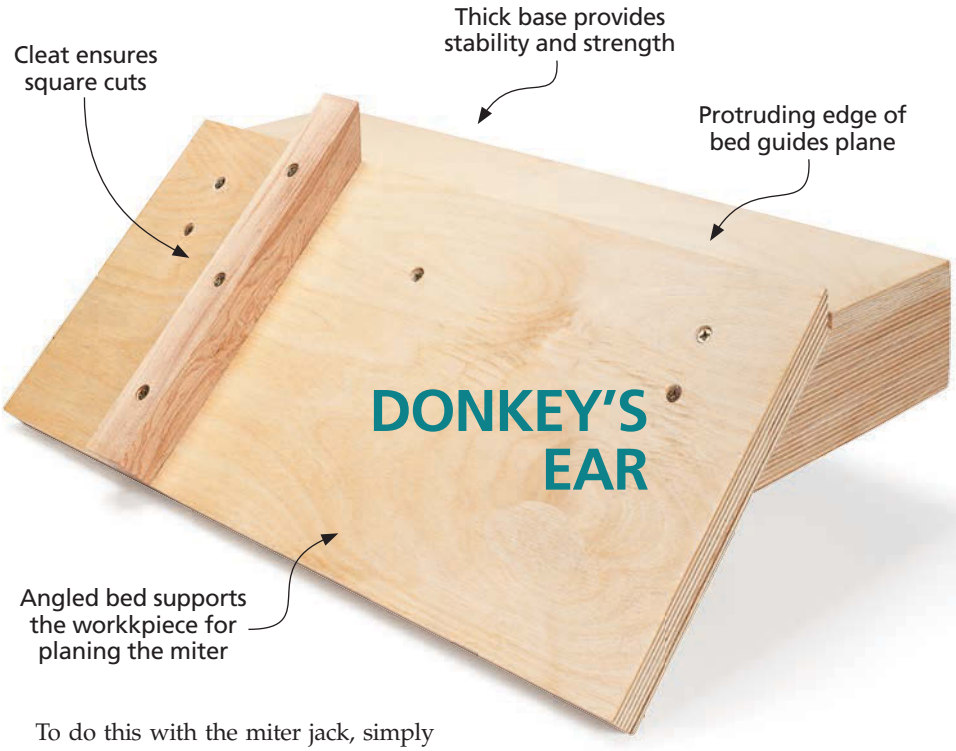
There are a few things I want to point out that will get you on your way toward creating seamless miter joints. These tips apply whether you're using the miter jack or donkey's ear.

SHARP PLANE. The first thing you'll need to do is make sure the iron on your plane is razor sharp. A few minutes spent honing the edge makes shaving end grain almost effortless.

LOW-ANGLE PLANE. As I mentioned before, you can use a standard hand plane, but I prefer a low-angle plane as shown in the box below. The lower cutting angle works better on end grain.

WET THE END GRAIN. If it's a struggle to trim the end grain, you can use a trick some of the old-timers used. And that's to wet the surface to soften the wood fibers. Water, denatured alcohol, or mineral spirits work well.

SHIM TO FIT. As you've probably experienced, there always seems to be a gap in at least one of the joints when assembling a mitered frame. Closing up such a gap is where these accessories really prove their worth. They make it easy for you to shave off the heel or toe of the miter until the joint fits perfectly.



To do this with the miter jack, simply tilt the workpiece slightly as you tighten the jaws to clamp it. Your goal is to leave the heel or toe proud so you can easily trim it. To accomplish this on the donkey's ear, place a thin shim under the workpiece where needed to allow trimming the heel or toe of the miter to fit.

PERFECT RESULTS. For me, the mystery of seamless miter joints was solved once I learned how to use these time-tested accessories. I think you'll agree that the results you get are worth the investment of time involved in making them.

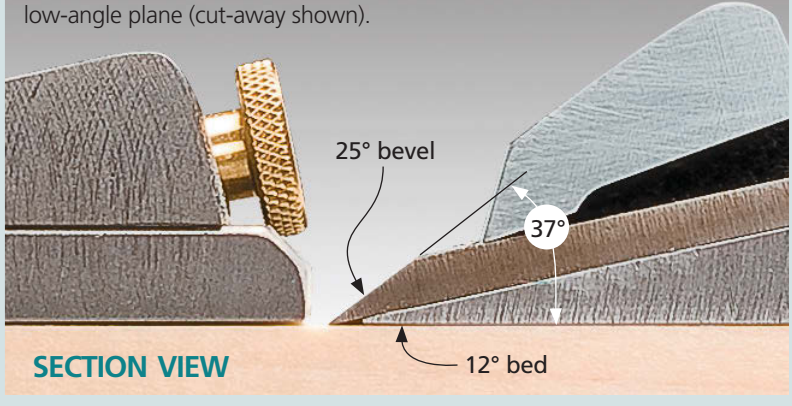
Low-Angle Plane

When faced with the task of shaving the end grain of a workpiece to create a perfect joint, I rely on a low-angle hand plane. Sometimes referred to as a "bevel-up" plane, it's particularly suited for this task because of its low cutting angle. Low-angle planes are available from several manufacturers.

As you can see in the detail photo, the plane iron is bedded at 12°. Combined with a 25° bevel on the iron, this results in a 37° cutting angle. This lower angle means there's less effort required to slice across the wood fibers of end grain. The end result is a smoother cut that shaves the end grain clean.

Low-angle planes range in size from small block planes to 15"-long jack planes and larger. For trimming miters using a shooting board or donkey's ear, you'll want to look for a plane with sides machined flat and square to the sole.

It's All About Geometry. Getting a glass-smooth surface on end grain is best done with a sharp iron installed in a low-angle plane (cut-away shown).



hand-cut Tenons

Here's an easy technique for building your hand tool skills and making tight-fitting joints.

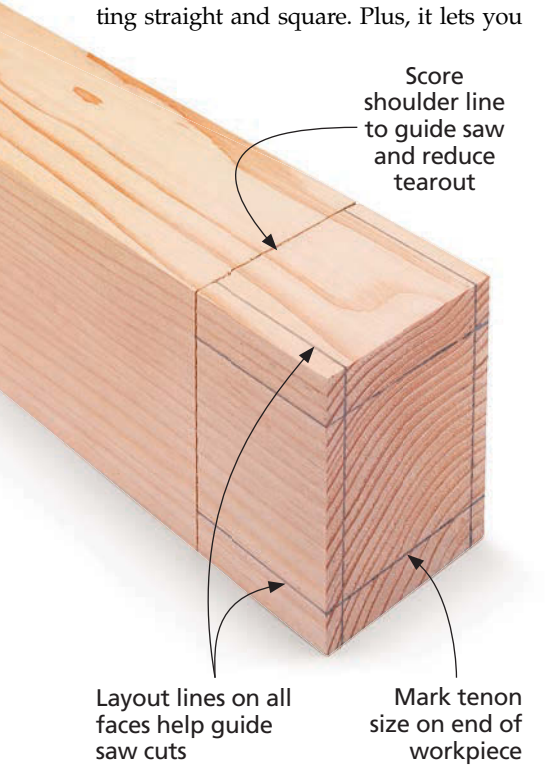
When it comes to hand-cut joinery, most woodworkers think of dovetails. But there's another traditional joint that's less intimidating to master — tenons. Cutting tenons by hand can be the way to go in several situations. For one, it builds skills like making accurate layouts and cutting straight and square. Plus, it lets you recapture an enjoyable, Old-World way of crafting joinery. Plus, for large tenons like the ones shown here, it can actually be a better method than using a table saw.

The photos on these pages give you a good overview of the steps involved in hand-cutting tenons. In addition, I'll provide some other tips and tricks to get the best results.

LAYOUT. Cutting a tenon begins with an accurate layout. The layout serves as a road map for the saw cuts. It's a good idea to have the mortises complete before you get started. This way, you have a reference to lay out each tenon.

THICKNESS & WIDTH. Begin by marking the thickness and width of the tenon on the end of the workpiece (photos below). It's a good idea to lay out the marks so the tenon ends up just a hair larger than the mortise. This avoids the problem of ending up with a tenon that's too small. And it won't take much time to fine-tune the tenon for a perfect fit later on.

TENON LENGTH. The next step is to mark the length of the tenon. Here I do things a



Thickness. Line up the tenon piece with the edge of the completed mortise. Then mark the thickness of the tenon.

Width. Rotate and turn the workpiece to mark the width on the other edge. Extend the marks across the end with a square.

little different. I like to use a cutting gauge (upper left photo on the opposite page). The scored line creates a starting point for the saw. This results in a cleaner line at the shoulder when the joint is assembled.

The final layout step is to carry the marks from the end of the workpiece across the faces and edges (upper right photo on the facing page).

CUT THE SHOULDERS. With the layout complete, you can start cutting. And the tool for this job is a medium-sized back saw. The stiff back helps keep the blade traveling straight during the cut. Although you can buy an expensive, specialty saw, an inexpensive pull saw like the one shown here will do the job just fine.

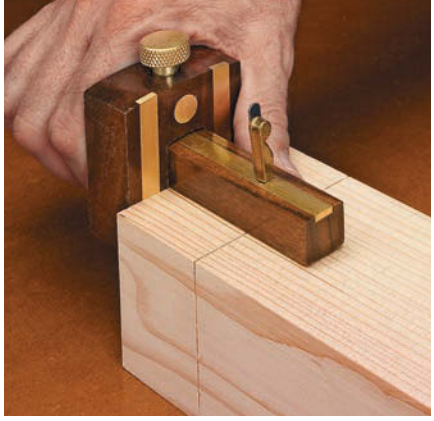
The first cuts define the shoulders, as in the lower left photo. The scored lines make it easy to align the saw. Place the saw in the scored line and start cutting. Keep the saw level to avoid cutting past the layout lines. Stop when the saw teeth just contact the layout lines on the front and back.

CHEEK CUTS. The next cuts will form the cheeks. It's best to cut these with the workpiece held securely in a vise. The key to great results is getting a good start.

The way I do this is shown in the main photo on the opposite page. By tilting the workpiece, I can use the layout lines on the end and face to cut straight and square.

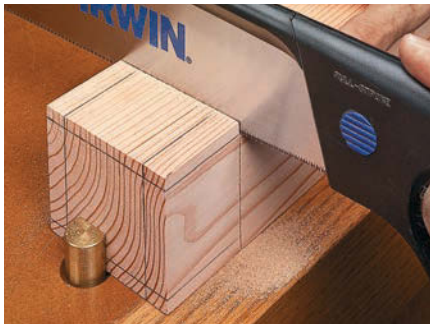
Once the kerf is established, lower the front of the saw and cut parallel to the shoulder line. Bring the saw down in long, even strokes. As you approach the shoulder line, slow down and make a few light strokes until the waste piece just falls away. Repeat the process for the opposite tenon cheek. After making two cuts, you'll need to re-mark the layout lines on the freshly cut faces. Then after two more cuts, the tenon is complete.

Now it's time for a test fit. Since the tenon was cut oversize, you'll need to do some fitting. Take a look at the box below for some tips. Your goal is a tenon that slips into the mortise with hand pressure.



Shoulders. With a cutting gauge, score the shoulders to establish the tenon length.

Cheeks. Transfer the marks on the end of the workpiece down each of the faces.



Shoulder Cuts. Clamp the workpiece to the bench and cut all four shoulders.

Cheek Cuts. Level the saw to complete the cheek cut. Take it slow to avoid overcutting.

Perfect Tenon. Crisp shoulders and smooth cheeks ensure a strong joint that also looks great.

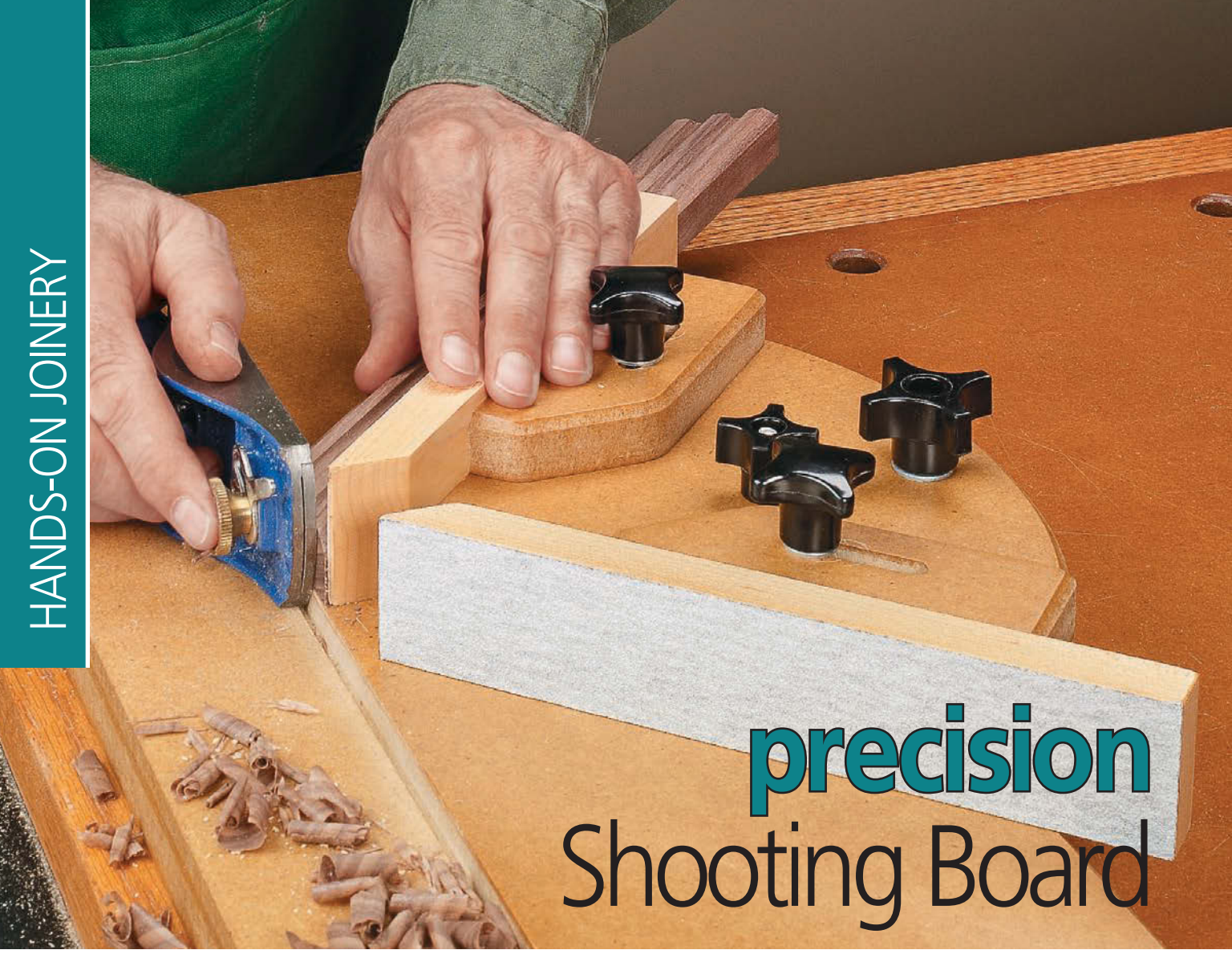
Fine-Tuning Tenons

It would be nice if the tenon fit snugly in the mortise right off the bat. And the more practice you get, the easier this is to do. But it's best to cut the tenon a little oversize. This way, all it takes is a some fine-tuning for the tenon to slip snugly in place.

The first thing to do is to compare the tenon to the mortise to see where the fit is too tight (first photo at right). From there, you can use a hardwood sanding block to touch up the faces, as in the second photo. Be sure to sand equally on both faces to keep the tenon centered on the workpiece.

Test Fit. Angle the tenon and compare it to the mortise to find out where the tenon needs more work.

Sanding Block. A hardwood block with sandpaper on one face makes quick work of fine-tuning the fit of the tenon to the mortise.



precision Shooting Board

This must-have jig allows you to take whisker-thin shavings off the end of a workpiece to fine-tune the fit of a joint.

Though miter joints are fairly easy to cut quickly, they don't always fit together perfectly when you're building a frame, a box, or other square assembly. To solve the problem, shop craftsmen have been making use of shooting boards for centuries. As you can see above, the concept is pretty simple. You cut the miter to its rough angle with a saw first. Then, the shooting board, paired with a block plane, handles the work of honing in on the fit. Just shave a bit off the end of the workpiece at a time, until the miter mates up perfectly.

The reason a shooting board is a must-have for the shop is that it allows for precision, paper-thin cuts in a manner that's just about impossible to accomplish with a tool like a table saw or miter saw. And the optional sanding "plane" (photo at right) lets you make even finer adjustments to a miter joint, or simply sand a surface smooth.

Sanding Block. Another option for fine-tuning the fit of a mitered workpiece is to use this shop-made sanding block. It slides along the base just like a hand plane.

OVERVIEW. The shooting board is a base made from two layers of ¾" MDF with a cleat for clamping the jig in a bench vise (Figure 1). The base serves an important purpose. A rabbet along the edge of the base guides the hand plane (or sanding block) in a straight path as you trim the workpiece.

Later, a pair of fences are attached to an adjustable stop so you can quickly and easily set the fences to 45° or 90°, or lock in any angle in between. And the fences adjust to back up the workpiece and prevent tearout.

START WITH THE TOP. Since most of the detailed work is on the top layer of the base, that's where I started. The first step is to cut the top to overall size and then do a little layout work.

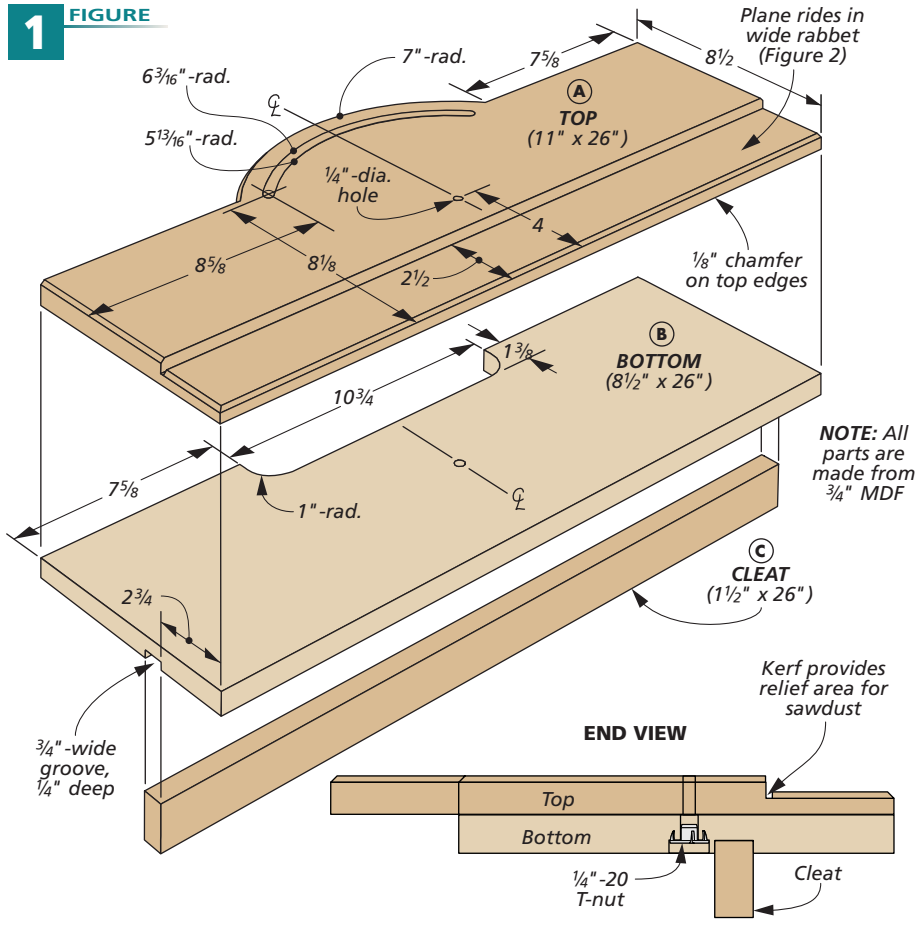
The key to the layout is locating the hole for the pivot pin. It's used to mark the curve along the edge of the top as well as the location of the curved slot used to lock the pivoting stop block in place.

Once you have the layout work completed, you can cut the curved slot. To make quick work of this, I drilled out the ends of the slot and then used a jig saw to remove the waste. I used my jig saw to complete the shaping along the edge of the top, as well.

ADD THE BOTTOM. To build up the base, I added a bottom layer. As in Figure 1, the bottom is sized to match the overall length of the top and its width matches the width at the ends of the top.

Before gluing it to the top, you'll need to create a notch along one edge for the fence locking system that's added later. And to accept the ¾" MDF cleat, you'll need to cut a groove in the bottom face. The cleat allows you to secure the shooting board in a bench vise. You can cut the cleat to size now, but don't glue it in place yet.

FIGURE 1



COMPLETING THE BASE. After gluing the top and bottom together, there are a few things left to do. The first is to drill the hole for the pivot pin through the glued up base. Then, on the bottom side, enlarge the hole and add a counterbore to accept a T-nut.

The last step is to create a wide rabbet in the top to guide the plane in a straight path as you trim a workpiece. As you can see in Figure 2, cutting the rabbet is a two-step process. First, to provide a dust relief, cut a kerf in the base (Figure 2a). To complete the rabbet, reposition the rip fence to cut away the waste, as in Figure 2b. Adding a tall auxiliary fence provides solid support as you make the cut.

All that's left to do on the base is add the cleat. It's simply glued into the groove you cut earlier.

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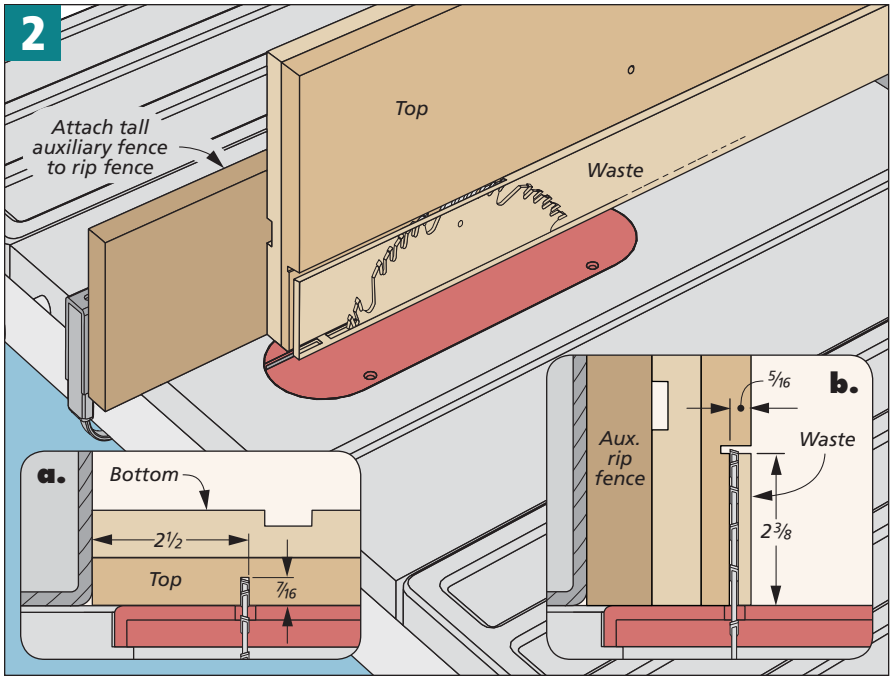


adjustable fence System

The rabbet cut in the base of the shooting board guides the hand plane. But in order to make an accurate cut, you need a fence to securely hold the workpiece in place. The fence system on this shooting board is also designed to pivot so it can be set up to trim miters of almost any angle.

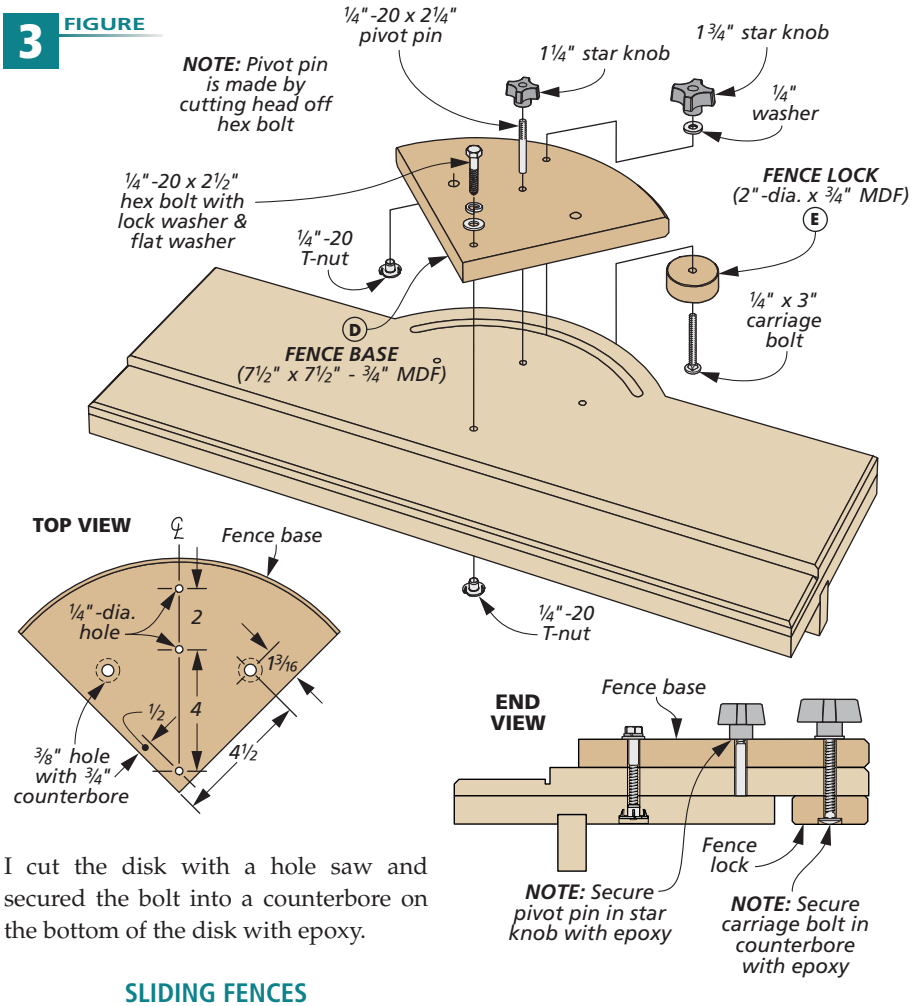
To provide adjustability, the system starts out as a fence base made from ¾" MDF (Figure 3). As you cut the blank to size, it's important that the base have a true, 90° corner.

The next step is to lay out a series of holes in the base (Top View in Figure 3). With the layout complete, drill the three ¼"-dia. holes for the pivot pin, locking pin, and locking knob. Then, to lock the fences in place, you'll need to drill a couple of counterbored holes for a pair of T-nuts (Figure 3). Finally, rout a small chamfer on the top and bottom of the curved edge of the base.

LOCKING SYSTEM. Most of the time, a shooting board is used for trimming workpieces at 45° and 90°. To secure the fence system for other angles, you'll need to add a lock for the fence base. This is detailed in Figure 3.

The fence lock consists of a carriage bolt and a ¾" MDF disk (End View in Figure 3). A knob and washer lock it in place.

FIGURE 3



I cut the disk with a hole saw and secured the bolt into a counterbore on the bottom of the disk with epoxy.

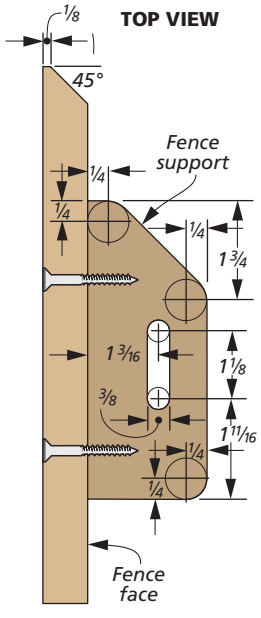
SLIDING FENCES

In order to back up the workpiece when "shooting" a miter, there's a pair of sliding fences attached to the base. You can see these illustrated in Figure 4. The two sliding fences are mirror images and are made up of a fence support and a fence face. To lock the fences in place, you'll need to cut a slot in each support for a studded knob (margin drawing at left).

Once the slots are complete, you can chamfer the top edges of each support. The front edge is left square for adding the fence faces.

ADDING THE FENCE FACES. The next step is to add the fence faces to the supports. The fence faces are just strips of ¾"-thick hardwood, mitered on one end (left margin drawing). I sanded a slight chamfer on the bottom, front edge to create a relief area for sawdust.

The fence faces are attached to the fence supports with screws. This way, you can replace them if they ever get chewed up. Finally, the sliding



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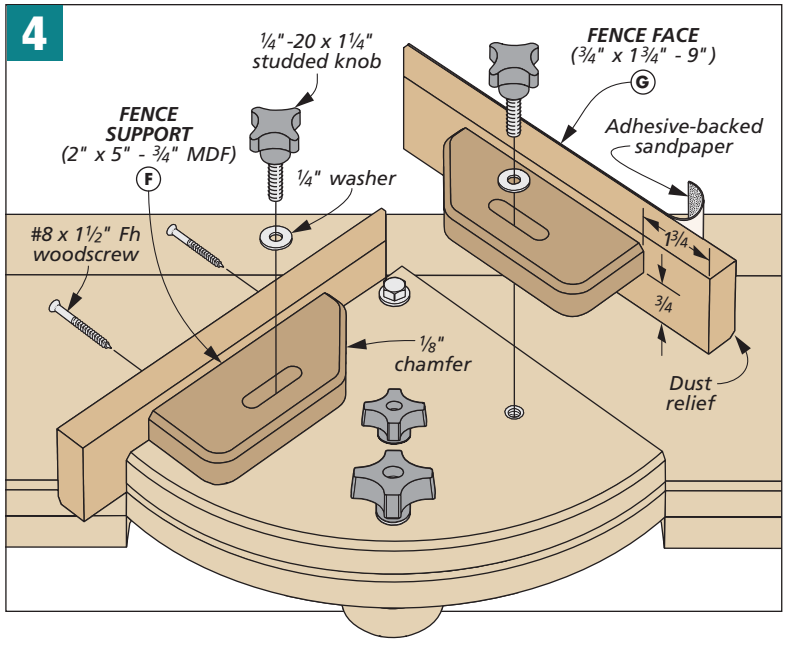


fences are mounted to the fence base with knobs and washers.

LOCKING PIN. There's one last step to complete the locking system for the fence. And that's to drill a few holes in the base of the shooting board for a locking pin, as in Figure 3. These holes make it easy to quickly set the stop for the 45° and 90° positions.

The photos at right show you how to use a combination square and the holes in the fence base to accurately drill into the main base of the shooting board. Just be sure to lock the fence base in place as you drill each hole and don't drill into your benchtop.

I made the locking pin by cutting the head off of a hex bolt and gluing it into a knob with epoxy. Finally, adding adhesive-backed sandpaper to each of the fence faces provides a more secure grip during use.

SANDING OPTION. The shooting board is designed for use with a hand plane. But you can also fine-tune the fit or simply sand the end grain of a workpiece smooth using a sanding block (Figure 5).

The sanding block is just a thick block of hardwood with a narrow rabbet cut along one face. This forms a reference edge that rides against the shooting board to ensure accurate sanding.

After beveling the top edge of the block, I sanded a small flat on a dowel and screwed it to the beveled face. Finally, I mitered the ends of the block (and handle) to provide a more comfortable grip.

The shooting board makes quick work of taking a thin shaving off the end of a workpiece (photos at left). It's a sure way to fine-tune any workpiece for a perfect fit. If you'd like more information on using a shooting board, check out our website, *WoodsmithSpecials.com*.

Setup for 45°. After positioning the fence, drill a hole in the base using the hole in the fence base as a guide.

Square It Up. Repeat the process in order to drill the two holes in the fence base for the pair of 90° settings.

Using the Shooting Board

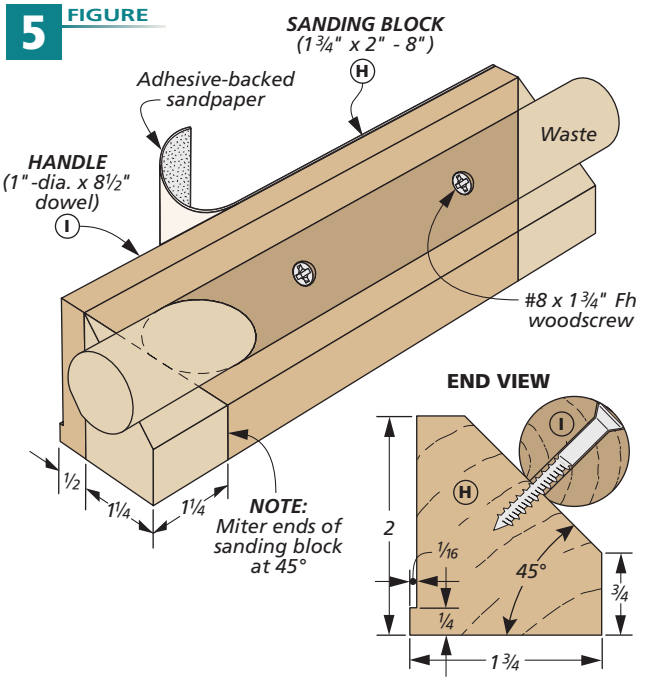
Square an End. With the fence set perpendicular to the edge of the shooting board, you can shave a hair off the end of a workpiece at a perfect 90° angle.

Other Angles. By disengaging the locking pin, you can adjust the fence for any angle. Simply lock it in place at the desired angle, adjust the fence, and you're ready to plane.

GO 2 Online Extras

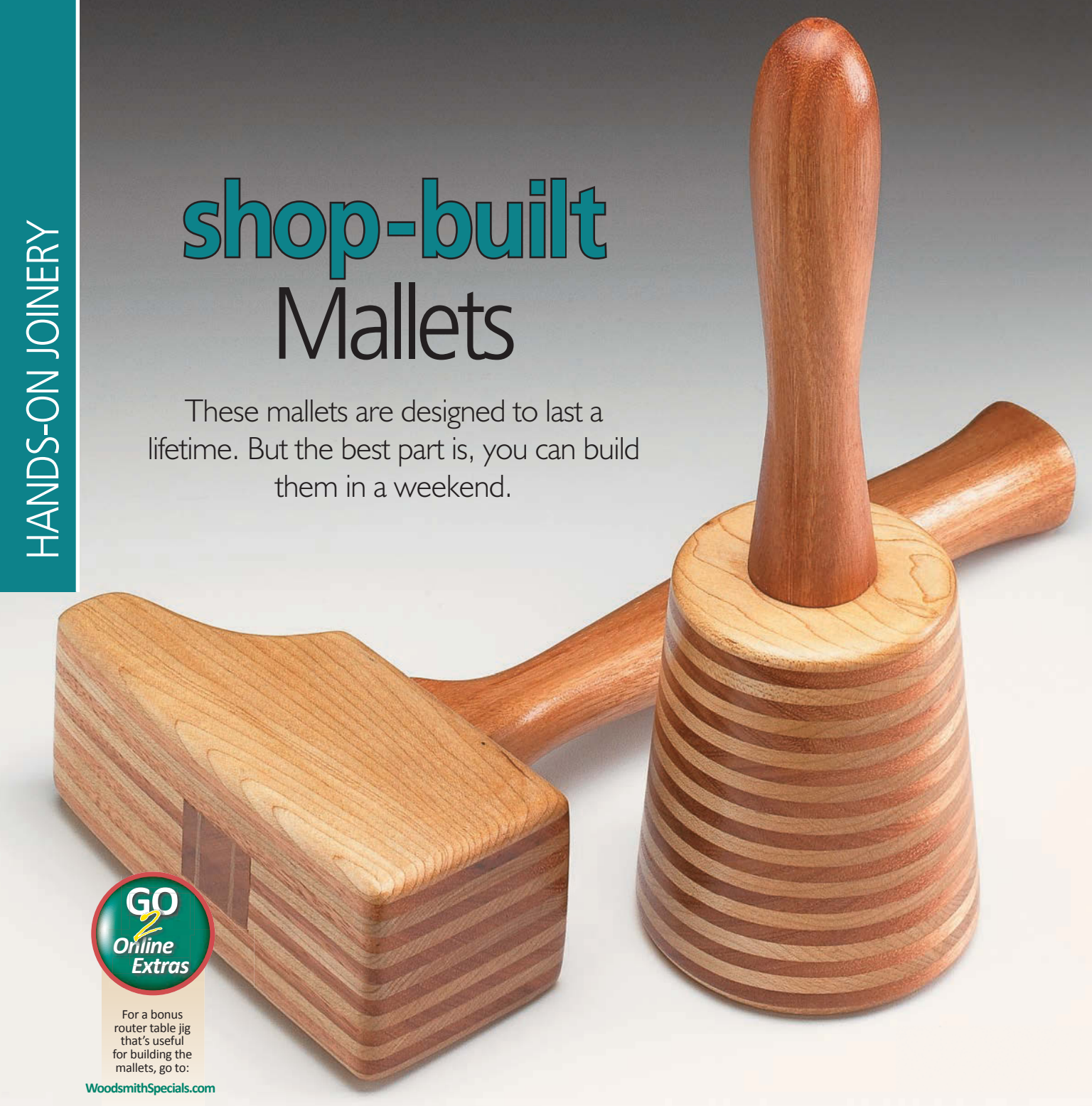
For an article on setting up and using the shooting board, go to:
WoodsmithSpecials.com

FIGURE 5



shop-built Mallets

These mallets are designed to last a lifetime. But the best part is, you can build them in a weekend.



GO 2 Online Extras

For a bonus router table jig that's useful for building the mallets, go to:
WoodsmithSpecials.com

There's a certain satisfaction that comes from building a practical, quality tool and using it in the shop. So when I first saw these shop-made mallets, I knew they'd be a big hit.

The cabinetmaker's mallet on the left is great tool for all-around shop use. It's shape and heft come in handy during project construction and assembly. And the rounded carver's mallet (shown on the right) provides just the right control for chisel work and carving.

Both of the mallets you see above share the same laminated design for the head. I used alternating layers of Lyptus and maple, but you could use any contrasting hardwoods you have available. The layered construction makes them easy to build and durable enough for a lifetime of use.

One of the keys to creating a hand tool that you'll really use is making it comfortable to hold. So shaping the handles of the mallets is critical. The nice thing is, it's easy to do with a simple technique and a shop-made jig for your router table. Besides being a great way to custom-fit them to your hands, it guarantees that it won't take long to appreciate the usefulness of these mallets.

laminating a **Blank**

The strength of these mallets comes from their laminated hardwood construction. In the photos and drawings on this page, you'll see the basics of creating the laminations and gluing up a blank for the carver's mallet. The process for the cabinetmaker's mallet is nearly identical, as you'll see later on.

LAYOUT THE CUTS. The first step in making the carver's mallet is resawing some stock on the band saw to create the laminations. To do this, you'll need to establish guide lines on the edge of your stock. The goal is to end up with $\frac{3}{16}$"-thick strips, so I marked layout lines roughly $\frac{1}{4}$" apart.

RESAW. Now it's time to set up your band saw for resawing. A simple, shop-made pivot block makes it a snap to keep the blade cutting right on the layout line, as shown in the photo above.

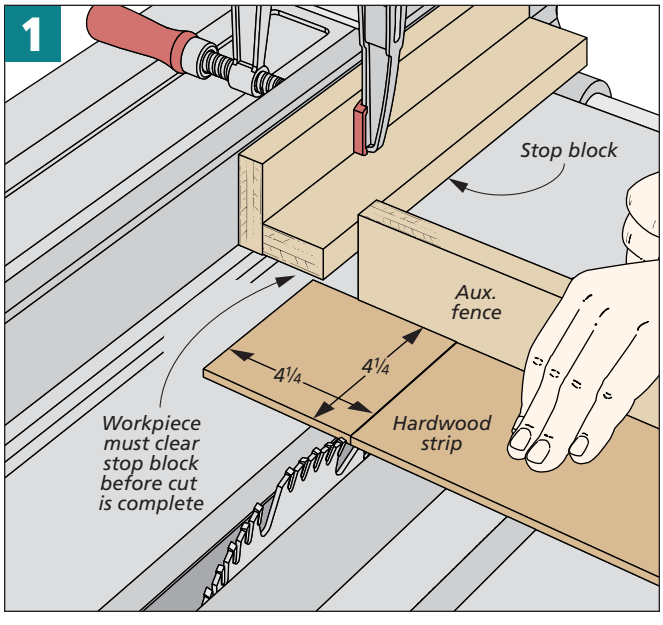
PLANE TO THICKNESS. Once you have the strips cut, you can plane them to final thickness. Planing thin stock can be a challenge. To make this process easy and safe, I like to plane the strips by fastening them to a "sled" of $\frac{3}{4}$"-thick melamine, like you see in the photo at right. With the strips planed smooth, you're ready to glue up the blank for the head of the carver's mallet.

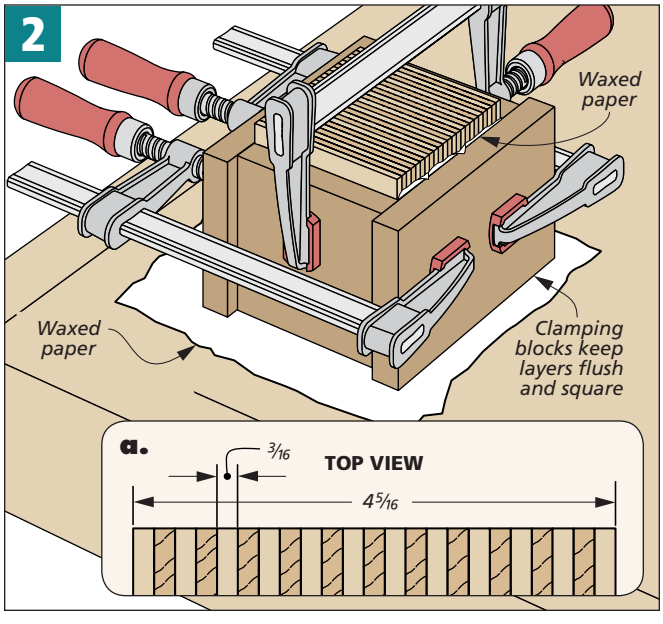
Resawing. A simple pivot block helps you keep the blade cutting on the layout line.

SIZING THE LAMINATIONS. When it comes to gluing up the head of the carver's mallet, I learned that creating a blank with square, smooth edges makes things a lot easier later. So you'll want to take care as you first rip the strips to width and then cut them square (Figure 1).

GLUING UP THE BLANK. Now you're ready to glue up the blank. What's important here is to alternate grain direction of each layer as you assemble the blank. As you can see in Figure 2, waxed paper and clamping blocks keep the sides flush. Finally, let the glue dry overnight then turn the page to start shaping the head.

Planing Sled. Each strip is fastened to a sled with double-sided tape for planing.





carver's Mallet

Controlled Taps. The round head on the carver's mallet means more control over your cuts for carving and chisel work.

Once you have the blank glued up for the head, you're ready to work on shaping it. Then, you'll drill the hole (the "eye") for the handle.

You might wonder how the tapered head is shaped. If you have a lathe, it's pretty straightforward. But if you don't own a lathe, don't worry. The secret is a simple jig for your router table, available online at *WoodsmithSpecials.com*.

MARK CENTERS. To get started on shaping the head, the first step is to mark a centerpoint on both ends. I did this by drawing diagonal lines from each corner. Then, using a compass, I marked a 4"-dia. circle on the blank. This will be the finished diameter of the large end of the mallet head.

ROUGH SHAPING. To make routing the head to its final shape a little easier, I tilted the blade of the table saw to 45° and cut off the corners of the blank. Figure 1 shows the blank after making these cuts.

CENTER HOLES. You'll also need to drill a centered hole in each end. These holes will be used later to shape the head. It's important for these holes to align. So after drilling one hole, I attached a scrap to my drill press table and drilled an alignment hole using the same bit. After slipping a pin in place, simply set the blank over it and drill the other hole, as indicated in Figure 1 below.

ROUTER SLED. Now you are ready to shape the glued-up blank using a simple router jig. The jig is nothing more than a plywood sled that holds the blank at a slight angle as you "turn" the blank to shape.

With the blank sanded smooth, you can round over the ends at the router table with a ¼"-radius roundover bit. Then, all that remains to complete the head is to drill the hole for the handle.

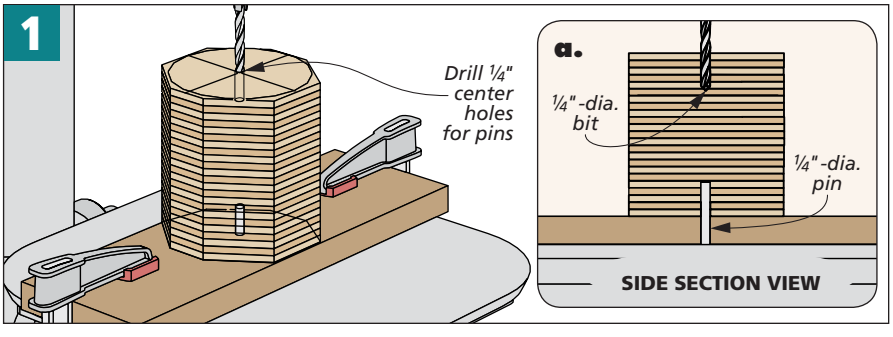
DRILLING JIG. The handle requires a 1"-dia. hole all the way through the blank. But I didn't have a drill bit that was long enough. So I built the drilling guide you see in Figure 2. It helps keep the drill bit aligned and square to the blank as you drill through from each end.

To use the jig, place the mallet blank tight into the corner of the jig. Use a ¼"-dia. drill bit chucked in the drill press to locate the jig and blank, then clamp the jig in place. Now you can switch to a 1"-dia. Forstner bit and drill as deep as you can, going slow and clearing the chips as you go. Then flip the blank over, making sure it's tight into the corner of the jig and drill through to complete the hole.

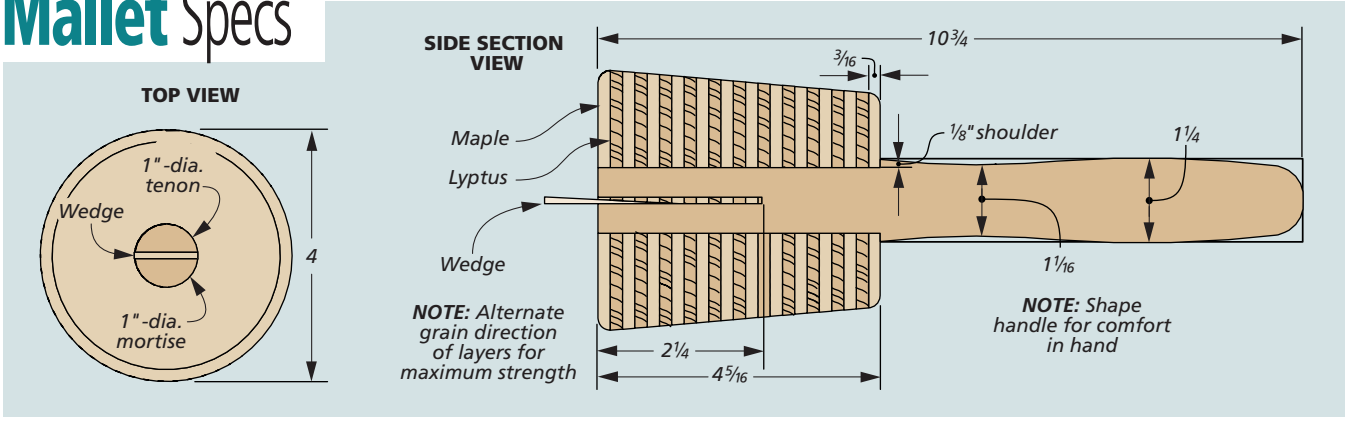
ADDING THE HANDLE

Now you can set the mallet head aside and turn your attention to making the handle. I used both the band saw and another router table jig to shape the handle.

I started out with a blank about 5" longer than the finished handle. This allowed me to keep each end square while shaping the handle.



Mallet Specs



START WITH THE TENON. The first step is to create a "tenon" on the blank, as you can see in the margin drawing. I did this with a dado blade. This part will become the round tenon that fits into the head.

Once that's complete, you can head over to the band saw and rough out the basic shape of the handle using the pattern you see on the opposite page.

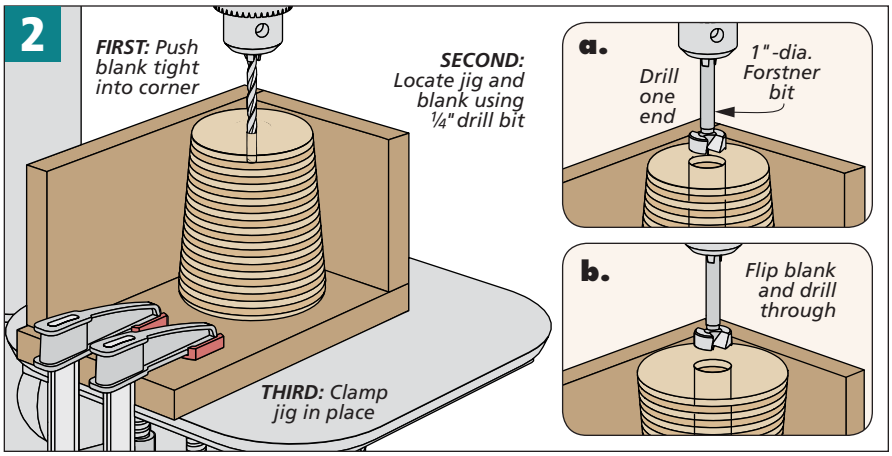
The next step is to make the tenon round. To do this, I built the "turning jig" in Figure 3. It holds the ends of the handle blank so you can rotate it over a straight bit in the router table. You'll want to sneak up on the size. (I used calipers to check my progress.)

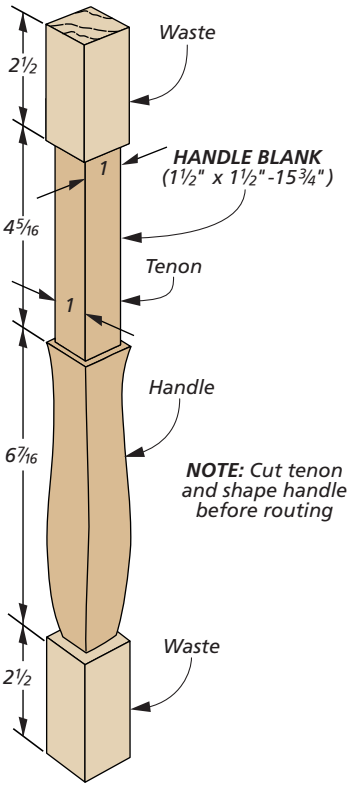
Now you're ready to round over the edges of the handle. The problem here is the handle is a complex curve, so you can't really rout a roundover using the flat surface of a router table as a reference. So I made a "bridge" to help out with this task (Figure 4). It acts as a pivot point to position the handle properly against the bit's bearing for effective routing.

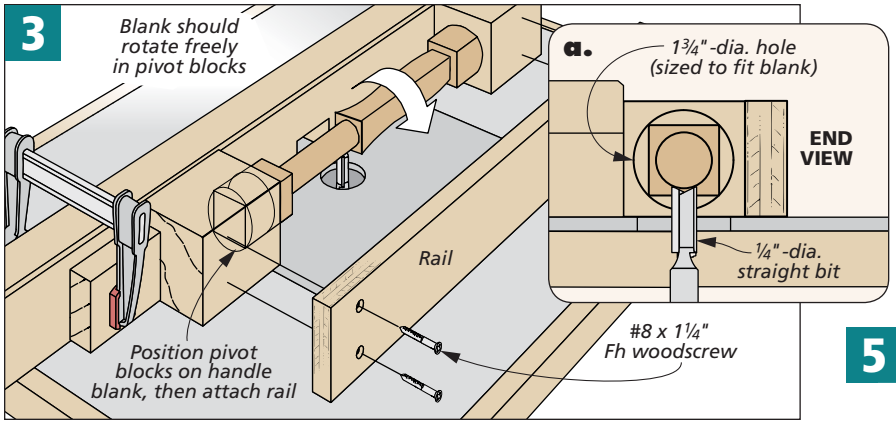
FINAL SHAPING. The next thing to do is cut off the square ends and smooth the handle using a rasp and sandpaper. Take your time here to fit it just right for your hand.

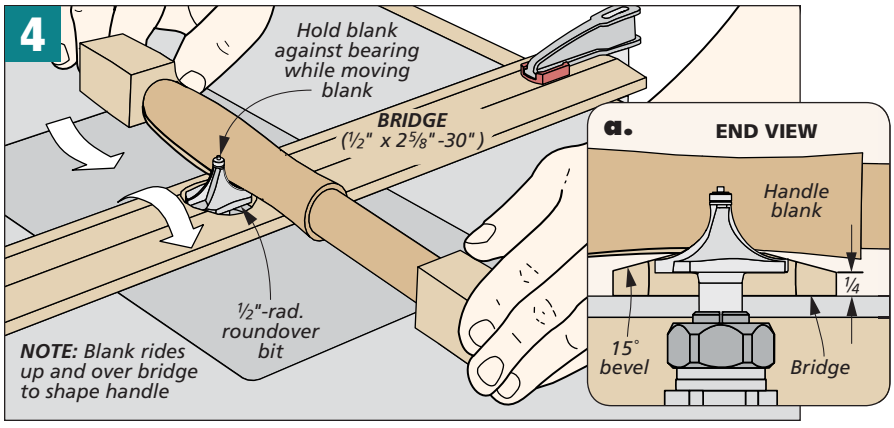
GLUE AND WEDGE. Now you're about ready to glue and wedge the handle in place. First, I used my band saw to cut a slot in the round tenon for a wedge. While I was at it, I cut the wedge to shape.

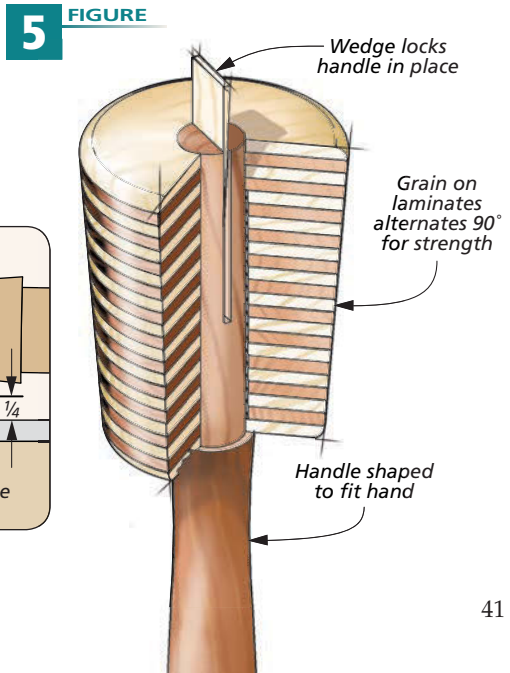
After checking the fit of the handle, apply a thin layer of glue and tap the handle tight against the head. Finally, add a little glue to the wedge and tap it in place. After trimming the wedge and tenon flush to the head, sand everything smooth.











cabinetmaker's **Mallet**

A cabinetmaker's mallet, like the one you see in the photo, gets a lot of use in my shop. It's handy for knocking joints together during assembly — and knocking them apart after a dry fit.

PLANNING THE GLUE-UP. The head on this mallet is laminated, like the carver's mallet. But instead of gluing up all the layers at once, you'll be doing it in steps. This makes it easier to create the "eye," or opening for the handle. And there's one other difference here. I added some steel weights to give the mallet extra heft. They're just short sections of steel rod glued in place.

RECTANGULAR BLANK. I started off by gluing up nine layers of the $\frac{3}{16}$"-thick rectangular strips. Note: Unlike the carver's mallet, the grain on all the strips of the cabinetmaker's mallet run in the same direction. And keep in mind that one side of the blank will be to the outside, so you'll want the strip here to look good. Just mark the inside of the blank so you'll know which side gets the dado for the handle later on.

CUTTING THE "EYE." After the blank is dry, joint one edge so you've got a good reference face for cutting the handle opening. With that edge against the miter gauge, use a dado blade to cut the eye, as shown in Figure 1 on the following page.

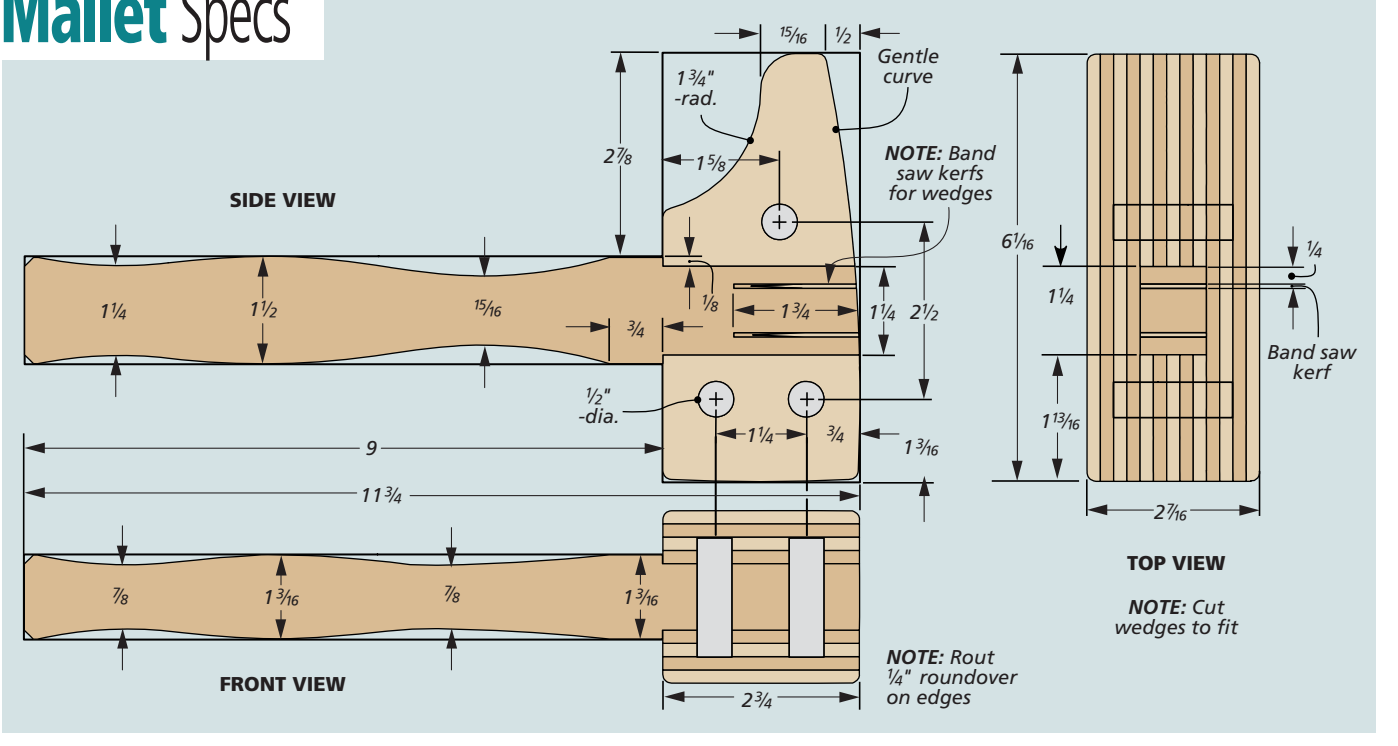
WEIGHT. The next step is to add two more layers and then add some weight to the head. After gluing the two layers in place, I drilled $\frac{1}{2}$"-dia. holes for the short sections of steel rod. Epoxy holds them in place until the outer layers are added.

FINAL LAYERS. The only thing left to do to complete the glue-up is add the last two layers of laminations. The trick here is to make sure to use enough glue for a solid bond, but not get any glue in the dado you cut earlier. But if some glue seeps in, you can use a chisel to clean out the opening later.

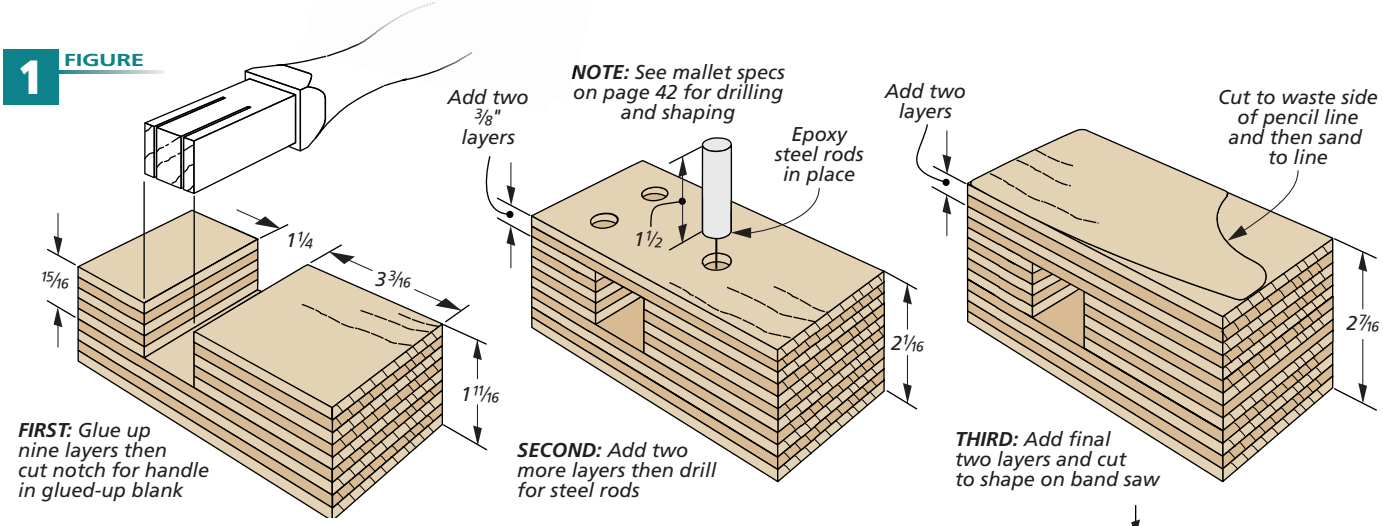
Solid Force. The broad, smooth face of this mallet knocks joints together without marring the surface.

Gentle Taps. The small end reaches into tight areas to provide a little bit of "gentle persuasion" when joining parts.

Mallet Specs



1 FIGURE



SHAPING. Once the glue dries, you can take the head to the band saw and cut it to shape using the pattern on the opposite page.

Here's where you want to take some extra time to get the shape of the head just right. A drum sander or belt sander is handy for removing saw marks. And "crowning" the large end slightly keeps the mallet from marring a workpiece.

Once you're happy with the final shape, head over to the router table and rout a ¼" roundover on the outside edges and give everything a final sanding.

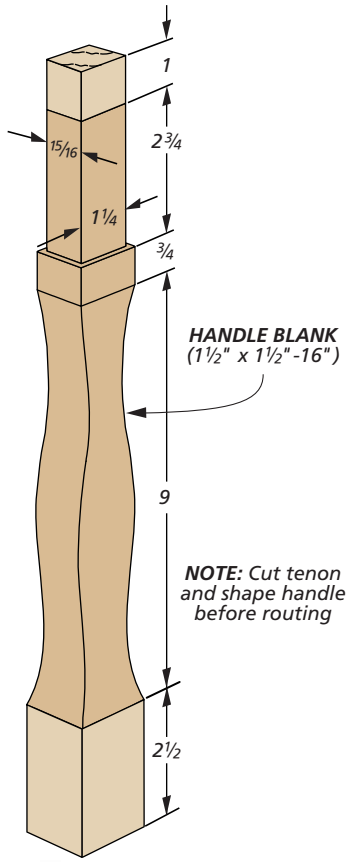
SHAPING THE HANDLE

Starting with an extra-long blank, the handle for the cabinetmaker's mallet is shaped using a technique similar to that used for the carver's mallet. First, use the pattern on the opposite page to shape the handle. Then round over the sharp edges using the same "bridge" technique on the router table. To form the tenon, I used a dado blade. You're aiming for a snug fit in the eye. The glue and wedges you'll add later will hold everything tight. I left the tenon a little long so I could trim it flush later.

Next, step over to the band saw and cut two slots in the tenon for the wedges and cut off the "tail" of the handle. Once again, you can use rasps and sandpaper to fine-tune the shape. Take the time to shape the handle so it feels right to you, then sand it smooth.

As before, cut the wedges at the band saw. After adding a little glue, tap the handle in place. Finally, glue in the wedges and then trim and sand everything flush. A coat of oil is all you need to finish it off.

With their practical function and sturdy construction, these mallets will have a permanent home in your shop for years to come.



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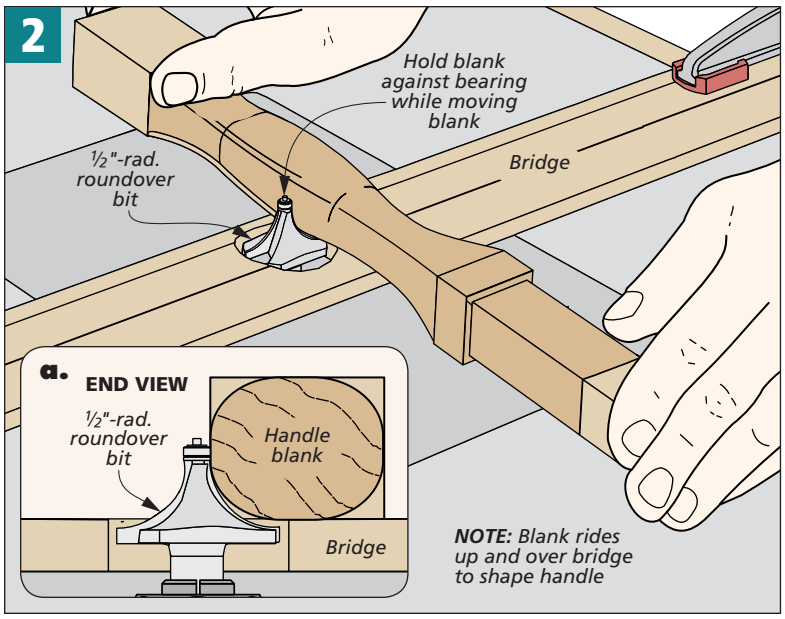
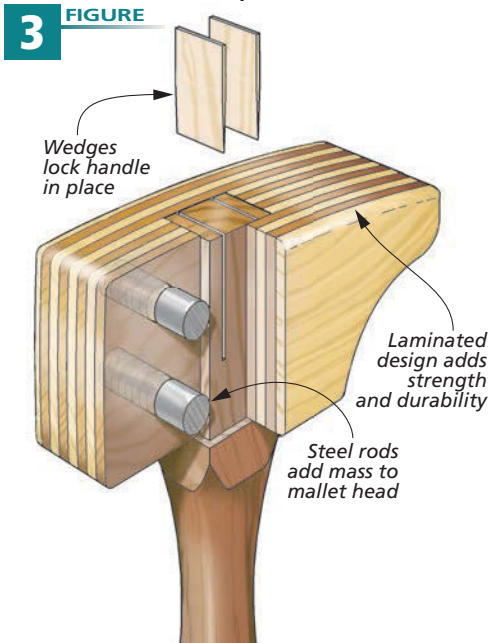


3 FIGURE



cleaner Cuts

Everyone knows that sharp tools and solid techniques are the keys to getting clean and accurate cuts in your project parts. Here's what you need to know to get the most from your hand tools.

SECRETS FOR SAWING STRAIGHT.... 46

5 CHISEL TIPS & TECHNIQUES.....48

SANDPAPER SHARPENING 50

PULL SAW MITER BOX.....52

PARING & SKEW CHISEL SET 56

secrets for Sawing Straight

By following a few shop-tested strategies, you can turn your collection of hand saws into precision cutting tools for a variety of different woodworking projects.

The old joke goes, "How do you get to Carnegie Hall?" The answer, "Practice, practice, practice." The same can be said of hand tool skills. Sawing to a line or layout mark is a good example of this idea. Unfortunately, most hand tools don't come with an owner's manual. So you're on your own when it comes to operating a hand saw. The good news is, all it takes to make it a precision woodworking tool are patience, knowledge, and, yes, a little practice.

Saw Helper. A bench hook consists of a base, a cleat that butts against the bench, and a fence for your workpiece. Guide your saw along the edge of the hook to make cuts in wide boards simply and accurately.

I should confess from the outset that I use power tools for the bulk of my sawing tasks, but my hand saws still see plenty of action. I enjoy the quiet in my shop without the noise of a table saw.

It doesn't matter if you prefer a Western saw or a Japanese-style saw. Either one can give you very high-quality results. And despite the fact that they cut differently, (Japanese saws cut on the pull stroke), the techniques for using them have many similarities.

MARKING. Before you pick up a saw, you need to mark where you plan on cutting. This might sound like an obvious step, but making a proper mark that runs the length of the cut is important, especially when you're working on honing your skills. I use a pencil for marking saw lines. Learning to saw consistantly right next to the line (on the waste side, of course) is what it's all about.

HOLDING YOUR WORK. Half the battle of sawing accurately is holding the workpiece steady and supporting the cut. Each type of cut often requires a different solution, but a good bench vise will solve many of your problems. With a vise, you can secure the workpiece in the correct orientation for a variety of cuts (main photo above). The traditional bench hook shown in the photo at left is an effective method as well. And for a coping saw, a special bird's mouth board works well (see the box on the opposite page).

POSTURE. Good posture not only sets you up for success, but it can make the difference between working all day and knocking off early with a sore back. It's not a big deal if you're only making one or two cuts, but cutting a few dovetailed drawers without using proper posture can make for an uncomfortable day, at the very least. The photos at the top of the facing page have a few tips for developing good sawing posture.

GRIP. How you hold the saw will play a big role in determining your success. A light but firm grip may sound like a

Angles. For angled cuts like dovetails, tilt the workpiece in the vise to match the angle. Then you can make a straight cut.

Posture. Good posture not only helps your back, but your woodworking, too. Stand as straight as possible with your elbows close to your body.

contradiction, but that's what you need. Point your index finger in the direction you want to cut, but keep the other fingers fairly loose on the handle, especially when starting the cut. The index finger advice goes for pull saws, too.

STARTING THE CUT. With the line marked and the workpiece ready, place the blade of the saw on the workpiece and use your thumb or knuckle as a guide to start the cut. This works for both push and pull-cutting saws.

For Western saws, I like to start a crosscut using the teeth closest to the handle. This gives me a little more control as you establish the line. For a rip cut, the teeth toward the end of the blade are sometimes ground to make starting easier. With a Japanese saw, I start both crosscut and rip cuts near the handle.

CUTTING. There are a few things to focus on while making the cut. Again, some practice will make these skills second nature. First, try to keep the blade on a consistent line, just kissing the pencil mark (right photo). You'll find this is easier to do if you keep your elbows, shoulder, and wrist in line with the blade of the saw. By doing so, you'll naturally avoid tilting and twisting the saw blade. It might feel awkward at first, but it won't take long until it feels natural.

Next, make long strokes, using the full length of the blade to take advantage of the tool. Avoid a short, choppy action in favor of a smoother, longer stroke. This will also help keep the saw cutting straight. Above all, don't try to push down or force the saw. Just maintain a light pressure and let the blade do its job.

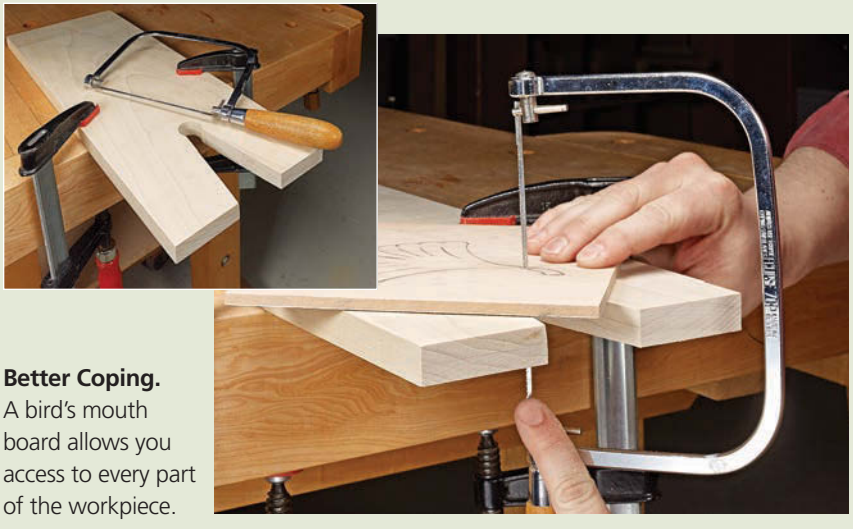
No matter how useful your power tools are, you'll find that there are plenty of situations when a hand saw is a good option. Proper hand saw technique will pay off in just about every project you build. As you can see, it doesn't require much to take your cuts from good to great.

Precision. As you practice, work on just barely touching the pencil line. The closer you can get, the less you'll need to clean up.

Coping Saw Cuts

When it comes to making a curved cut, I reach for my coping saw. But like the other cuts shown above, you need a way to hold the workpiece.

The traditional method for holding a workpiece in this case is a bird's mouth board, clamped to your workbench. The inset photo at left shows how this handy device got its name. The notch at the front looks like a bird's beak. The "mouth" allows you to move the saw blade around. You hold the workpiece by hand on the board, so it's easy to turn it to any angle you need to complete the cuts.



Better Coping. A bird's mouth board allows you access to every part of the workpiece.

5 chisel Tips & Techniques

Skilled craftsmen know that a sharp chisel is their secret weapon. Here are a few handy uses that you may not have thought of.

It's tough to think of a hand tool that gets more use in my shop than my set of chisels. They're a jack-of-all-trades tool that can tackle a wide variety of tasks in a short amount of time. And while it's tempting to just pick up a chisel and start working, you can get better, more consistent results by using the right technique. On these two pages, I've picked out five everyday shop tasks that give you a good overview of some basic chisel techniques.

[1] SQUARING UP A RABBETED CORNER

I often use a router to create an opening for a cabinet back. But the router leaves rounded corners (photo at left). With a chisel, you can square them up in a snap. So this first technique — squaring up a corner — provides a good starting point for mastering your chisels.

The first step, though, is to define the corners with layout lines. In the left photo below you can see what I'm talking about.

CHOPPING CUTS. Cleaning up the corner is done in two steps. The first step consists of a series of vertical, chopping cuts to define the corner. I use a wide chisel to provide a stable bearing surface to keep the cuts in line with the routed rabbet, as shown in the photo at right. I also hold the chisel on the blade for greater control.

PARING CUTS. The second cut is a horizontal, paring cut that removes the waste (right photo below). Here my left hand is steering the chisel and the right hand provides the power.

You can also see the chisel is positioned bevel up. This allows the wide, flat back to keep the cut even with the bottom of the rabbet.

Lay Out Corner. Use a pencil and a combination square to mark the layout lines to guide the chisel.

Remove Waste. After defining the corner with a vertical cut, clean out the waste with a paring cut.

[2] TWO WAYS TO PARE PLUGS

Plugs are a good way to disguise the heads of screws. The challenge is trimming them flush. Here's a simple, three-step process that will guarantee great results.

The first thing to do is to cut off the plugs close to the surface with a hand saw. The second step is to use a chisel to trim the plug flush. And doing this depends on the type of plug you use.

END-GRAIN PLUGS. A section of dowel can be used to make an end grain plug for a screw hole. But it's difficult to make a smooth chisel cut across the tough end grain. To trim the plug flush, I start with scoring cuts around the perimeter (photo at right). Then gradually increase the depth until the plug is cut off nearly flush. A last bevel-up cut will trim it smooth.

FACE-GRAIN PLUGS. Face-grain plugs are a little simpler. The thing you want to avoid here is having the plug split off below the surface. To prevent this, I take thin cuts across the grain, working down to the surface (inset photo).

Finally, you can touch up the plug and surrounding wood with a little light sanding.

The Right Angle. To trim end-grain plugs, make cuts from all sides to avoid breaking off the fibers. On face-grain plugs, a cross-grain paring cut will keep the wood from splitting below the surface.

No More Glue. To remove glue from corners, hold the chisel bevel down. Along an edge joint, a vertical, "scraping" cut eliminates glue and protects the surface (inset photo).

[3] VERSATILE GLUE SCRAPER

Even though removing dried glue squeeze-out is a common task, it's no picnic. The photos at left show two ways a chisel is the perfect tool for the task.

When glue has dried in a corner, like the drawer you see at left, I use a bevel-down grip to "pop" the glue out. The bevel acts as a "safety" to keep the cutting edge from gouging the workpiece.

Squeeze-out on edge joints call for a different approach. Here, you want to hold the chisel nearly vertical and pull it along the glue line (inset photo). This scraping action quickly shears off dried glue.

One more thing: To avoid having to spend a lot of time resharpening my best chisels, I bought an extra, inexpensive chisel just for this job.

[4] TRIM EDGING FLUSH

Trimming edging flush to the end of a plywood panel may seem like a tricky task. But it's really not much different than trimming an end-grain plug.

I like to start by rough-cutting the edging with a hand saw, so it's just slightly proud of the surface of the plywood. Then with a horizontal cut, make several passes with the chisel to bring the edging flush. To avoid tearout, trim from both edges toward the center. A final, light pass will level out the slight hump in the center of the edging.

MARKING KNIFE. To use a chisel as a marking knife, simply hold the back against the square and tilt it up so the edge won't catch.

quick & easy Sandpaper Sharpening

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WoodsmithSpecials.com

You don't have to spend a fortune on fancy equipment to get a razor-sharp edge on your tools. Simple sandpaper can do the job quite nicely.

Keeping a sharp edge on your chisels, knives, and plane irons is a crucial step in successful hand-tool work. A dull edge simply won't perform well and will often lead to pushing harder on the tool or forcing a cut. This, in turn, can lead to accidents. In these situations, a dull blade is far more dangerous than a sharp one.

The Right Paper. Silicon-carbide sandpaper is inexpensive and available at most auto parts stores.

So it's important to develop a system for sharpening your tools that's reliable and doesn't take away too much time from your woodworking.

THE OPTIONS. Every sharpening method begins with an abrasive that's hard enough to scratch tool steel. And to refine an edge, the process requires you to work through several different grits of abrasive. There are lots of options: waterstones, oilstones, diamond plates, and different types of bench grinders. But I've found that using wet/dry sandpaper fixed to a piece of glass not only produces great results, but is quick and easy, as well.

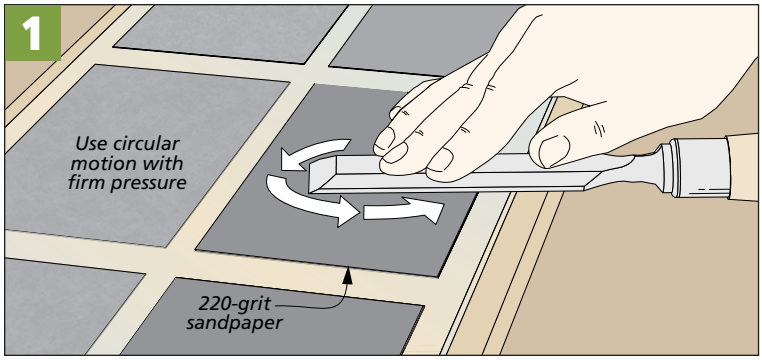
WHY SANDPAPER? If you're new to sharpening, this method is the perfect starting point. What makes it such a great choice is that unlike other options, there's no need for a large outlay of cash to get started.

Sandpaper comes in a range of grits that can take your tools all the way to a surgically sharp edge. And it's available everywhere. However, the type of paper you choose makes a difference.

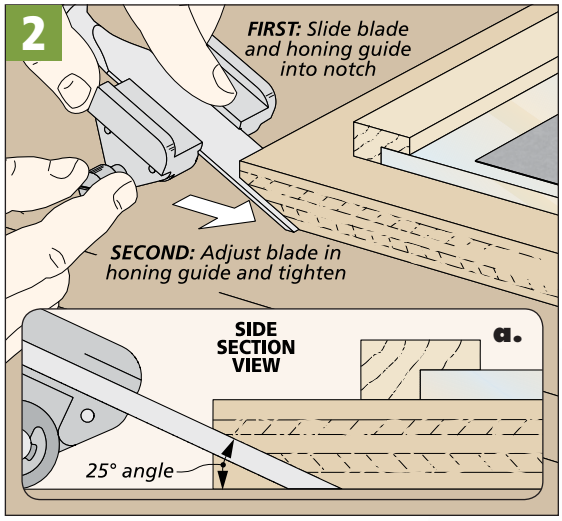
You can use standard aluminum oxide paper for grits up to 220, but a better choice for the real polishing work is wet/dry silicon-carbide paper (margin photo). Another option is shown in the box at the bottom of the opposite page.

The next thing you need is a flat surface, like a piece of plate glass. The main photo above shows my solution. I mounted the glass on a plywood platform. Two rabbeted cleats hold the glass in place. (See our Online Extra for the plans.)

You can cut the sandpaper sheets in half and attach them to the glass with spray adhesive. But go easy on the adhesive. All it takes is a light spray to hold the paper. If you use too much you'll end up with lumps under the paper which may cause it to tear on the first pass of a sharp blade.



Flatten the Back. Hold the face of the tool flat on the sandpaper and move it in a circular motion to flatten the back. When you have an even scratch pattern on the surface, move to the next grit.



Set Up the Guide. To set up the tool in the honing guide, use the notches on the platform to establish the correct angle. Then tighten the guide to hold the tool.

The system shown holds six different grits. I use 150, 220, 400, 800, 1500, and 2000. If you have a tool with a damaged edge, however, like the top one in the right margin photo, you'll need to start with a coarser grit to re-establish the bevel on the edge. I add a splash of water to help remove the swarf and keep the paper clean.

SHARPENING TECHNIQUE. Once you've put together your sanding platform, the sharpening technique is pretty straightforward. The goal in any sharpening method is to form two flat, intersecting planes. So the first step is to flatten the back face of the tool. Figure 1 above shows this step. When you have an even scratch pattern on the back, move to the next grit. Continue through the grits until you have a polished back face. At the 2000-grit stage, it should shine like a mirror.

HONING GUIDE. Now you're ready to sharpen the bevel. I use a honing guide for this step. The guide holds the tool at the proper angle so you can sharpen the bevel. You can see a honing guide in action in the main photo on the opposite page.

Before you can start honing the bevel, you need to set the angle in the guide. For most woodworking tools this angle is in the 25° to 35° range. I made notches on the sharpening platform to make setting up either a 25° or 30° angle a little easier. As you can see in Figure 2 above, all you need to do is place the blade in the notch and lock it in position in the guide.

Work through the grits as before. After that, another light pass on the back to remove the fine wire burr might be needed. At this point, the tool should be ready to put to use.

TOUCH UP. You won't need to use all the grits of sandpaper for every sharpening session. As you gain experience, you'll learn when the tool needs a "touch up" and you can then move right to the appropriate grit. Also, it's not necessary to go all the way to 2000-grit with every tool. Most will be plenty sharp at 1000 or 1500.

All in all, it's tough to beat the results from this method of sharpening. And since it doesn't require a major investment, there's no need to compromise your woodworking with a dull tool.

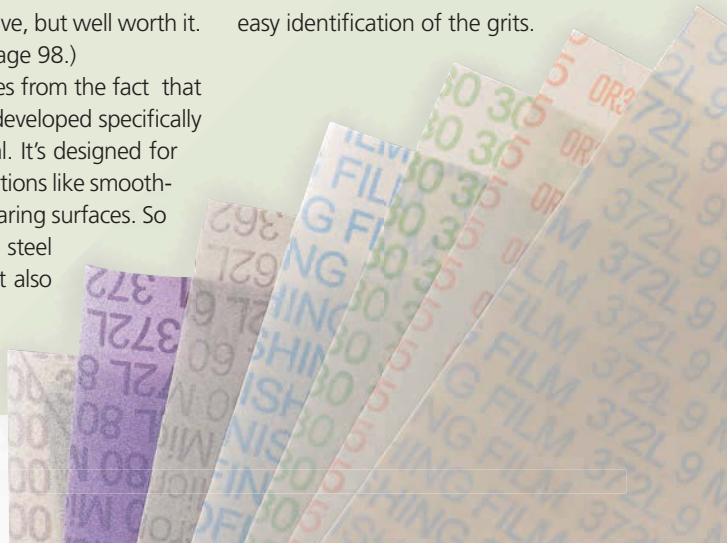
Razor Sharp. By working through the grits, you can sharpen the edge of any tool.

3M Microfinishing Film

I've used the gray, wet-dry sandpaper for years with great results. But it does have one weakness — it tears easily, especially when you use water to lubricate it. Recently, I found another type of abrasive that I like even better — it has a plastic film backing.

The product is *3M's 372L Microfinishing Film* shown in the photo at right. These flexible sheets employ uniformly sized particles of aluminum oxide, bonded to a polyester film. The film is very thin (5 mil), but really tough. It ended my tearing problems. It's a little more expensive, but well worth it. (Refer to Sources on page 98.)

The advantage comes from the fact that this film abrasive was developed specifically for working with metal. It's designed for use in industrial applications like smoothing crankshafts and bearing surfaces. So polishing up your tool steel is no challenge at all. It also means this product will outlast most other abrasives.



Another Option. *Microfinishing Film* from *3M* is color-coded for easy identification of the grits.

pull saw Miter Box

Cut small pieces accurately and safely with a pull saw using this simple shop-made miter box.

Working with small pieces is always a challenge, even when it's something as simple as cutting a workpiece to length or mitering an end. Using a table saw or power miter saw to do this can result in an uneven cut or tearout along the edge. Or even worse, the piece can literally explode as it's being cut.

So whenever I have to cut small pieces, I turn to a pull saw and the shop-made miter box shown above. The pull saw cuts a really narrow kerf with little to no tearout. And the miter box solves the tricky part of making an accurate cut.

FEATURES. But this miter box has more going for it than most. To start with, guides attached to the top of the miter box are adjustable, so you can fit it to your saw. And they provide support for the three most common angles — 45° left, 45° right, and 90°.

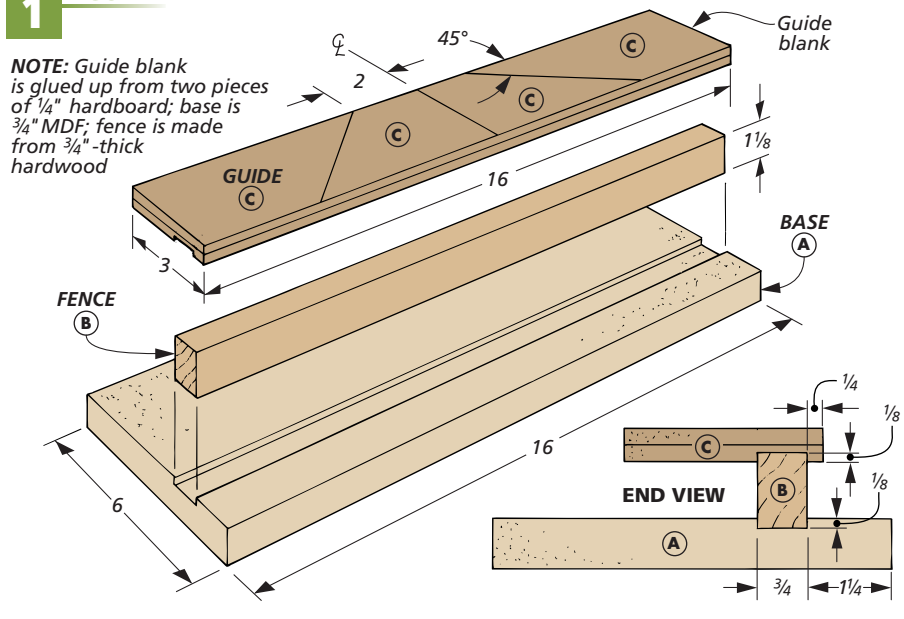
To do this, the guides are held in place with large washers and screws that pass through oversized holes. This way, you can "squeeze" the guides against the blade of the pull saw for a snug fit.

You'll also notice some "portholes" on the top of the miter box. As you can see in the inset photo above, it provides a convenient way to look through the top of the miter box and see the layout line for aligning the workpiece.

Finally, cutaways at the ends of the miter box make it easy to hold small workpieces as you make the cut or to clamp a stop in place for cutting a number of pieces to identical length. (To see how this works, turn to page 55.)

PARTS. Another nice benefit is this miter box is quick to build. That's because it consists of only three main parts: a base, a fence, and a set of guides, as illui in Figure 1. I used a scrap of medium-density fiberboard (MDF) for the base, a piece of

FIGURE 1



¾"-thick hardwood for the fence, and two pieces of ¼" hardboard for the guides.

BASE & FENCE. I started work on the miter box by cutting the base (A) and fence (B) to final size at the table saw. Note: The width (height) of the fence allows you to work with stock up to ¾" thick.

To keep the fence aligned during assembly, there's a shallow groove in the base, as shown in the End View on the previous page. Once the groove is cut, you can set the base and fence aside and begin work on the guides.

GUIDES

The heart of this miter box is the set of guides that fit over the top of the fence, as shown in Figure 1. These guides provide solid support for the saw as you make a cut.

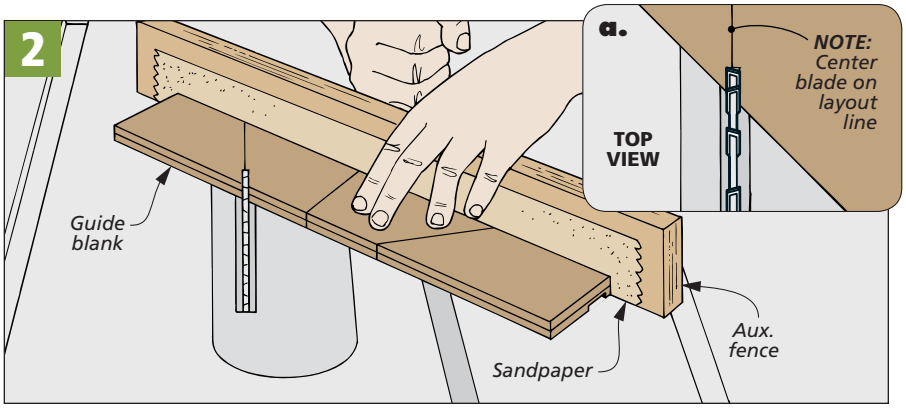
To do this, the guides slide together and "sandwich" the blade of the saw. This keeps the blade perfectly straight and prevents it from wandering during the cut.

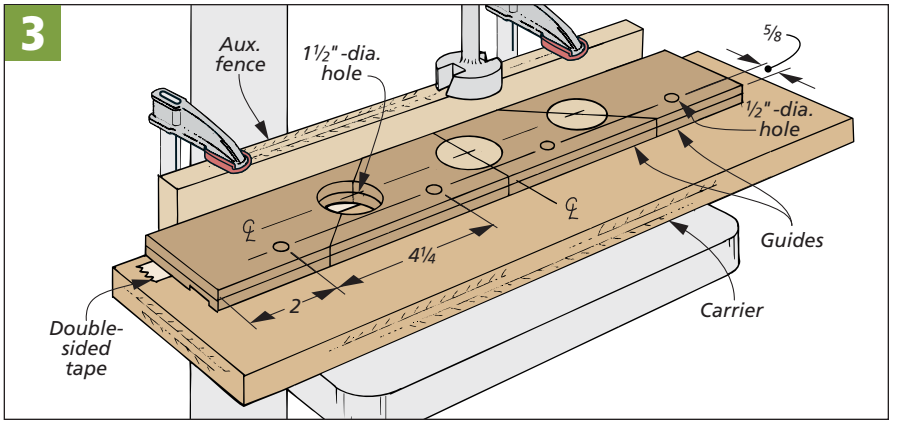
GUIDE BLANK. Because these guides are rather small, I started with an oversized blank. This blank consists of two layers of ¼" hardboard, as you can see in Figure 1.

After trimming the blank to final size, you're ready to cut a shallow groove in the bottom (Figure 1). Like the base, this groove helps to align the guides on the top of the fence during assembly.

GUIDES. Once the groove is complete, you're ready to cut the blank into four separate guides (C) (Figure 2). These pieces will form "slots" to guide the pull saw at three separate angles — one at 90° and the other two at 45° left and right.

I used the table saw to cut the guides to size. But before doing that, it's a good idea to check the alignment of your miter gauge.





Checking for 90° isn't difficult. For that I just use my try square. You can also use a try square to check the 45° angle for accuracy, as shown in the right photo below.

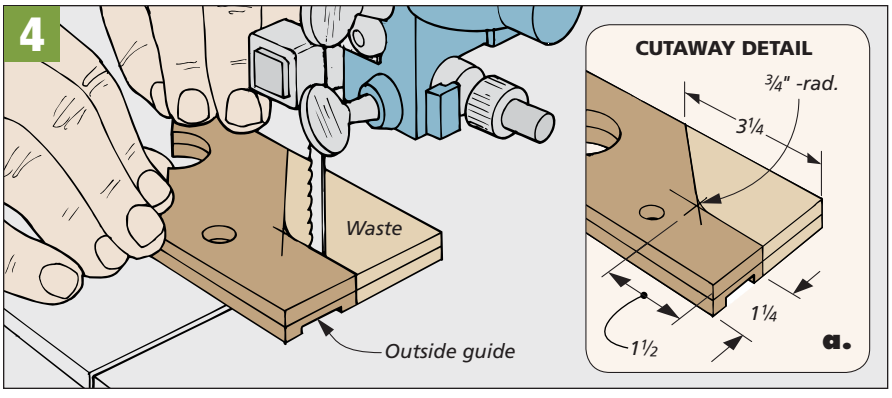
To ensure the blank doesn't slide around as you make the cuts, attach an auxiliary fence and a strip of sandpaper to the miter gauge. Then cut the guides to size (Figures 2 and 2a).

CIRCULAR CUTOUTS. Now you can turn your attention to the circular cutouts. These cutouts are just centered holes drilled along the joint line between each guide.

Drilling a hole across a pair of guides is a challenge. So I made a carrier to hold the guides, as you can see in Figure 3. To keep the guides from slipping, they're held in place with double-sided tape. And a fence clamped to the table of the drill press positions the guides accurately.

MOUNTING HOLES. While I was at it, I drilled a mounting hole in each guide. These holes are centered over the groove in each guide. And they're oversized to allow you to adjust the guides once they're installed.

CUTAWAY. There's one last thing to do to the guides before they can be installed. And that's to make a curved cutaway on the two outside guides so it's easy to clamp or hold a small workpiece. As you can see in Figures 4 and 4a, a band saw makes quick work of removing the waste.



Miter Check. To check the 45° setting on your miter gauge, cut a scrap in two and form a right angle. If it checks square, then you know that the 45° setting is accurate.

box Assembly

Now that all the parts of the miter box are complete, you're just about ready to assemble everything. However, because the teeth of the pull saw have set (flare out at the bottom), they create a small problem.

The guides of the miter box are designed to sandwich the blade of the saw. So if you try to feed the saw between the guides, the teeth will cut into them, widening the slot and creating a loose fit.

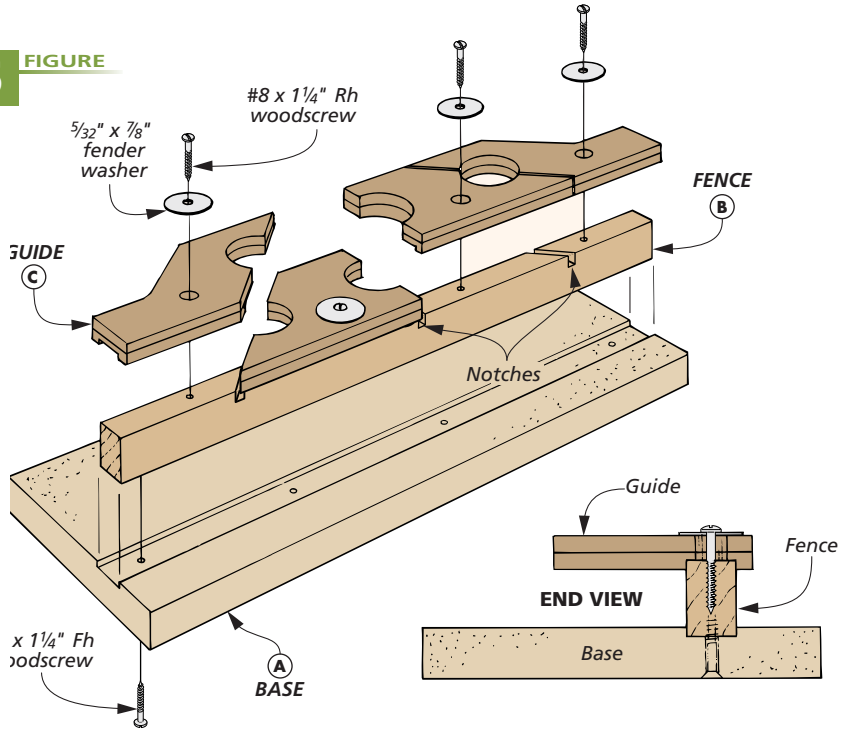
CLEARANCE FOR THE TEETH. To solve this problem, I added a set of notches to the top of the fence, as shown in Figure 5. As you can see in the margin photo, this notch provides a resting spot for the teeth of the saw. Note: For this to work, you'll need to feed the blade of the saw into the miter box with the teeth below the guides, but more about that later.

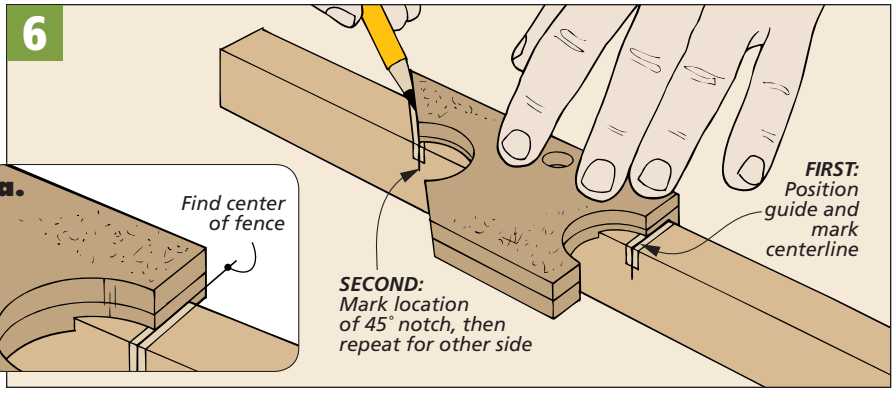
LOCATE NOTCHES. The first thing to do is to locate the position of each notch. As you can see in Figures 6 and 6a, locating the layout line at 90° is easy. Just make a mark at the center of the fence. But for the 45° position on each side of the center, I didn't use any measurement. Instead, I used the guides to locate the notches. Just fit one of the center guides over the top of the fence so the 90° edge is aligned with the mark you just made on the fence (Figure 6). Then on the opposite edge, make a another mark for the location of the 45° notch. To locate the other 45° notch, simply repeat the process using the other 90° guide.

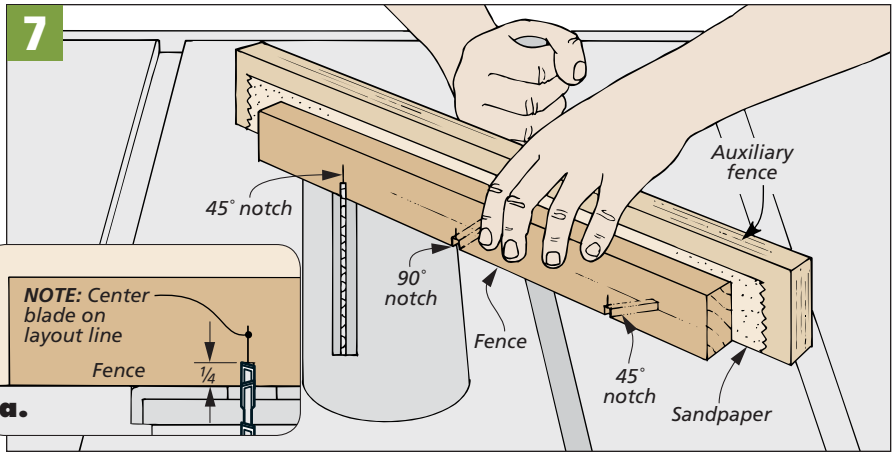
CUT NOTCHES. Now you're ready to cut the notches on the table saw. Here again, when making cuts like this, it's a good idea to attach an auxiliary fence to your miter gauge along with a strip of adhesive-backed sandpaper, as you can see in Figure 7.

This solves two problems. First, the auxiliary fence prevents chipout on the back side of the workpiece. And second, the sandpaper keeps the workpiece from slipping as you make the cut.

FIGURE 5







Notch for Teeth. To avoid widening the slot between the guides, the teeth of the saw blade rest in a notch that's cut in the top of the fence.

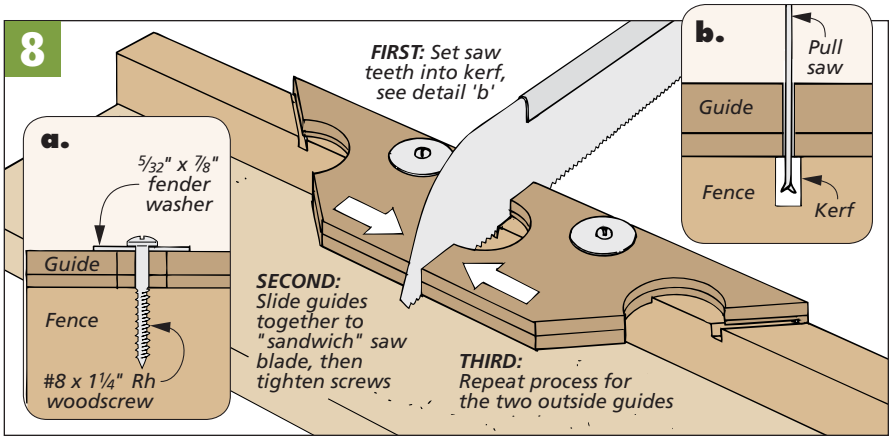
After cutting a ¼"-deep kerf at all three locations (Figure 7a), you can screw the fence to the base of the miter box, as illustrated in the End View of Figure 5.

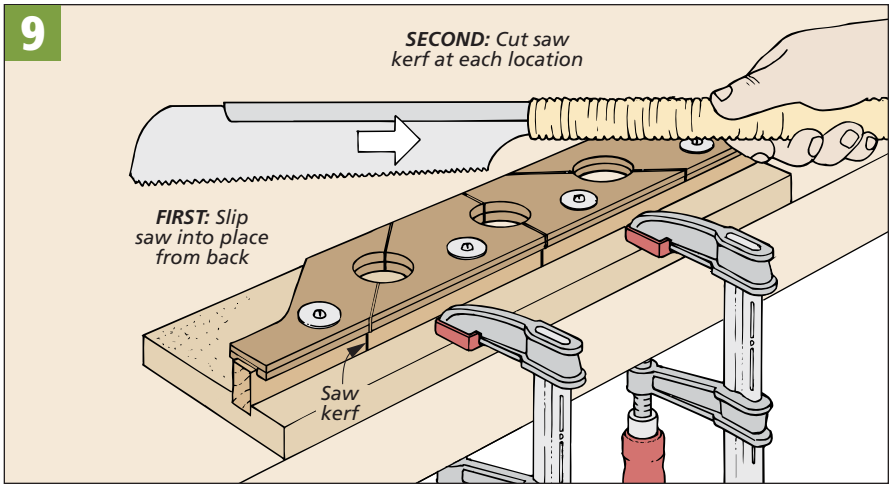
ATTACH GUIDES. At this point, you can turn your attention to attaching the guides to the top of the fence. The first step is to fit the two center guides over the fence and make a mark for the mounting holes on the top of the fence. The marks don't have to be perfectly centered since the oversized holes allow plenty of room for adjustment.

After drilling pilot holes at these marks, attach the two center guides loosely, as illustrated in Figures 8 and 8a. Then feed the saw between the guides so the teeth rest in the center notch (Figure 8b).

Now slide the guides against the blade of the saw and sandwich it in place. Then tighten the screws on the top of each guide. What you're looking for here is a snug fit against the blade, but not so tight that it binds and prevents the blade from sliding back and forth.

To locate the outside guides, just repeat the process. But since the center guides are already positioned, you only have to concentrate on one guide at a time.





USING THE MITER BOX

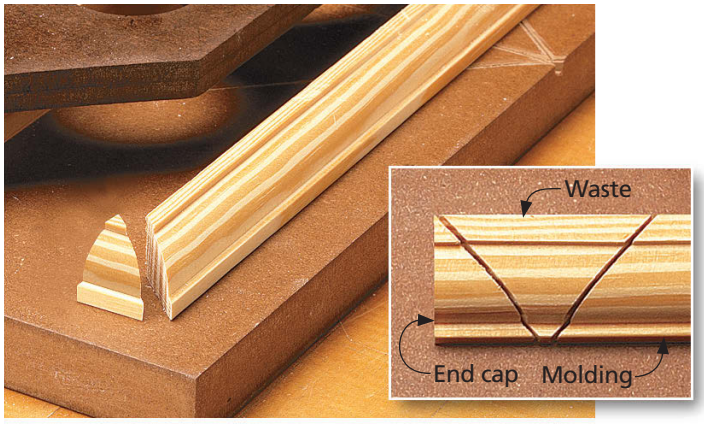
At this point, you're almost ready to start using the miter box. But before cutting any workpieces, it's a good idea to make an initial cut through the fence at each position. To prevent the box from moving around, clamp it in place (Figure 9).

Then position the teeth below the bottom of the guides and slip the saw in place from the back of the miter box. This prevents two problems. First, you don't have to worry about "buckling" the blade of the saw as you try to feed it into the opening from the front. And second, the teeth won't cut into the guides and widen the slot.

All you need to do now is pull the saw back and allow it to cut its own kerf all the way down to the base. Repeat this process to cut the kerfs at the two 45° positions.

Once all the kerfs are cut, you're ready to put the miter box to use. Although you'll probably find a number of jobs perfectly suited for this miter box, the photos below show a couple of my favorite uses for cutting small workpieces quickly, accurately, and safely.

Cutting Dowels. The cutaway at the end of the guide makes it easy to clamp a stop block in place and cut small pieces, like the dowels shown above, to identical length.



Molding. Cutting a small piece, like the end cap above, is also easy and safe. First, cut an end cap off the molding (refer to the inset), then make a second cut to remove the waste.

paring & skew Chisel Set

These handmade, specialty chisels are sure to be a treasured and useful addition to your collection of fine hand tools.

While standard bench chisels do the bulk of the work in my shop, there are times when specialty chisels like the ones shown here come in handy. And this trio is tough to beat for both good looks and functionality.

The first thing you notice is the detail of the brass and steel bolster that ties into the cocobolo handle. Then your eye is drawn down the blade by the slight chamfer along the edges. But what really matters is the "business end" where the steel meets wood. The long paring chisel allows you to make fine, controlled cuts while the skew chisels get into tight corners. All three are sure to make great additions to your shop.

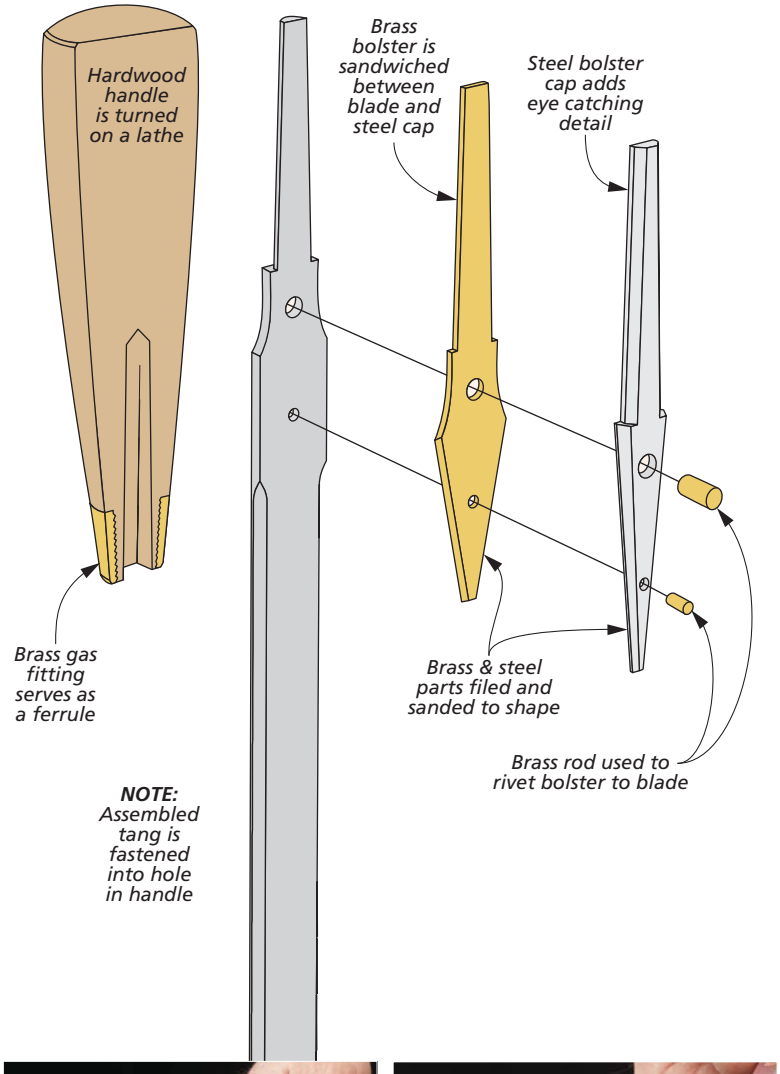
Skew Chisels. The angled cutting edge excels at paring and cleaning up those hard-to-reach areas, like the hand-cut, half-blind dovetails you see here.

Construction Details

OVERALL DIMENSIONS:

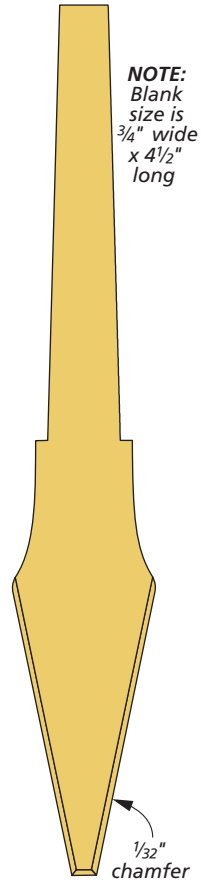
¾" PARING CHISEL: 14⅝" OVERALL LENGTH

½" SKEW CHISELS: 12⅝" OVERALL LENGTH

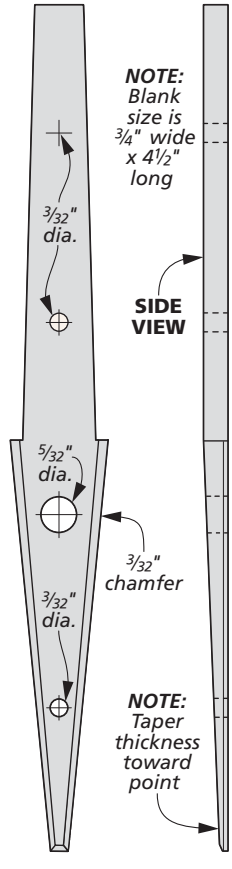


Paring Chisel. The long, thin blade of the paring chisel makes it great for paring cuts, such as cutting the subtle chamfer around this tenon (left photo). Plus, the blade flexes for flat cuts like trimming tenon shoulders (right photo).

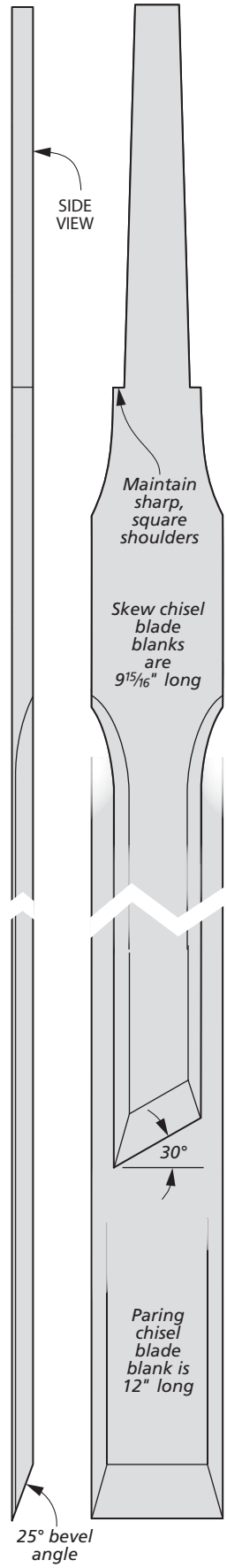
BRASS BOLSTER
(Actual size)

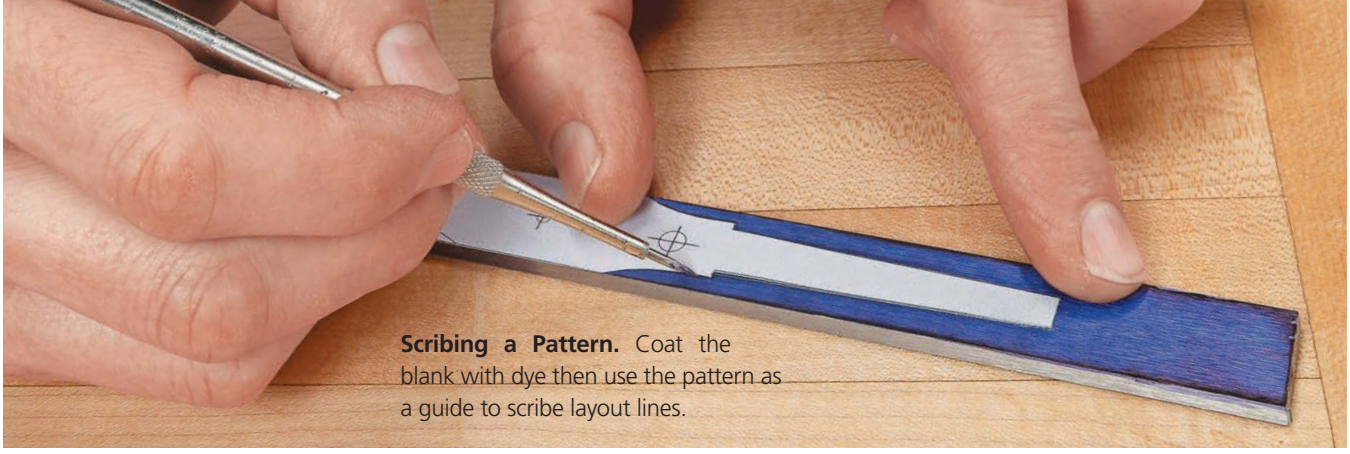


STEEL BOLSTER
(Actual size)



PARING & SKEW BLADES
(Actual size)





Scribing a Pattern. Coat the blank with dye then use the pattern as a guide to scribe layout lines.

shaping the **Blades**

To make the chisels, you'll work on the blades first. The blades for the paring chisel and skew chisels start out the same. You'll be shaping them from ¾"-wide x ⅛"-thick O1 tool steel bar stock. The skew chisels will be ground down to their narrower ½" width later. You'll add the brass and steel bolsters and then harden and temper the blades before adding the hardwood handle.

The great thing about working with O1 tool steel is that it's relatively soft. It'll take a little bit of work to cut and shape the steel and brass, but it's manageable if you try not to hurry.

START WITH TEMPLATES. The shape of the top of the blade, tang, and bolsters is identical on all three chisels. The easiest way to lay out the shape is to use a template. You can use the full-size drawings on the previous page to make templates. I glued the drawings to a piece of posterboard and then cut out the shapes with a sharp hobby knife.

To lay out the shapes on the brass and steel, I coated the metal with layout dye. (A permanent marker works just as well.) Just follow the template with a sharp metal scribe or awl to create clean, crisp lines, as you can see in the photo above.

CUT, GRIND, & FILE. I used a hack saw to cut the tang portion of the three pieces for each chisel. The only part that requires a little care is keeping the shoulders square. You can see what I mean in the far right drawing on page 57.

To create the curved sections of the blade, you can use a hack saw to remove most of the waste. Then you can smooth the curve with a coarse sanding drum. You don't need to be too fussy at this point — you'll do the final shaping and smoothing after the two bolster pieces are riveted to the blade blank.

SKEW BLADES. If you're making the pair of skew chisels, you'll need to do one more thing. The finished blades are only ½" wide, so you'll need to grind and file ⅛" off each side. The far right drawing (page 57) shows where the blade narrows just below the bolster. A pair of scribed lines serve as your guide when grinding and filing.

Again, a sanding drum helps smooth the arc that transitions from the ¾" to ½" width. Finally, smooth the straight edges with a file before filing the bevels.

BEVEL EDGES. The decorative bevel along the top edges of the blade also serves a couple of practical purposes. It softens the top edge and allows the chisel to get into tight corners.

To create the bevel, I attached the blade to a wide hardwood blank with double-sided tape. The thickness of the blank matched the width of the blade (far left photo). The wide blank elevates the blade above your benchtop to provide clearance for filing the bevels.

After clamping the blank in a vise, use a coarse file to remove most of the waste. To create a consistent bevel, I've found that it helps to make long strokes along the entire length of the bevel. Finish up with a smooth file and a 120-grit sanding block.

ROUGH BEVEL. At this point I took the opportunity to form the rough bevels on the ends of the blade. For the skew chisels, you'll need to grind the 30° skew angle before creating the rough 25° bevel angle.

The steel is soft enough to make forming the bevel an easy task using a honing guide and a coarse diamond stone (refer to the photo at near left for the setup I used). Coarse sandpaper works just as well. You don't need to form a sharp edge at this point. You'll do that after the handle is attached.

File the Edge Bevels. When shaping the bevels on the edges of the chisels, it's best to take long, even strokes for consistency.

Rough Bevel. Sandpaper or a coarse stone makes quick work of forming the rough bevel at the end of the chisel blade.

Drill for Rivets. Use CA glue (also known as super glue) to fasten the bolsters to the blade before drilling rivet holes.

ADDING THE BOLSTER. You can set the blade aside for now and start to work on the brass and steel pieces that make up the decorative bolster. You'll find full-size patterns on page 57. The layout process is the same — coat the blanks with dye and then scribe the pattern.

The parts that will require the most attention are the visible, tapered portions. Both pieces are lightly chamfered along these edges. Note that the steel piece is also slightly tapered in thickness (see the side view drawing on page 57).

Hardening. Use pliers to hold the blade blank while you heat it to an orange-red glow with a gas torch.

Peen the Rivets. With the rivets slightly proud, peen them on both sides by tapping them firmly with a mallet.

RIVETS. With these pieces in hand, you'll work on attaching them to the blade blank. I started by marking the hole locations for the rivets with a center punch. Using a gel cyanoacrylate (CA) glue, align the bolster pieces on the blade and clamp them in place for a few minutes. Then you can drill the four rivet holes through the stack, as you can see in the left photo above.

Short lengths of brass rod form the rivets. Use a ball-peen hammer to "mushroom" the rivets, locking the bolster to the blade. A little filing and sanding will make everything smooth, as you can see in the photos above.

HARDENING & TEMPERING. Since the steel is pretty soft, it won't hold a sharp edge for very long. As shown on the left, you'll need to harden it by heating the cutting end to an orange-red glow, then quickly quenching it in a can of vegetable oil. (It's best to do this outdoors.) I used MAPP gas since it burns a little hotter than propane. You can use a propane torch, but it might take a little longer to heat up the blade.

Quenching. Quickly immerse the hot blank into vegetable oil and move it around in order to cool the blade.

Smooth the Arc. A sanding drum is a great tool for making the arc flush on all three pieces of the chisel blade.

The steel is hardened at this point, but brittle. To temper the steel so it will maintain a sharp edge, you'll need to heat it in the oven following the instructions included with the steel. Mine specified 450°F for one hour. The blade and bolster clean up nicely with a buffing wheel and a little polishing compound.

MATERIALS & HARDWARE

A	Steel Blade (3)	1/8 x 3/4 - 12
B	Brass Bolster (3)	1/16 x 3/4 - 4 1/2
C	Steel Bolster (3)	1/8 x 1/2 - 4 3/8
D	Handle (3)	1 3/32-dia. x 4 1/4

- (3) 1/4"-20 Flared Tube Gas Fitting
- (1) 3/32"-dia. x 12" Brass Rod
- (1) 5/32"-dia. x 12" Brass Rod

turning the **Handle**

Now that the metal work is done, you can turn your attention to making the handle. I chose cocobolo for an attractive complement to the brass and steel. A brass gas fitting serves as the ferrule and a nice transition from the blade to the wood handle. (When working with exotic woods, be sure to wear a dust mask. Some woods can cause allergic reactions.)

A BRASS FERRULE. The first order of business is to obtain the brass fitting that makes up the ferrule (photo at left). You'll use it to size the tenon on the handle. The first step is to drill a ⅛" center hole in the fitting, as shown in the photo below. This hole provides a centerpoint to mount the handle assembly on the tailstock of your lathe after you turn the tenon on the handle blank. You'll start on that task next.

Ferrule. A simple brass gas fitting serves as a ferrule.

Shaping a Chisel Handle. The lathe is the perfect tool to use for shaping the exotic hardwood handle and brass ferrule. Take it slow and steady in order to end up with a smooth, polished handle.

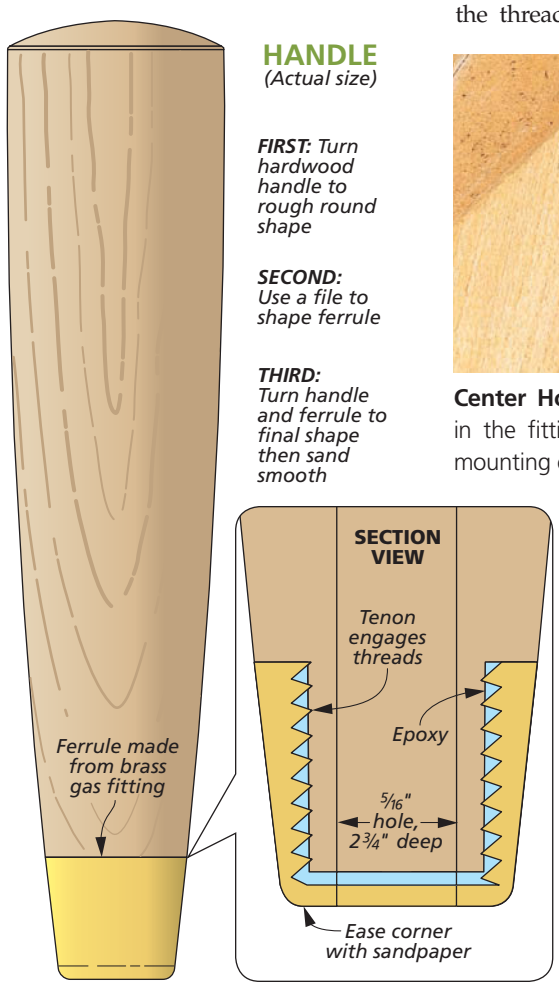
As you can see in the middle photo below, the next step in making the handle is to turn a tenon on the end of the handle blank. You're aiming for a fit that engages the threads on the brass fitting (lower right photo). You'll want to maintain a square shoulder on the handle for a tight fit with the brass fitting. Once you can thread the fitting onto the tenon so it rests tight against the shoulder, apply a little epoxy to fasten the fitting permanently.

Center Hole. A small center hole drilled in the fitting serves as a centerpoint for mounting on the lathe.

TURN THE HANDLE. Now you can mount the handle and ferrule assembly on your lathe to begin shaping it. First, you'll do some rough shaping to turn the handle round. I used a roughing gouge to remove the bulk of the waste.

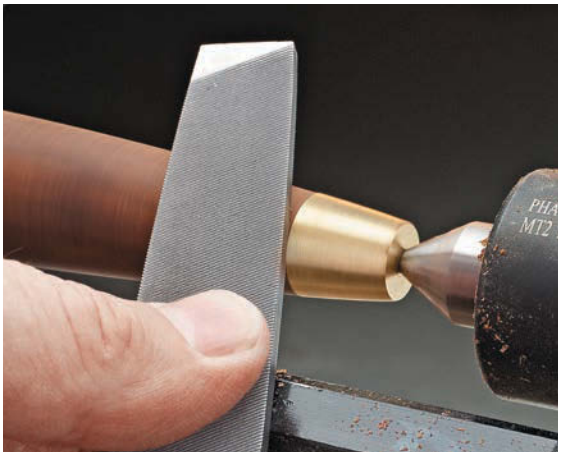
Next, you'll need to turn the brass fitting round. This is easy enough to do with a coarse file while running the lathe at low speed (upper left photo, opposite page). Then switch to a smooth file to home in on the final shape of the handle and ferrule, as shown in the drawing at left.

To create a satin sheen on the handle assembly, sand it with progressively finer grits of sandpaper while the lathe



Turn a Tenon. Turn a short tenon on the end of the handle blank to fit the ferrule.

Checking the Fit. Turn the tenon close to its final size, then check the fit in the threads.



Turning with Files. After turning the ferrule and handle round, use a series of files to fine-tune the parts and bring them to final shape before sanding.

A Smooth Finish. Use progressively finer grits of sandpaper to smooth the handle and ferrule while they're spinning on the lathe. I hold thin strips on either side of the spinning handle as shown above.

is running. I started with 120-grit and worked my way up through 600-grit (upper right photo). For a higher gloss, you can sand to a higher grit and apply wax with the handle still spinning on the lathe. I simply sprayed my handles with a coat of lacquer.

FITTING THE TANG. The final step in the process is fitting the blade assembly into the handle. To avoid gaps between the blade and ferrule, you'll want to exercise a little patience. The goal is for the shoulders of the tang to fit tight against the face of the ferrule with no noticeable gaps.

START WITH A ROUND HOLE. Before you can start fitting the tang to the handle, you need to enlarge the hole in the ferrule. I used the 1/8" center hole in the ferrule as a guide (upper left photo below). A wood handscrew with a V-notch cut in each jaw makes it easy to clamp the handle for drilling. Then use a 5/16" bit to drill the hole for the tang.

FILE & FIT. Here is where patience comes into play. You're going to file the sharp corners of the tang round and shape the hole in the ferrule to a square shape (refer to the photos below).

The target here is a snug fit. Aim to get the tang of the blade into the handle to the point where the shoulders are within 1/4" to 1/2" of the ferrule.

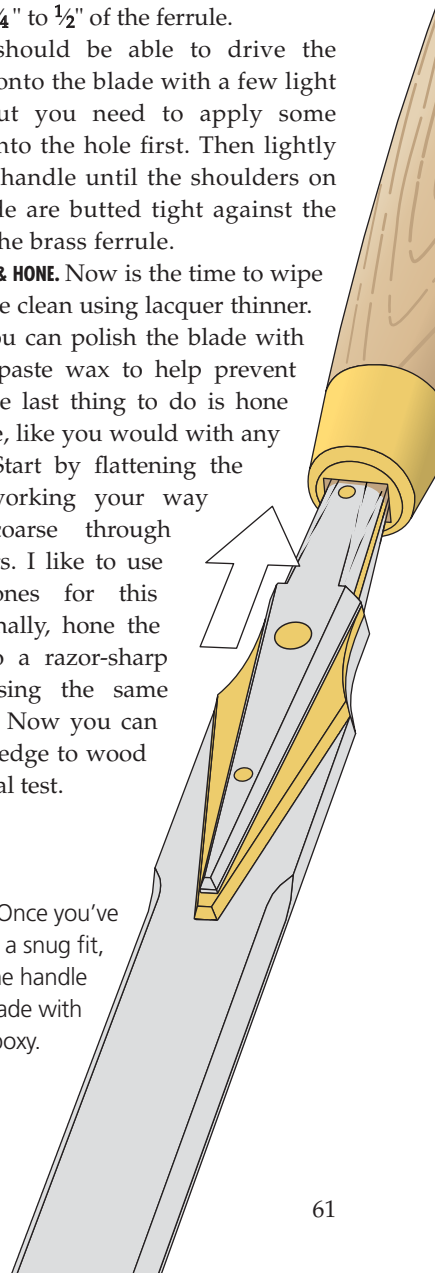
You should be able to drive the handle onto the blade with a few light taps. But you need to apply some epoxy into the hole first. Then lightly tap the handle until the shoulders on the blade are butted tight against the end of the brass ferrule.

POLISH & HONE. Now is the time to wipe the blade clean using lacquer thinner. Then you can polish the blade with a little paste wax to help prevent rust. The last thing to do is hone the edge, like you would with any chisel. Start by flattening the back, working your way from coarse through fine grits. I like to use waterstones for this task. Finally, hone the bevel to a razor-sharp edge using the same process. Now you can put the edge to wood for a final test.

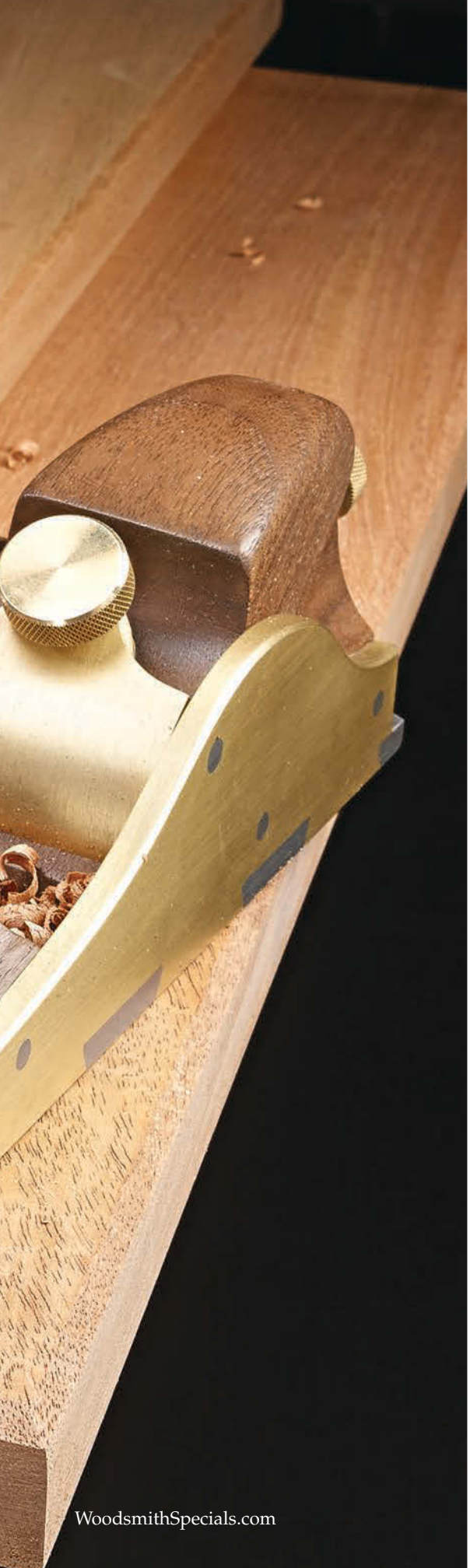
Hole for Handle. Drill the 5/16" hole into the handle as a starting point for adding the blade to the chisel.

Shape the Hole. Use small files to square the hole. Check the fit of the tang in the hole, and make adjustments as needed.

Shaping the Tang. Round over the sharp corners of the tang to make it easier to fit into the handle. Continue shaping the tang and hole in the handle until the fit is seamless.



Fitting. Once you've achieved a snug fit, secure the handle to the blade with a little epoxy.



smoothing & Shaping

Giving your projects that heirloom, hand-crafted look really comes down to shaping the parts for gap-free joinery and glass-smooth surfaces. And it only takes a handful of tools and techniques to get there.

THE ESSENTIAL BLOCK PLANE.....64

MAKING FLAT PANELS.....66

WORKING WITH RASPS & FILES.....68

INFILL BLOCK PLANES 70

CUSTOM SPOKESHAVES 78

the versatile Block Plane

Master a few basic techniques and strategies, and you'll be reaching for this valuable tool every day.

Roundovers. Layout lines on the sides and end grain help to form a smooth profile.

A block plane is one of the most versatile tools I have in my shop. And once you learn some basic tips and tricks for this simple tool, I'm sure you'll use it in some way on almost every project you build.

Trimming End Grain. A low-angle block plane is a good choice for flush trimming end grain, such as the pins on box joints or dovetails that protrude beyond the surface.

BASIC TECHNIQUES. If your experience with a block plane is limited, you can improve your skills with a little practice. Just start with a very sharp iron (blade) that's set to take a very thin shaving. Then work on a scrap piece until you're comfortable with the tool.

In most cases it's best to hold the plane at an angle to the workpiece, which is firmly clamped to a workbench. Skewing the plane like this effectively lowers the angle of the blade and you'll get a cleaner cut. The goal is to remove thin shavings until you've achieved the result you're looking for. Taking too much material at once can create tearout and result in a rough finished surface.

TRIMMING

Once you have the basics down, you can put your block plane to work on a project. One way is to use it for trimming.

JOINERY. A block plane can make quick work of trimming joinery. I like to cut dovetails or box joint fingers a little long so I can trim them perfectly flush after assembly, as in the photo at left. When doing this, it's important to work from the edge of the workpiece back. This prevents the part being trimmed from chipping. Just make light passes across the ends of the fingers until the joints are flush.

HARDWOOD EDGING. There are several ways to trim hardwood edging on plywood, but a block plane can be one of the quickest.

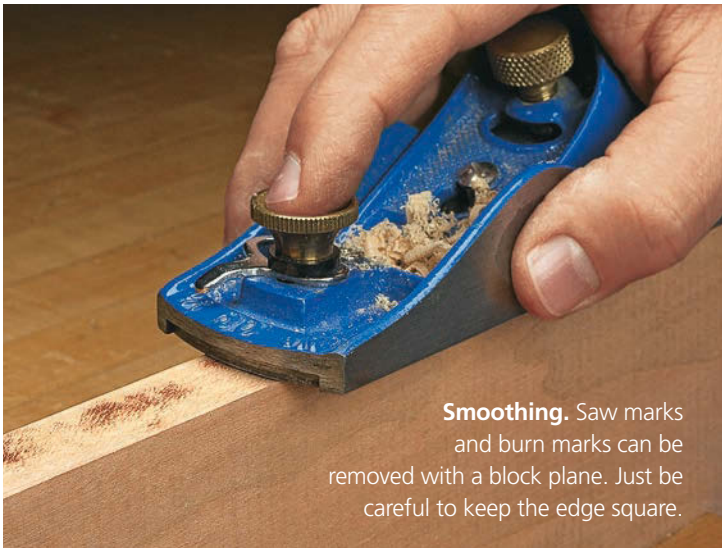
As you trim, just skew the plane toward the edge of the panel, as shown in the left photo on the opposite page. This way, you'll minimize the risk of gouging the face of the plywood. Then just make several passes along the edging until it's flush with the plywood.

SHAPING

A block plane makes a handy shaping tool as well. It can be faster and more convenient than a router.

CHAMFERS. I like to use my block plane to create chamfers of all sizes. Even wide chamfers are simple to shape

Flush Trimming. To keep from marring the face of the plywood as you trim the edging flush, angle the plane away from the workpiece.



Smoothing. Saw marks and burn marks can be removed with a block plane. Just be careful to keep the edge square.

with the block plane. For chamfers less than ⅛", all you need to do is make a few passes by eye. But if the chamfer is wider, like the one shown in the main photo on the opposite page, I find it best to draw layout lines on the workpiece as a guide.

This way, all you need to do is keep the plane centered and make several straight passes until you reach the lines. For tips on chamfering end grain, see the box below.

ROUNDOVERS. Even a roundover is fair game for a block plane. Here the technique is a little different. First, draw the profile on the end of the workpiece along with layout lines on the edge and face. Next, to get the desired profile, vary the angle of the plane as you make each pass. Removing the waste at the center of the profile may take several passes, while the edges may only need one pass to create a smooth profile.

SMOOTHING & FITTING

Cleaning up an edge with a block plane is faster and more efficient than sanding. You can remove saw marks, burn marks, and mill marks with just a few passes, as shown in the right photo above.

SMOOTHING. Here again, keep the plane slightly skewed for a cleaner cut (see right photo above). And be careful to maintain a flat, square surface. Then make a few passes along the edge until all the marks are gone.

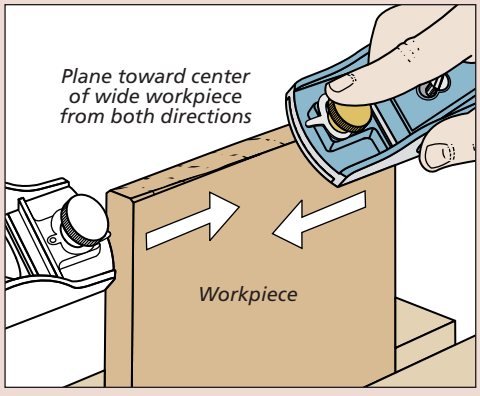
INSET DOORS. One more use for this tool is trimming an inset door to fit an opening. But don't try to trim the entire edge all at once. You'll find it easier if you first remove some material at the back of the edge by planing a slight bevel. This way, you can fine-tune the fit by taking small amounts of material off the front. Just be sure to check the fit after each pass to gauge your progress.

As you can see, with just a few simple techniques, you'll find that a block plane is the best tool for fine-tuning your work or putting the finishing touch on any project.

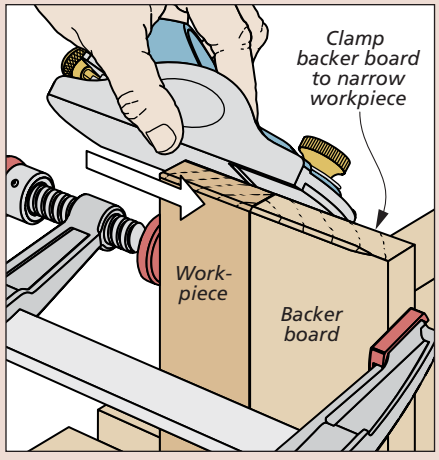
Planing End Grain

Planing a chamfer on the end grain of a workpiece is more challenging since the blade can chip out the edge at the end of the cut.

But there are a couple ways to avoid this. On a wide workpiece you can plane toward the center by working from both edges. And for a narrow workpiece, you can clamp a backer board for support. This way, the edge of the workpiece can't chip out as you complete the pass with your block plane.



Coming and Going. To avoid tearout when chamfering end grain, plane toward the center of the workpiece from both edges.



Backer Board. A scrap board clamped against the edge of a narrow workpiece helps prevent tearout.

making Flat Panels

With the right combination of basic hand and power tool techniques, you can transform glued-up solid-wood panels into flat, smooth parts for your projects.

A great-looking, glued-up panel is the showpiece for many woodworking projects like tables and cabinets. And there's a surprising number of woodworking techniques that go into making one: wood selection, creating tight edge joints, and finishing, just to name a few important tasks.

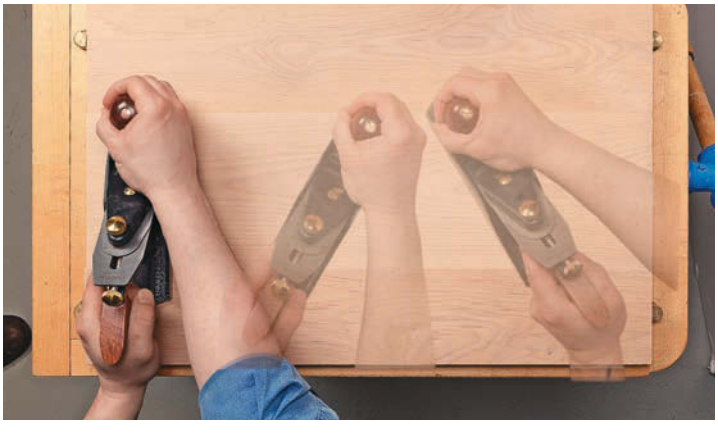
No matter what the project, if the panel isn't perfectly flat you're likely to have problems at assembly time. That's why developing a quick process for checking that a panel is flat and a reliable technique for flattening panels of any size is time well spent. I tend to rely on a few long straightedges to check the panel, simply placing them at various locations along its length.

If a panel needs flattening, the technique I use combines a hand plane and a random orbit sander to get the job done quickly. But it may not be in the order you think.

Instead of using the plane to smooth the wood, I use it to do the heavy work of leveling joints and flattening any major distortions. Then all that's left for the sander is to smooth out the top and prepare it for finish.

START FLAT TO END FLAT. Before getting into the nitty gritty of how to flatten a panel, I want to mention a few things about gluing up the panel in the first place. No flattening and smoothing technique can make up for a bad assembly. So it pays to spend a few extra minutes aligning the boards as you tighten the clamps.

In the box at the bottom of the page, you can learn a few tips I used for getting your



Cross Grain. Plane straight across the grain or at a slight angle to level joints and flatten the panel.

Stop Tearout. Plane a chamfer along the edges both to soften them and to prevent the grain from splintering later on.

Highlights. Set up a low, raking light to locate imperfections in the surface.

By Hand. Finish the smoothing process with a sanding block wrapped with 180-grit paper.

panel started off on the right foot. Even with good prep work, more than likely there will still be some minor unevenness in the joints. Additionally, the panel may have cupped or twisted slightly. Finally, the panel needs to be smoothed. It's best to tackle these tasks one at a time.

THE PLANE. You can use almost any plane for this step. But a longer plane will make it easier to create a flat surface since it will ride over minor dips in a workpiece to take down the high spots.

The trick is using it the right way. Instead of working with the grain, I find it works best to take strokes across or diagonal to the grain. You can see this in the lower left photo on the opposite page. This way, the plane takes coarse shavings that are less likely to cause tearout.

DEPTH OF CUT. I recommend setting the plane to take a light cut to start with. Then, as you gain experience and see how the wood responds, you can work up to taking thicker shavings.

Working across the grain does have a downside. As the plane completes a cut, the unsupported back edge can splinter. To prevent this from happening, I plane a slight chamfer on both long edges before getting started, as shown in the lower right photo on the facing page.

HIT & MISS. When you first start, the plane will likely make short "skip cuts" across the surface. That's okay. Work your way down the panel and then back. With each successive pass, you'll take longer cuts.

In addition to leveling the glue joints, the plane can remove high spots caused by twist and cup. The trick now is knowing when you're ready to move on to the next stage. Your clue is when the plane can take a full shaving across the workpiece.

SANDING TIME. Now the panel is flat, but it isn't smooth. You can see what I mean in the photo above. The plane may leave tracks and a slightly wooly surface. The next step is to focus on smoothing the surface. Here I turn to my random orbit sander. The sander gives me predictable results and finish-ready surfaces.

I usually start with a 100-grit disc to erase the ragged look. To help highlight imperfections, set up a light to shine low across the panel, as in the upper left photo.

GRIT SEQUENCE. You can stop sanding as soon as the plane marks are gone. That's all I do for the unseen bottom face of a cabinet or tabletop. For visible surfaces, replace the 100-grit disc with a 120-grit disc and continue sanding. All you're doing here is leveling the scratches left by the previous grit. So these steps won't take much time at all.

I repeat the process with 150- and 180-grit sanding discs. The final step is to go over the workpiece by hand with 180-grit sandpaper backed by a firm block (upper right photo). Work in the direction of the grain to remove the swirls left by the sander.

At this point, the panel is smooth, flat and ready for a finish. The result is a workpiece that's worth showing off.

Flat Glueups

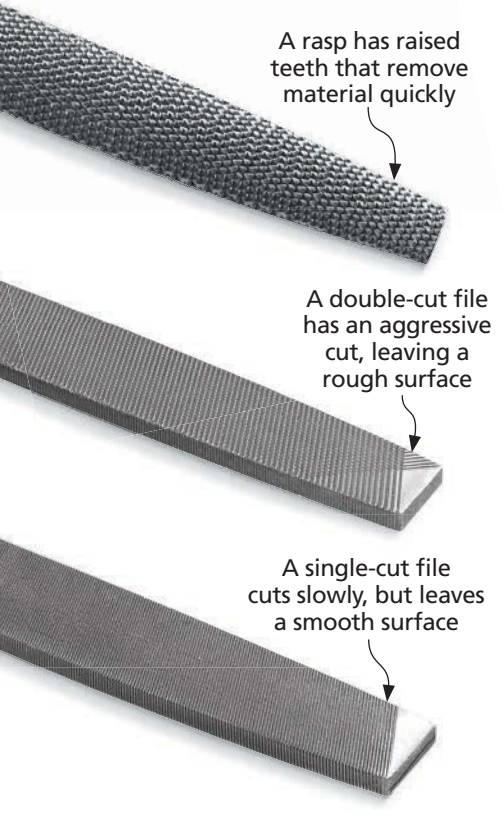
Gluing boards into a panel is a basic task. But the process still has its challenges. The biggest is keeping the boards in alignment while the glue dries. Here are two ways to get the job done.

Tap It Flat. Most small clamps can only reach in a few inches to level joints. But that doesn't mean you're out of luck. Instead, loosen the clamps slightly and use a hardwood block and a dead-blow mallet to nudge the boards into alignment, as shown in the upper right photo. When they're flush, snug up the clamps.

Clamp the Ends. Wood handscrews are a great way to keep the ends of boards flush in a glued-up panel, as you can see in the lower right photo. They have wide bearing surfaces that are less likely to leave marks on the workpiece. It's a good idea to wax the jaws, otherwise the clamps may get glued in place.

working with Rasps & Files

When you need to remove a lot of material in a hurry, it's tough to beat the results achieved with rasps and files. Here's how to go about the process.



Whether you cut curved parts at the band saw, with a jig saw, or by hand with a coping saw, your job is only halfway done. You still have to shape, refine, and smooth the parts. For that, you need a good set of rasps and files. They're the perfect solution when you have a workpiece or a project that needs a lot of hand work to achieve the final shape.

RASPS. Rasps remove stock in a hurry, so they're the go-to tools for the initial shaping work. They feature sharp teeth that protrude from the body of the tool. These teeth can be either cut into the steel blank by a machine or by hand.

The process of forming teeth is called stitching. As you'd expect, the hand-stitched variety costs a bit more, but their performance justifies the cost.

Machine-cut rasps suffer by comparison because the teeth are usually aligned and leave grooves in a workpiece. Hand-stitched rasps have a random pattern and leave a smoother surface.

Hand-stitched rasps are also available in several different grades of coarseness. These are known as "grains," and they typically run from 1 to 15, with 1 being the roughest and 15 being extremely fine.

Machine-cut rasps offer a more limited selection, often labeled smooth, second-cut, and bastard. The commonly available Nicholson #49 is a second-cut rasp, and the #50 is called smooth. In reality, they are coarse and somewhat less coarse, respectively.

FILES. Files are normally associated with metalworking. These are the tools for shaping steel. But they can also be of use to woodworkers. The biggest advantage of files is the different profiles. Flat, round, half-round, triangular-shaped, and square files are common.

The teeth of a file are almost flat, but each tooth has a forward-facing, angled cutting edge. The photos at left show both single-cut and double-cut files, so named for the rows of teeth.

TECHNIQUES

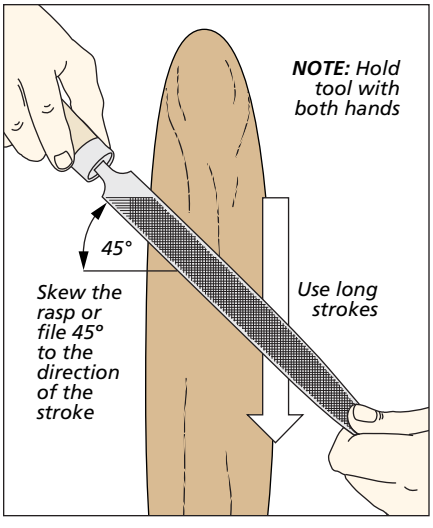
Even though files and rasps have different types of cutting edges, the techniques for using them are largely the same. A two-handed grip gives better control, and a skewed angle of attack is usually best. And you'll get better results when you use a light stroke.

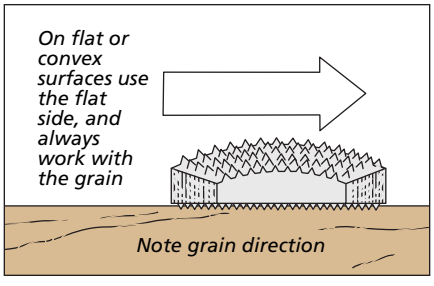
MARKING THE SHAPE. It's a good idea to mark the workpiece with the shape of the profile, since the stock will be cut away quickly. In the photo at right, you can see an example of how to mark the end of a workpiece with the profile you're shooting for. This makes it much easier to gauge your progress and helps stop you from going too deep.

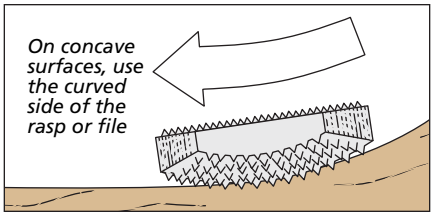
HOLDING THE WORKPIECE. Just like any other hand tool work, shaping requires that the workpiece be held firmly in position. The main photo on the opposite page shows how I use a carving vise to hold the piece while I round over the edges with a rasp. Not only is the vise versatile enough to hold the workpiece at many different angles, but the firm grip also prevents chatter while you work.

SHAPING. With the workpiece secured, you're ready to begin shaping. At this point, you're probably thinking that this is old hat, and that no instruction is necessary. But I've watched many experienced woodworkers make a fundamental mistake when shaping a workpiece. The tendency is to push the rasp or file with a saw-type stroke. That is, they push and pull the rasp over the surface. The problem with this approach is that you can dull a rasp rather quickly by putting pressure on the pull stroke. The teeth can wear under the pressure, especially on a hand-stitched rasp.

Mark It. Marking the desired shape on the end of a workpiece is an easy way to avoid cutting too deeply. You can also check your progress as you go.







STROKE. The far left drawing shows a normal stroke with the tool skewed at roughly 45° relative to the workpiece. By moving the tool from right to left as you go, you can remove a lot of material. Just remember to slightly lift the tool on the return.

The two drawings at left show how to deal with grain direction. As a rule, you'll want to work with the grain and move "downhill" on curved parts. But if you're leveling a large area, working across the grain is fine, since you're going to smooth it over in subsequent passes.

Rasps and files have been around for a long time. The box below shows a different idea that has found popularity with many woodworkers today. But no matter which tool you prefer, with a little practice shaping curved parts is well within your capabilities.

Shinto Rasps

For years, I thumbed through woodworking tool catalogs and chuckled when I saw the *Shinto* rasps shown in the photo at right. Let's face it, the design seems a little bit unusual.

So I was quite surprised when I finally decided to give the *Shinto* a more serious look. It not only cuts well in hard and soft wood, but it leaves a smooth surface. And it's almost impossible to load up with shavings and sawdust like a conventional rasp. The open, diamond pattern of the blades lets the shavings escape freely.

The top rasp at right features a comfortable handle that makes it easier to use, but it's a bit cumbersome when you need to switch from one face to the other. The simpler version below it is the way to go.

Unfortunately, the *Shinto* rasps are only available in a flat profile. But they're certainly worth a look. Refer to Sources on page 98 for where to find them.

Double-Sided. Both sides of the *Shinto* rasp are cutting surfaces. The coarse face features 10-TPI blades and the opposite, finer side is 24-TPI.

infill Block Planes

With an attractive combination of wood, brass, and steel, these planes will look great in your shop. But what's most important is that they work as well as they look.

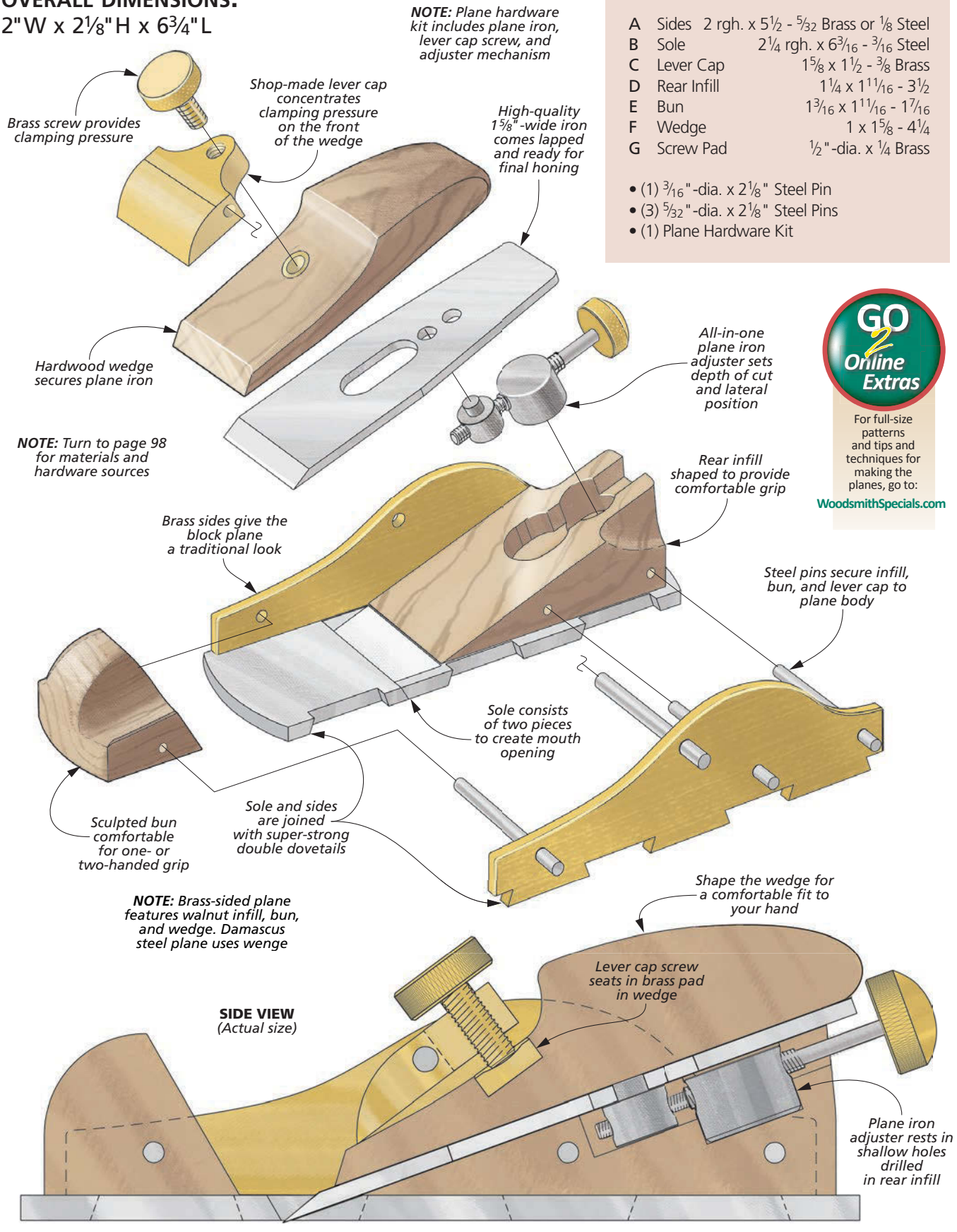
There's nothing quite like the feeling of using a fine plane — especially if you made it yourself. And if you've never had that experience, then building one of these block planes is a good place to start.

The small size reduces the time and cost compared to a larger bench plane. The metalwork involved in making the body of the plane is pretty straightforward. Brass sides give it a traditional look. Or you may want to consider Damascus steel for something more unique.

As a woodworker, you'll find making the wood infill and wedge a snap. And they're a great way to hone your shaping skills. The hardest part of building your own plane usually is making the adjustment mechanism for the iron. But here, we used a kit that includes a single adjuster for both the depth of cut and side-to-side positioning.

Construction Details

OVERALL DIMENSIONS:
2"W x 2⅛"H x 6¾"L



MATERIALS & SUPPLIES

A	Sides	2 rgh. x 5½ - 5/32 Brass or ⅛ Steel
B	Sole	2¼ rgh. x 6 3/16 - 3/16 Steel
C	Lever Cap	1⅝ x 1½ - ⅜ Brass
D	Rear Infill	1¼ x 1 11/16 - 3½
E	Bun	1 3/16 x 1 11/16 - 1 7/16
F	Wedge	1 x 1⅝ - 4¼
G	Screw Pad	½"-dia. x ¼ Brass

- (1) 3/16"-dia. x 2⅛" Steel Pin
- (3) 5/32"-dia. x 2⅛" Steel Pins
- (1) Plane Hardware Kit

GO 2 Online Extras

For full-size patterns and tips and techniques for making the planes, go to:
WoodsmithSpecials.com

creating the metal Sides & Sole

The foundation, as well as the starting point, for building the block plane is the four-part body. A pair of sides are joined to a two-piece sole with a seemingly impossible-to-cut double dovetail joint. (I'll get to that a little later.) Figure 1 provides an overview of the parts and how they relate. But before going any further, you need to make some material decisions.

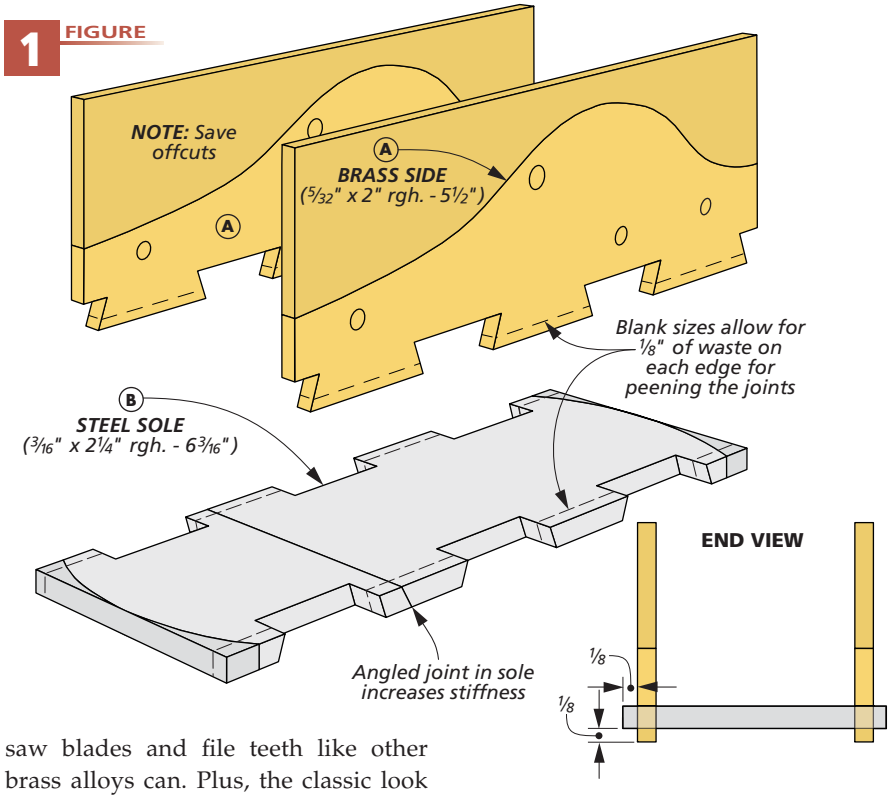
As I mentioned earlier, I made two planes. One features traditional brass sides, while the other has sides made from Damascus steel. This unique material has a pattern that's similar to highly figured wood grain. Each material has its advantages.

BRASS SIDES. The brass alloy is known as 360 brass. It's heavy, but soft enough for easy shaping. It's also "free cutting," which means it won't gum up saw blades and file teeth like other brass alloys can. Plus, the classic look of brass is hard to beat.

DAMASCUS STEEL. As you can imagine, Damascus steel is harder than brass. But it's still pretty easy to work. Since steel is stronger than brass, the material for the sides can be thinner. The result is a lighter plane overall.

THE SOLE. No matter what you choose for the sides, the sole is the same. To save time and effort over using ordinary

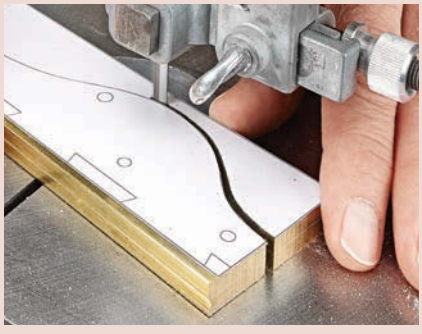
1 FIGURE



Step-by-Step Metal Work

While the metalwork for the block plane may seem unfamiliar — and a little intimidating — it really isn't much different than working with wood. And as I'll show later, it can actually be a little more forgiving than wood. The process shown in this box covers the basic steps for shaping the sides and sole as well as cutting the dovetail joinery. I used a few tricks to speed up the process and make getting better results a certainty. It starts with taping the side blanks together and doing as much work as possible on both parts at the same time. Consistency is the name of the game here.

Filing can be tedious work — and a good way to introduce error. So you want to remove as much waste as possible with other techniques. This way, the only filing needed is to clean up edges. Hardwood guide blocks serve as aids to keeping edges and angles smooth and even.



1 Tape the side pieces together and cut them out at the same time at the band saw. Save the offcut for a later step.

2 Transfer the dovetail layout across the edge and to the back face using layout fluid and a fine scriber.

3 Cut the sides of the tails using a hacksaw. Get as close to the line as you can to save time filing.

mild steel found at a hardware store, I used precision ground 1018 steel. With this material, the hard work of creating smooth, parallel faces and square ground sides has been done for you.

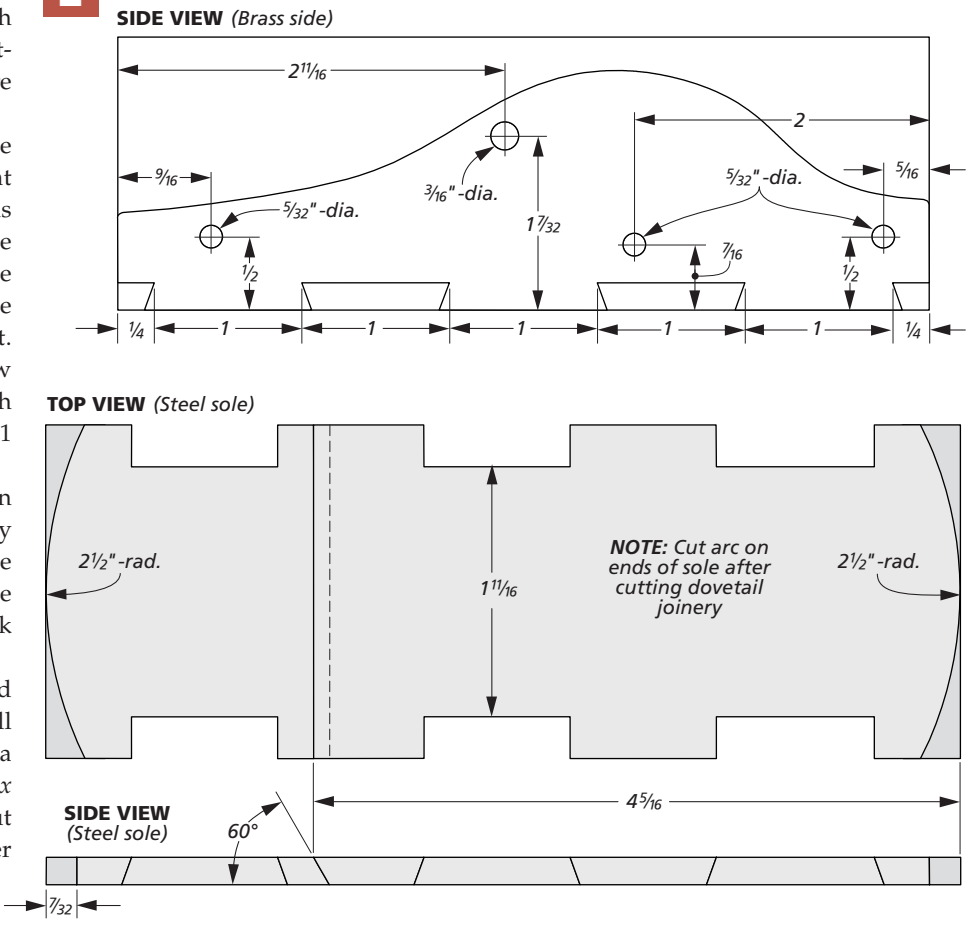
In the lower Side View of Figure 2, you can see the sole pieces meet at an angle. The reasoning behind this is the pressure from the iron could cause the sole to flex downward around the mouth. The angled joint allows the toe end of the sole to provide extra support.

STRAIGHTFORWARD PROCESS. The box below walks you through the steps to make each piece and cut the joinery. Use Figures 1 and 2 to find the dimensions you need.

I found it helpful to use a pattern (Figure 2) for shaping the sides. Simply attach it with spray adhesive. Just be sure to position the pattern ⅛" from the bottom edge to provide material to lock the dovetails together, as in Step 1.

Brass is soft enough to cut at the band saw. For the steel sides and sole, you'll need to use a hack saw. It's a good idea to invest in high-quality blades (*Lenox* or *Starrett*, for example). They'll cut faster, last longer, and leave a smoother edge compared to inexpensive blades.

FIGURE 2 **PATTERN** *(Enlarge 130%)*



4 Drill holes for the pins and to remove the bulk of the waste material. A block keeps the workpiece from lifting.

5 I used a cold chisel to punch through the thin material between the holes and pop out the waste.

6 Use a series of files to clean up the joinery. Thick, hardwood blocks serve as guides for the file.

7 After cutting the sole pieces, use angled blocks to file a matching angle on the mating ends of the parts.

8 The brass sides serves as a gauge to lay out the location of the pins on the sole pieces. Again, use layout fluid.

9 Rough out the pins just like you did the tails with a hacksaw. Then file the pins for an easy slip fit in the tails.

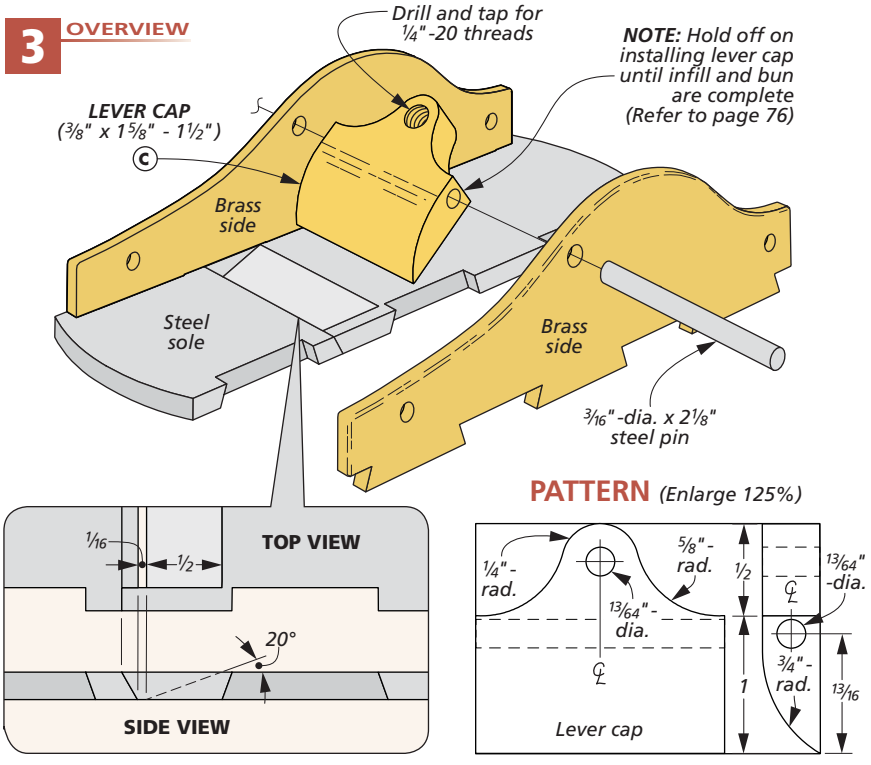
assembling the Plane Body

There's still a bit of metalwork left to do on the sole pieces before you can bring them together into a single body. And that's where the real fun begins. The sides and sole pieces are locked together by peening the metal. It's a solid and permanent connection.

SHAPING THE MOUTH. First things first: The rear sole piece needs to have a mouth cut in it for the plane iron to be exposed. As you get ready to cut it, keep in mind a few things. The first is the size of the mouth.

For fine cuts in figured wood, a smaller, tighter mouth will help prevent tearout. Another detail is keeping the bed flat across its width and square to the sides. Since you're removing a fair amount of material, any tricks to increase the accuracy and save some time are welcome.

You can see the approach I took in the box below. I took it in two main steps: Remove most of the waste as quickly as possible. Then clean up and fine-tune the surface. Turn to your hack saw to remove most of the waste.



When it comes to cleaning up the surface, I took some time to make hardwood guide blocks angled at the same 20° as the bed to help keep my file level. Create a sandwich with the blocks, sole, and some double-sided tape. Use a coarse and then a fine file to level and smooth the bed. Finish up with 220-grit sandpaper.

DOUBLE DOVETAILS. Even if the dovetails you cut in the sole and side pieces are pretty

More Details

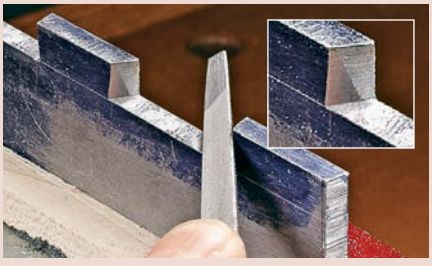
Cutting the mouth and bed is a critical step in the process. The bed forms the contact surface for the plane iron. It needs to be flat and square to the sides in order for the plane to cut consistently. Steps 1-3 show the method I used. Once again, the key to precise results is using carefully cut hardwood guide blocks.

Relief Notch. Step 4 shows how to create the double dovetail look. The trick is filing a slightly angled relief notch. It should be just big enough to create an angled look from the bottom face, as shown in the inset photo. This means you don't have as much peening work to do. Once the peening is complete, you'll wrap up the metalwork by making the brass lever cap. After all the heavy filing of the body, the lever cap will seem a like walk in the park.

1 A series of closely spaced kerfs makes it easier and faster to create the mouth in the steel sole of the plane.

2 Hold the hacksaw on its side and cut in from each direction in order to clear out a majority of the waste for the mouth.

3 Sandwich the sole of the plane between two hardwood blocks to accurately file the mouth to a 20° angle.



4 Use a file to make some small angled notches in the sole to create the unique double dovetail look.

tight, they only lock together in one direction. For the strongest connection, put the malleability of the metal to work for you.

Step 4 on the facing page shows filing a small relief notch on the lower inside edge of the pins on the sole pieces. This gives the pin the look of a tail and creates a small, wedge-shaped gap between the pin and tail.

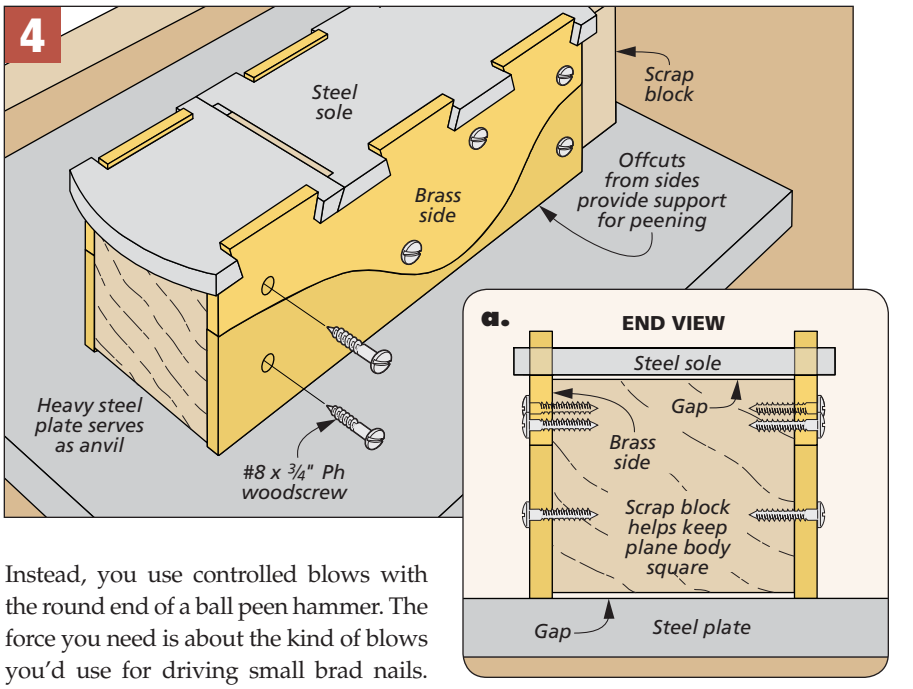
PEENING METAL. Filling the void and creating a locking wedge in both directions involves flowing some excess metal from the sides into the gap. You do that by peening the metal with a hammer.

The setup for peening is shown in Figure 4. There are a few key points to note. The first is supporting the sides. I used the offcuts from cutting the sides to provide solid backup while hammering.

You also need to keep the body square. To do this, I screwed the body to a hardwood block. There's a small gap both above and below the block (Figure 4a). The lower gap lets the metal provide maximum support to the sides. The upper gap allows the sole to seat firmly into the sides.

The actual peening isn't like a blacksmith waling on a chunk of metal. Instead, you use controlled blows with the round end of a ball peen hammer. The force you need is about the kind of blows you'd use for driving small brad nails. After repeated hits, the brass will work-harden and chip off. So you want the gaps filled before that starts to happen.

Take your time and stop when the gaps in the joinery are filled. Steps 5 and 6 show what the metal looks like after peening. Then it's time to settle in for some filing.



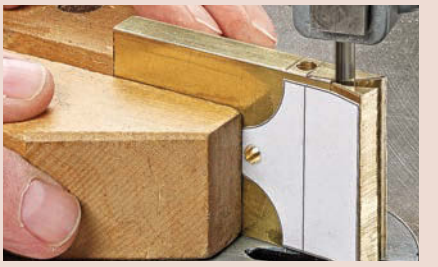
LEVER CAP. The final metal piece to make is the lever cap. It's made from thicker ⅜" brass. But don't worry. It's still easy to cut to shape at the band saw. You'll also need to drill a hole and tap threads in the lever cap to accept the screw that applies clamping pressure.

5 Using a ball-peen hammer, take your time peening the brass sides into the notches filed in the sole.

6 You can use firmer blows from the hammer to work the steel to fill any gaps in the brass sides.

7 It will take some time to file everything smooth after peening. The reward is revealing the tight-fitting dovetails.

8 Drill the pilot hole for the screw hole and the cross hole in the lever cap before shaping the part.



9 A handscrew is a good way to hold the lever cap blank steady and safely while cutting it to shape at the band saw.

10 Files and then some sandpaper make surprisingly quick work of smoothing the lever cap nose.

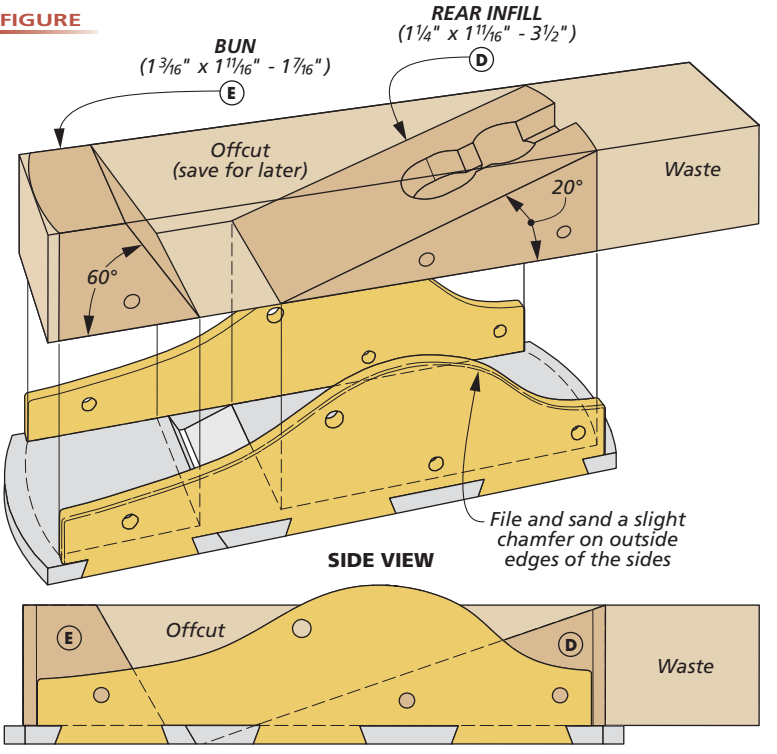
adding the Infill & Wedge

Even though the plane body still looks a little rough, it's time to change hats to do a little woodworking. The body is filled with a couple small pieces of wood. These are locked in place with steel pins that are peened and filed flush. So that's why you can hold off on the final smoothing for now.

BUN & INFILL. As you can see in Figure 5, the bun and rear infill aren't complicated to make. There are a couple challenges, though. The first challenge is working with small parts. And the second is getting the angle of the rear infill to match the angle of the plane iron bed in the sole. I made both pieces from an extra-long blank that I sized to fit snugly into the plane body.

REAR INFILL. The rear infill piece is shaped, but before you can get to that, you need to tackle a couple other details. The first is cutting the infill to match the bed angle. I put together a simple taper jig for the table saw to make the cut. You can read more about the jig and how to use it at *WoodsmithSpecials.com*. The other detail is to create the recesses for the plane iron adjuster mechanism. In Figure 6, you can see how to support the rear infill to drill three shallow holes at the correct angle. A little bit of chisel work connects the dots, so to speak.

5 FIGURE



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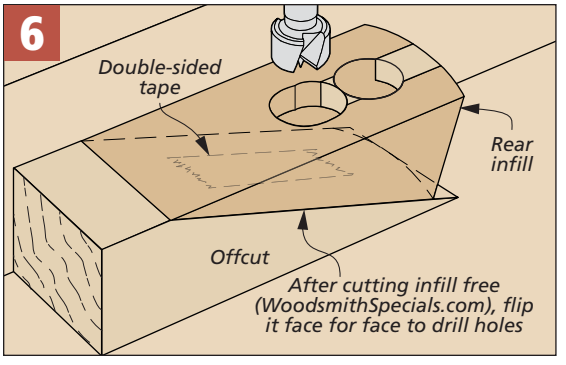
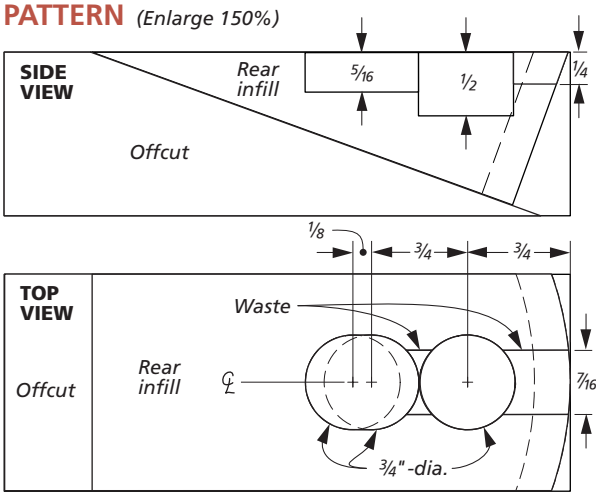


PATTERN *(Enlarge 150%)*



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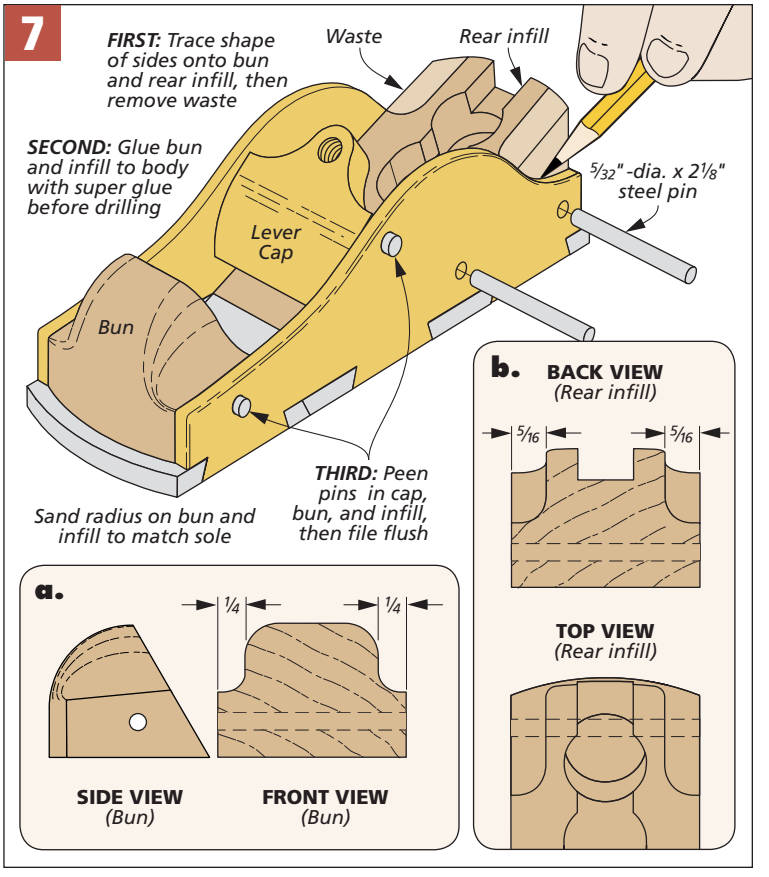
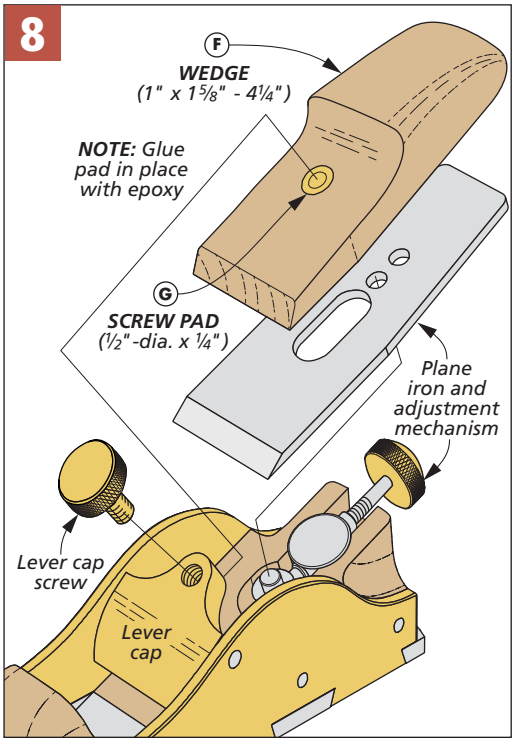
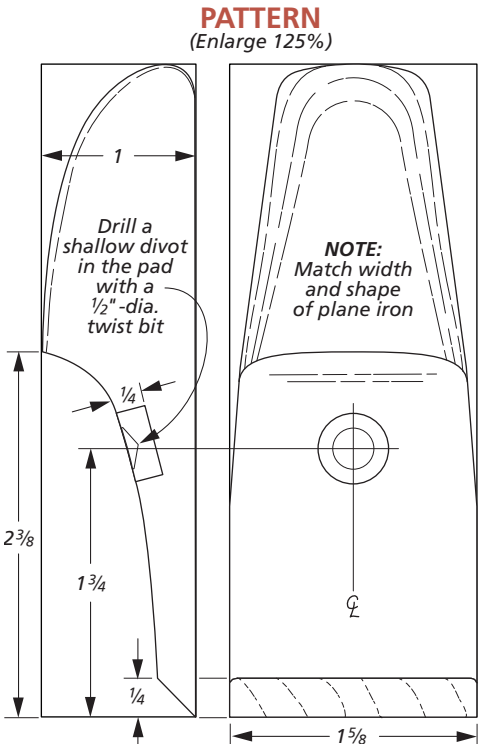


THE BUN. You use the offcut from the blank to make the front bun, as shown in Figure 5. Then take a look at Figures 7a and 7b as a guide for shaping both the bun and rear infill. The infill, bun, and lever cap are secured with pins, and you can see how to do that in the box below.

THE WEDGE. The final part to make is the wedge. Its job is to distribute clamping pressure from the lever cap to the iron. A brass pad in the wedge acts as a contact point for the lever cap screw. Figure 8 and the pattern at right provide the details for shaping the wedge. But feel free to alter the shape to suit your hand.

While there's a lot of pleasure in building a classic tool like this, there's even more in using it.





finish up the Plane

The last bit of metalwork on the plane is about making it look good. Before you can get to that, you need to install the lever cap, bun, and infill in place with pins.

I drilled through the infill and bun from both sides of the body. Drill most of the way though from each side. This way, the pins won't bind as they're installed.

Cut the pins about 1/16" longer than the width of the plane. To create a lock, you peen each end of the pin. This slightly swells the pin in the side, holding it tight even after the excess has been filed off. Thin shims under the plane body provide clearance for the excess while peening.

Some advice for sanding and smoothing your plane: First, be patient. It will take some time. Then, clean and change the paper frequently. The metal dulls the abrasive quickly. Also, sanding obscures the Damascus steel pattern. See how to to reveal it at *WoodsmithSpecials.com.*

1 After drilling through the infill and bun, slip the pins into place. Then peen each end to lock the pin in the side. Thin shims support the plane body.

2 Remove any file marks using coarse, adhesive-backed sandpaper applied to the table saw. Use the rip fence to create a parallel scratch pattern.

3 Use the same technique to clean up the sides of the plane, as well. Work your way up to 400-grit. The rip fence helps to keep the sides square to the sole.

4 An abrasive pad puts the final touches on the sides and bottom of the plane. You can protect the sides and bottom by applying a thin coat of paste wax.

GO 2 Online Extras

To find jigs useful in building the spokeshaves, go to:
WoodsmithSpecials.com

custom Spokeshaves

There's no better way to create smooth, even curves than using a spokeshave, which is a tool designed specifically for that purpose. And you can't beat the satisfying results when it's a tool you've made yourself.

A spokeshave is the perfect choice for smoothing out a convex or concave surface quickly and easily, as you can see in the photos on this page. Buying a spokeshave is an option, but I like the look and feel of a wood-bodied spokeshave. And having a pair is best, one with a flat bottom for convex curves and another with a curved bottom for concave surfaces.

CREATING THE BODY BLANK

The body of a spokeshave is nothing more than a piece of wood with a narrow opening at the bottom for the blade. This throat opening widens toward the top, creating a bed for the blade and clearance for shavings. Trying to create this shaped opening from a single piece could be a real challenge.

The solution is to make each spokeshave from two parts, a narrow front piece and a wider rear piece, as shown in the drawing on the opposite page. Using two parts makes it easy to create a precise opening and an angled bed for the blade. What's even better is both spokeshaves start out with identical blanks and require the same work. The final shaping of the bottom face is the last step.

SINGLE BLANK TO START. Although you can make the front and rear bodies for each spokeshave from two separate pieces, I found it best to start with a single extra-wide, extra-long blank planed to final thickness. By starting with a single blank, the grain will be an almost perfect match once you glue both parts back together. And the extra length and width make it easier to work with. So after ripping the blank in two to create the front and rear bodies, you're ready to work on some details on each part.

SECURING THE BLADE. The blade is held in place with a studded knob that passes through a blade retainer (more on this later). So the rear body needs a counterbored through hole, as in Figure 1 of the

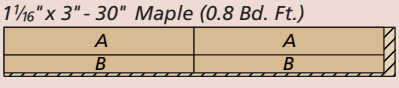
Curved Bottom Spokeshave. Building two spokeshaves is as easy as one. Instead of leaving the bottom flat, creating a gentle radius on the sole makes it easy to smooth out a concave surface.

MATERIALS, SUPPLIES & CUTTING DIAGRAM

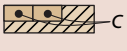
A	Rear Bodies (2)	1 1/16 x 1 3/4 - 14
B	Front Bodies (2)	1 1/16 x 1 1/8 - 14
C	Wear Plates (2)	1/4 x 1 1/8 - 2 1/8
D	Blade Retainers (2)	5/8"-dia. x 2 3/32" Steel Rod

- (2) 1/4"-20 x 1 1/4" Knurled-Rim, Studded Knobs
- (2) 9/32" I.D. x 5/8" O.D. Black Washers
- (2) Spokeshave Blades (2 1/16" wide)

1 1/16" x 3" - 30" Maple (0.8 Bd. Ft.)



1/4" x 2" - 6" Cocobolo (0.1 Sq. Ft.)



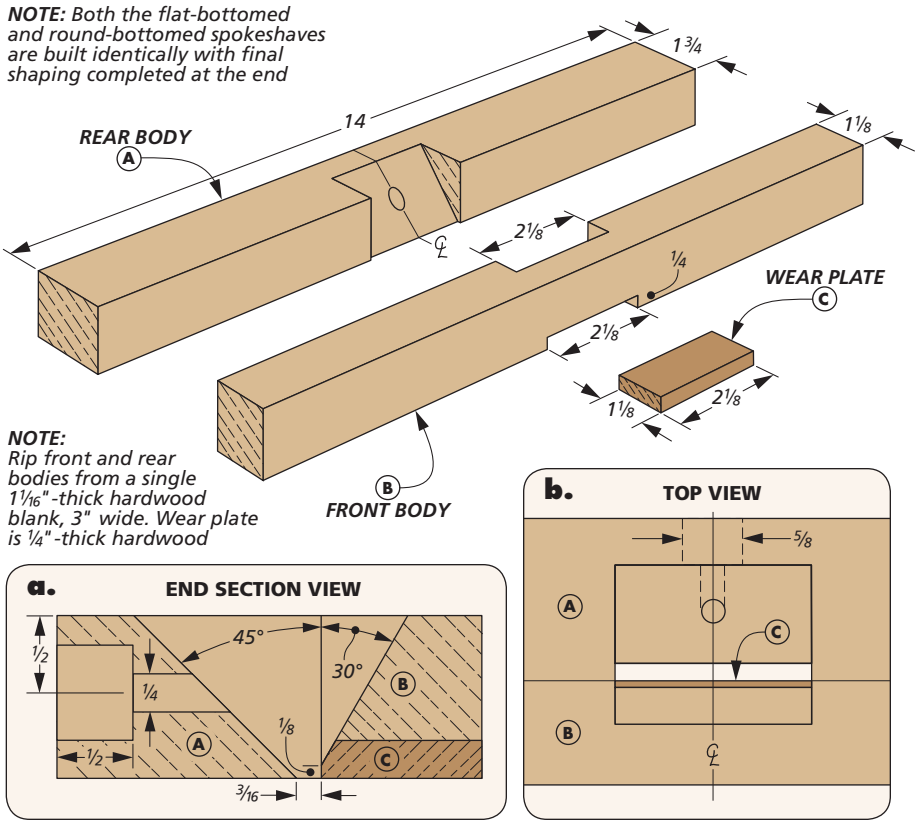
How-To box, below. Be sure to note that the hole isn't centered on the thickness (detail 'a' at right).

Since the bottom of the spokeshave runs along the surface you're smoothing, it's important to minimize any wear and tear on the bottom face ahead of the blade. To do this, I cut a shallow dado in the front body to accept a wear plate (Figure 2). I made the wear plate from a harder wood (cocobolo), sizing it to fit the dado and then gluing it in place.

A SLED FOR NOTCHES. The beveled notches in each piece are just angled dadoes. The challenge is holding each body in the correct position while making passes across a dado blade. In Figure 3, you can see how I did this using a dual-purpose sled. You can find out more about the sled online at *WoodsmithSpecials.com*.

REAR BODY FIRST. After setting up my dado blade to make the widest possible cut, I attached the sled to a wood auxiliary fence on my miter gauge using double-sided tape. With the rear body centered over the blade, make a series of passes, raising the dado blade between passes until the depth of cut creates an opening along the bottom edge of the rear body, as shown in detail 'a' above.

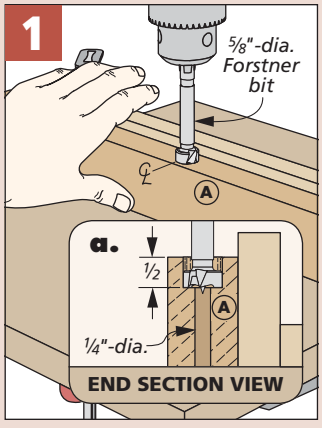
Once you have the depth of cut set, you can use the edges of the dado cut in the sled for reference to create a 2⅛"-wide notch centered in the rear body.



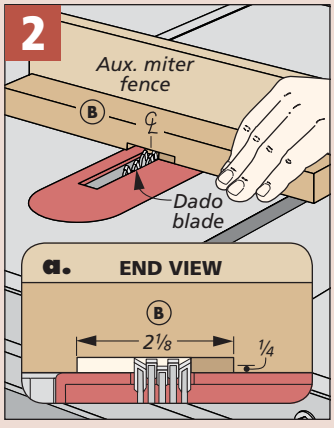
Cutting the centered notch in the front body is essentially the same. You'll start by flipping the sled around to use the V-notch along the opposite edge of the sled to establish the correct angle. Then just repeat the process to cut this centered notch to the same width as the one in the rear body. To avoid a fragile edge along the wear plate, it's important to leave a small flat, as shown in detail 'a.'

CAREFUL GLUE-UP. All you need to do at this point is glue both parts back together. To minimize the amount of work you'll have to do later, be sure to keep the ends and surfaces flush as you apply the glue and clamps.

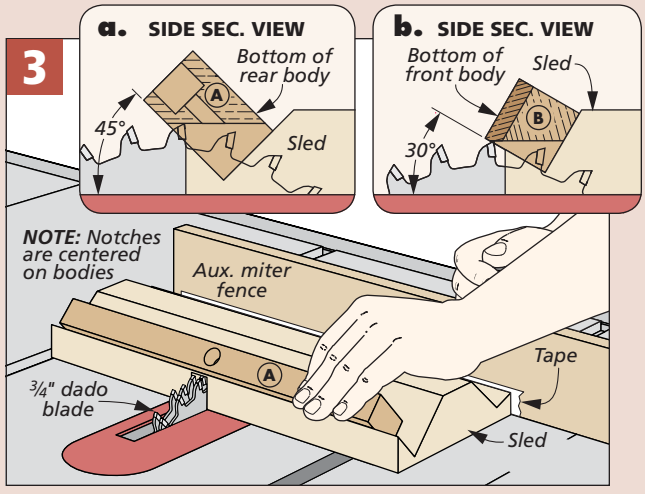
How-To: Create the Body Blank



Knob & Washer Hole. Drill a counterbore and then a through hole in the rear body.

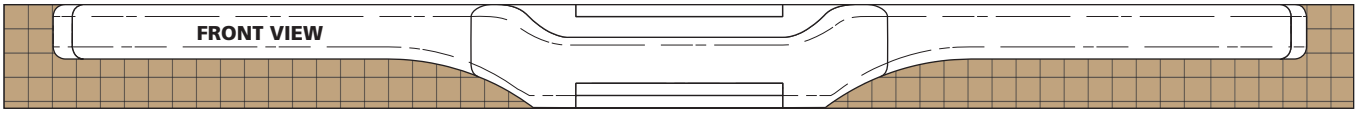


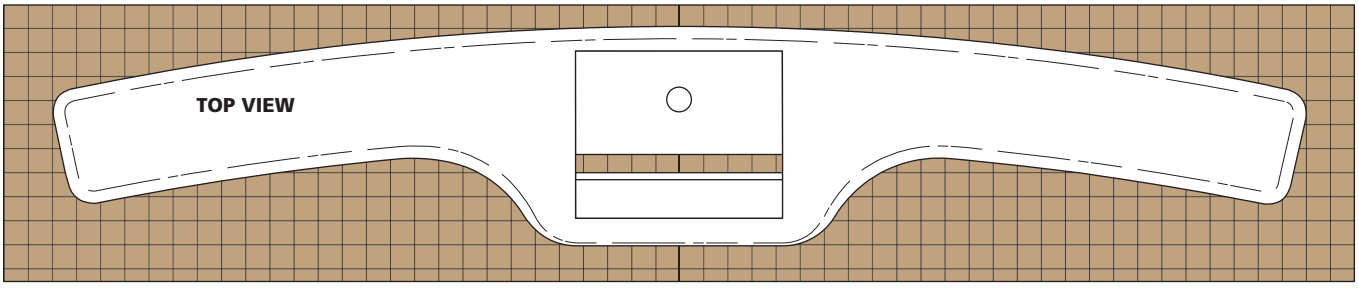
Wear Plate Dado. A shallow dado centered on the front body accepts the wear plate.



Body Notches. A dual-purpose sled provides support while you cut an angled notch along the inside edge of the front and rear bodies. Sled plans are at *WoodsmithSpecials.com*.

PATTERNS *(One square = ¼") Enlarge 200%*





completing the Spokeshave

Now you're ready for some real fun. And that involves transforming the freshly, glued-up blocks of wood into a pair of spokeshaves with a classic shape that fits comfortably in your hands.

SHAPING THE SPOKESHAVE. Don't worry about having to come up with a nice, pleasing shape. The patterns shown above take care of that. Just enlarge them to full size and attach them to the top and front edge with spray adhesive. The first couple of cuts remove the waste along the bottom, as in Figure 1 below. Staying just outside of the layout lines allows room for final sanding later to smooth everything out. With the waste removed, making the next set of cuts would be a bit unsteady. To provide support, I used double-sided tape to reattach the waste pieces to the bottom of the spokeshave before making the final cuts (Figure 2).

FINAL SMOOTHING. The remaining shaping is taken care of by using a series of rasps and files to customize the overall fit to your hand (Figure 3, below). Sandpaper makes quick work of any final edge easing and smoothing.

That's all you need to do for the flat-bottomed spokeshave, but if you also decided to make the curved-bottomed version, there's one last step. And that's to shape the bottom to a smooth radius. A rasp and file make quick work of removing most of the waste. Then sand it smooth using the jig shown in the article online at *WoodsmithSpecials.com*.

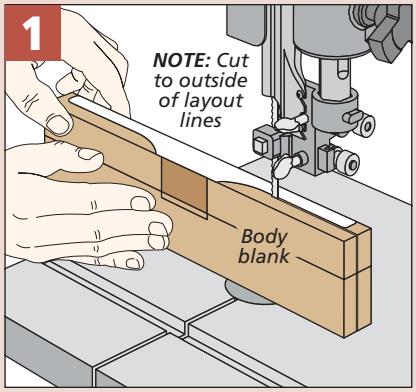
APPLY A FINISH. I like the natural feel of wood on hand tools, so I applied a couple coats of wipe-on oil. Once the oil was dry I buffed everything smooth.

INSTALLING THE BLADE

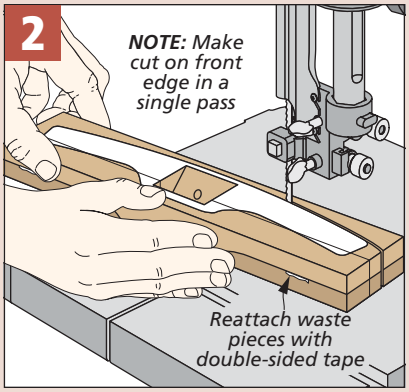
While the finish dries, you can turn your attention to working on the hardware that holds the blade in place. The drawing on the opposite page shows the simple system I used for this.

A studded knob passes through the rear body and into a threaded blade retainer. As you tighten the knob, it clamps the blade against the bed created by the beveled notch. A small piece of

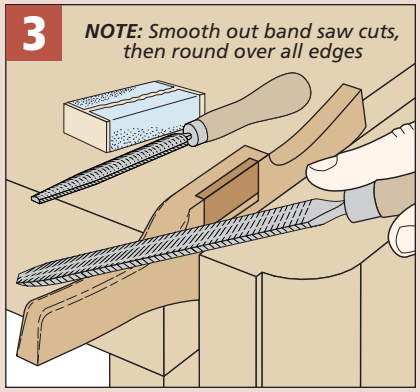
How-To: Shape the Spokeshave Body



Shape Bottom of Handle. Two simple band saw cuts remove the waste along the bottom of the spokeshave.



Reattach Waste. The waste pieces provide support as you make sweeping cuts to complete the shaping.



Final Shaping. With rasps, files, and sandpaper, complete the final shaping by smoothing out all the edges.

adhesive-backed sandpaper (150-grit) attached to the bed ensures the blade won't slip during use.

BLADE RETAINER. I started by making the blade retainer. It's just a piece of steel rod that's sized, tapped, and then cut in half lengthwise. Don't worry, it's actually not as challenging as it sounds. The key is the holding block that's detailed online at *WoodsmithSpecials.com*.

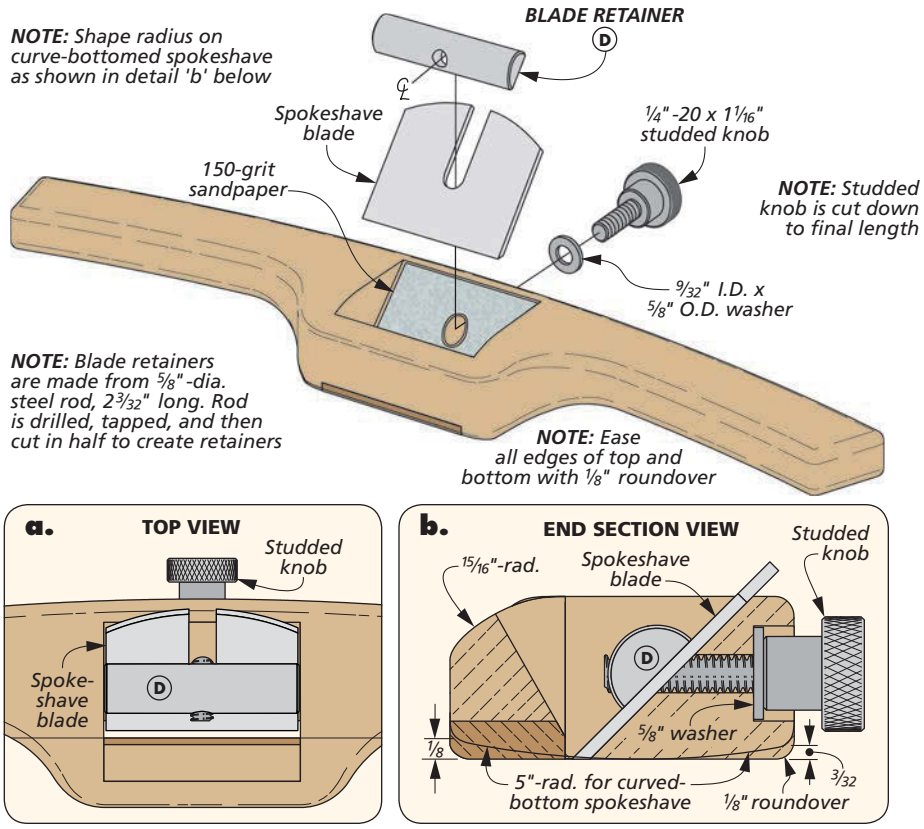
PUNCH, DRILL & TAP. The first step is to slip the rod into the block, clamp it, and then using the end of the block as a guide, cut the retainer to final length with a hacksaw. After filing a small chamfer at each end to ease the sharp edges, slide the rod back in place and mark a vertical line on the rod's end for reference.

A punch provides a positive start for drilling a 7/32"-dia. hole to accept a 1/4"-20 tap (left photo below). Now slide the rod partially out of the block and reclamp it to tap the threads (center photo).

SLICE IN HALF. The next part is a little tricky, and that's cutting the rod in half lengthwise. The cut needs to be at a 45° angle to the tapped threads. This results in a pair of blade retainers, one for the flat-bottomed spokeshave and the other for the curved-bottom version.

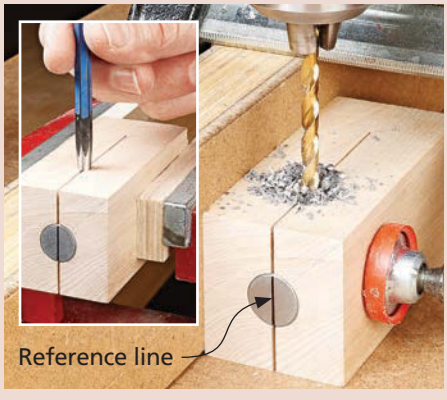
Again, the holding block works great for this. To orient the rod correctly for the cut, rotate it so the mark on the end of the rod aligns with a diagonal mark made across the end of the block. With it clamped securely, use the cut in the center of the block to guide your hacksaw.

FINE-TUNE. The surface left behind by the hacksaw will be a little uneven, preventing the retainer from resting tightly against the blade. I used sandpaper to fine-tune the fit so when I tightened the knob, it pulled the retainer flat against the blade, as shown in detail 'b.'



KNOB. All that's left is to add the studded knob. It's a purchased item, but the stud was a bit too long. I used a hacksaw to trim it down so it only extended slightly through the retainer when it was tightened up. With both spokeshaves complete and sharp blades installed, you're ready to tackle the shaping and smoothing tasks on your next curved project parts.

How-To: Drill, Tap & Cut



Drill a Hole. A punch helps to keep the bit centered (inset). Then use a gentle touch to keep the bit from wandering.

Tap the Hole. Use the block and a vise to secure the steel rod while you are tapping the threads in the hole.

Cut It in Half. After rotating the rod 45°, cut the rod in half with a hacksaw in order to create a pair of blade retainers.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clamping & Assembly

When the glue and clamps come out, that's when you know that your project is finally nearing completion. You can be assured of better results by checking the strategies on the following pages first.

CLAMPING & ASSEMBLY BASICS 84

THE VERSATILE HANDSCREW 88

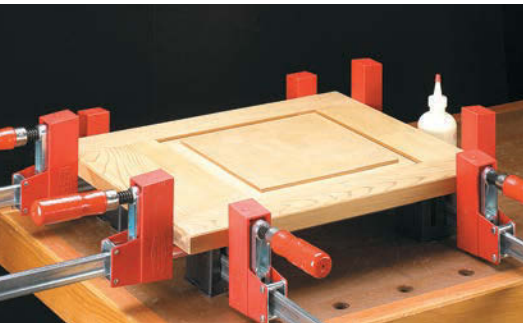
SQUARE ASSEMBLIES.....90

5 SHOP-MADE CLAMPS.....92

master clamping & Assembly Strategies

Create projects that will look great and last forever with the right approach to each and every glueup. Here are the clamps and techniques to consider.

Gluing up a project can be a little bit unnerving, especially if it's a big assembly. By the time you're ready to put it all together, you've cut, shaped, and sanded all the parts of the project to make them just right. But if the assembly doesn't go smoothly, the finished product might not live up to your high expectations. That's why learning about clamps and a few key techniques for clamping up an assembly is time well spent.



Keep It Square. Parallel jaw clamps are among the more expensive styles, but they're tough to beat for square assemblies.

CLAMPS

For every assembly, there's a clamp that's right for the job. Whether it's a simple cabinet or a complex piece with curves and irregular surfaces, there's a way to assemble it and keep it together while the glue dries. Here are a few of my favorite clamps that see regular action in the shop.

BAR CLAMPS. These clamps, sometimes referred to as "F-style" clamps, are the workhorses for most of us. They couldn't be easier to use — just slide the clamp head in place and twist the handle to put pressure on the workpiece. The advantage of these clamps is that they come in all sizes and the prices won't break the bank (photo at right).

Better Bars. Bar clamps are popular for reasonable prices and high performance. Here, a bar clamp levels two workpieces.

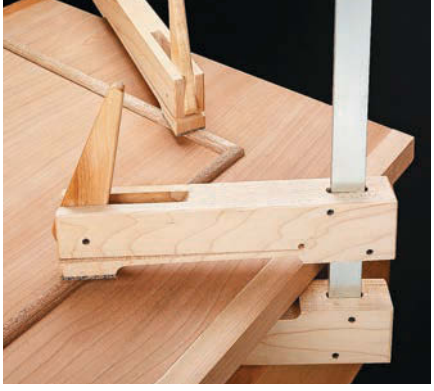
PIPE CLAMPS. Pipe clamps, like those in the main photo, are not terribly expensive, especially if you provide the black pipe. For the money, these clamps are the way to go when you're working on large, heavy assemblies like tabletops

or benchtops. Pipe clamps can channel a lot of clamping power to an assembly.

PARALLEL JAW CLAMPS. Parallel jaw clamps are more expensive than most other types of clamps. Nevertheless, they're my favorite for assembling cabinets, edge-glued panels, and anything else that needs to be kept flat and square. True to their name, the greatest feature of these clamps is the fact that the two tall jaws remain parallel even when tightened. The photo at the bottom left of the facing page shows how two pairs of clamps can be stacked.

CAM CLAMPS. Another traditional clamp, the cam clamp uses a lever to put pressure where you need it, but without a great deal of force. They're handy for precision work and small assembly jobs. The left photo above shows them holding molding in place.

ONE-HAND CLAMPS. "Squeeze-style" clamps are great for all kinds of tasks, and the one-hand grip is convenient. Don't be fooled by all the plastic in these clamps. They provide plenty of clamping power for most projects. These clamps save the day when you're juggling project parts and trying to hold one in position (top right photo).



Extra Reach. Cam clamps are lightweight and easy to use. Their padded jaws allow you to use them on fine, detailed work.

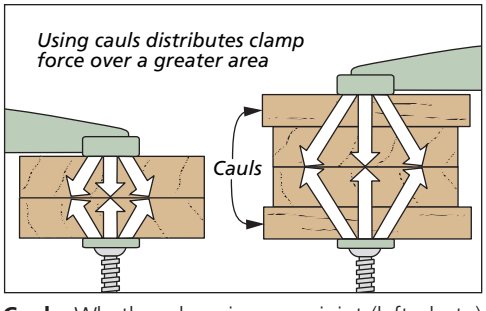
Handy Helper. One-hand clamps excel at light work and times when you need an extra hand to hold something in place.

BAND CLAMPS. Band clamps come in a number of different styles, but they all consist of a nylon strap (the band) and a tightening mechanism (the clamp), either in the handle or a ratcheting lever. The photo at right shows a typical use — assembling a box. They're also the perfect way to clamp round or multi-sided projects.

Band Clamps. When it comes to boxes, multi-sided, or round assemblies, a band clamp provides effective holding power.

CLAMPING ACCESSORIES

In addition to the clamps, there are a few items I wouldn't be without for most glueups. They make assembling projects easier or allow your clamps to work more efficiently.



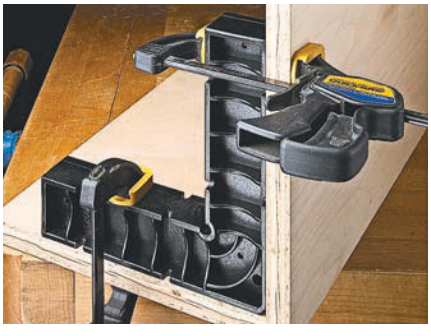
Cauls. Whether clamping up a joint (left photo) or two workpieces, cauls distribute the clamping pressure evenly and ensure a good bond.

CAULS. It's important to channel the force of your clamps effectively. In other words, you want the clamping pressure distributed over the entire length of the joint whenever possible. The far left photo shows how a pair of cauls can help. Since clamping pressure radiates out at a 45° angle from the jaw, the caul distributes the force by backing the clamp away from the edge of the project (left drawing).

GLUE SPREADERS. You'll also need a way to spread the glue on your joints. I've used everything from my fingertips to acid brushes (lower left photo) and purpose-made spreaders. All of them work well. The goal is to spread a thin coat of adhesive on the surface of the joint.

CLAMPING SQUARES. Keeping a cabinet square during assembly is critical. If you make a mistake, the doors won't fit properly and you'll have to spend a lot of time trimming them to match the opening. Fortunately, you can eliminate the worry with a couple of plastic clamping squares (near left photo). They also give you a welcome assist by holding two adjacent pieces together while you complete the assembly.

Brush It On. Applying an even coat of glue is easy with a small brush. Store it in a bottle of water and you can use it again later.



Square It. Clamping squares take the guesswork out of assemblies. Just clamp them to the workpieces and you're off.

TECHNIQUES

Having a selection of clamps and other accessories is a good start toward assembling a project. But using them properly and having a strategy for how to proceed during the assembly is what produces the best results. However, there are still a few more things to keep in mind. For starters, keeping a project square is a big concern, as is pulling the joinery together for a gap-free fit. This is when proper techniques play a role.

FLAT SURFACE/SQUARE PROJECT. Before you begin assembling a project, you need to have a good place to put it all together and clamp it up. If you assemble a project on a surface with depressions or ridges, you'll find it difficult to keep the project square during the glueup. But if your benchtop or worktable isn't perfectly flat, there are workarounds.

Surface. Melamine makes a solid, flat surface that glue squeezeout won't stick to. By stacking a couple of pieces, you can compensate for an uneven worksurface. This flat surface ensures that the parts of your assembly will also remain flat during the glueup.

I keep a few pieces of melamine-coated MDF in the shop for just this purpose. They stay flat, especially when you double them up. And the melamine makes for an easy cleanup since glue won't stick to it. The photo above gives you the idea of how it works.

DRY FIT. The last preparation is to do a dry assembly. This is where you put the parts together without glue (photo below). It gives you a chance to go through the assembly process and will reveal any tricky spots or problems. I start by clearing the worksurface, benchtop, or assembly table. You don't want to deal with clutter or any other distractions during an assembly. Anything that isn't vital to the process needs to be moved out of the way.

At this point, I look for any subassemblies that I can glue up first. A good example of a subassembly is the two ends of a table base. By attaching the legs and rails for each end, you make the final assembly just a matter of adding the stretchers. Most projects have some parts that can be assembled in advance. Once you get in the habit of using this technique, you can eliminate the mad rush of putting everything together at once.

I also use this time to give each joint a thorough examination to make sure they close tightly and look good. If your joints won't close up without clamping pressure, however, this is the time to stop and fix the problem instead of using the clamps to pull the pieces together. If you don't take care of it, the joint will remain under stress and be subject to failure at some later date.

Dry Run. A dry assembly of the project can help you identify problem areas in the joinery or the assembly process. During the dry assembly you can also plan the order of operations for the final glueup. After a dry run, you can proceed with confidence to the final assembly.

APPLYING THE GLUE

By now you should be feeling ready for the assembly. You've worked out the process and fixed any problems with the project and the joinery. But there are still a few things to consider. The first is which glue to use.

You'll need to use a glue that matches your timetable. Some glues, like conventional PVA adhesive, have a short open time. That's fine if you can get the project assembled in a few minutes. But if you have a large assembly that needs to go together all at one time, look for a slower-setting glue like liquid hide glue (upper right photo, opposite page).

Once you've settled the question of which glue to use, the next step is to prepare your gluing accessories, like a spreader for the glue. Whether you prefer to put the glue on one or both surfaces is up to you, but either way works

fine, as long as you end up with an even layer across the entire joint. The proper amount of glue is what's important. Too little and the joint is glue-starved. Too much and you'll end up with a sticky mess on your assembly table.

You can tell you have it right when you add clamping pressure and an even line of glue beads up out of the joint line.

Good Joint. Beads of glue on the joint line as you tighten the clamps are a good sign that you've applied the right amount of glue.

Scrape. A scraper is ideal for cleaning up hardened glue. By using both hands, you can remove the toughest residue.

The top photo at left shows what you're shooting for. I don't try to remove the glue squeezeout while it's wet. Doing so usually results in spreading it around more and pushing it into the grain of the wood. It's usually better to wait until after the clamps are off.

AFTER ASSEMBLY

After an hour or so you can remove the clamps and start inspecting the project. Of course, there will always be glue to clean up. But on top of that, now is the time to inspect your work.

CLEAN UP SQUEEZEOUT. After removing the clamps, the squeezeout will have skinned over but still not fully hardened. Now you can easily remove it with a chisel and it won't leave much residue. The trick here is to use a chisel with the bevel down, flat on the workpiece. Once you get the feel for it, you can peel off the rubbery residue in no time at all. The key is to lock in the angle of the chisel with your arms and keep moving. The box below has another way of dealing with squeezeout.

The nice thing about waiting until this point to remove the excess glue is that very little of it will have worked its way into the grain to spoil a stain or finish. If there is any residue, you can touch up the surface with a little light sanding.

Sometimes, you might want a project to stay in the clamps longer and the glue will completely harden. In this case, I turn to a scraper to remove the beads. The lower

Options. Liquid hide glue and PVA glue are good choices. Hide glue gives you a lot more time for the assembly.

photo at left shows a type of scraper that works well for removing dried glue. The carbide blade of the scraper makes short work of the residue, but beware of tearing up the wood fiber.

FINAL INSPECTION. During all of this post-assembly cleanup, I take a hard look at the entire project. Now is the time to fix scratches or other marks you may have made during the process.

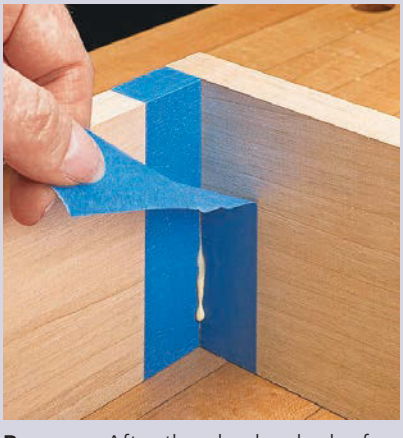
If you apply these methods for assembly to your next few projects, before you know it they'll be second nature. With the right clamps and a little patience, you can put together even the largest projects. And that will open up new doors for your creativity.

Dealing with Squeezeout

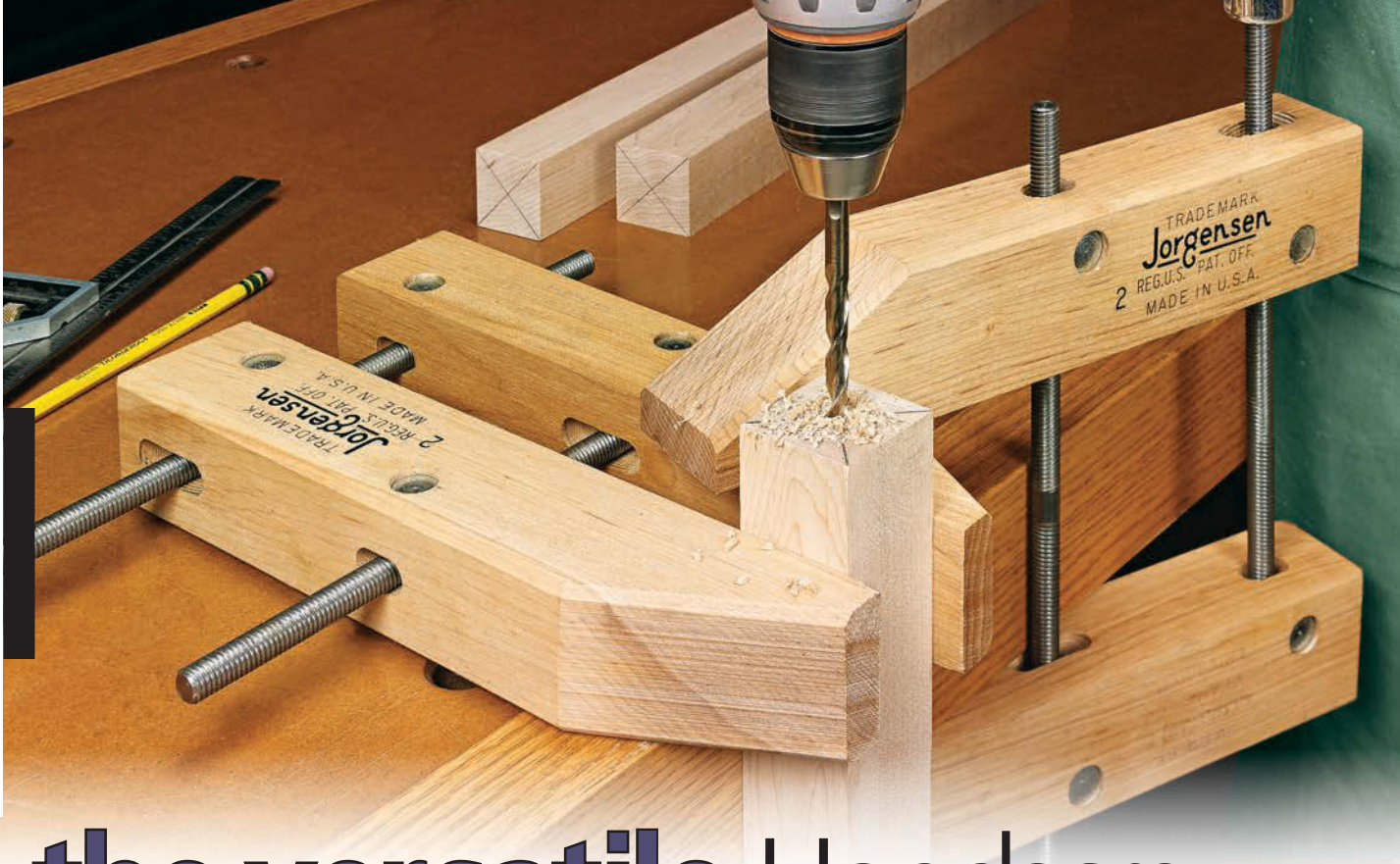
Cleaning up excess glue can be a real headache, especially if the glue is in a hard-to-reach area, like the inside of a box. For these assemblies, you might want to mask the mating components at the joint line, as shown in the photos at right.

Using blue painter's tape, apply the tape right at the edge of the joint. Be sure not to allow the tape to interfere with the joint closing. Once you've completed the assembly, let it sit for a few minutes and then pull off the tape. The excess glue will come off with it.

Tape. Align the tape with the edge of a joint, but not inside the joint line. Press the tape in place firmly so it adheres well.



Remove. After the glue has had a few minutes to set up, remove the tape slowly by peeling it away from the edge.



the versatile Handscrew

This traditional woodworking clamp still has a lot of uses in the modern shop. And it can handle many tasks that other clamps can't.

As far as woodworking tools go, you just can't get much more traditional than a handscrew. These clamps have been used in cabinet and furniture shops for centuries now, but in recent decades they have often fallen out of regular use in favor of more modern clamps.

STILL USEFUL. If you think this makes the handscrew a relic of the past, though, I would beg to differ. I still use mine frequently. And they can perform a number of woodworking tasks that other clamps simply can't do. Here are just a few of my favorite examples.

The Perfect Stop Block. The square jaws on a handscrew make a great stop block that's simple to attach to any auxiliary fence.

INSTANT VISE. Unlike a lot of clamps that have a single point of contact on each jaw, a handscrew's jaws are quite wide. This makes them perfect for pulling off the trick shown above: Using two handscrews to set up a vise anywhere on a worksurface. This is useful for anything from carving to drilling holes in the end of a post. All you have to do is clamp the piece in the handscrew, and use a second handscrew to clamp the first one to the worksurface.

Skew to the Correct Angle. Skewing the jaws gives direct clamping pressure on workpieces with beveled faces.

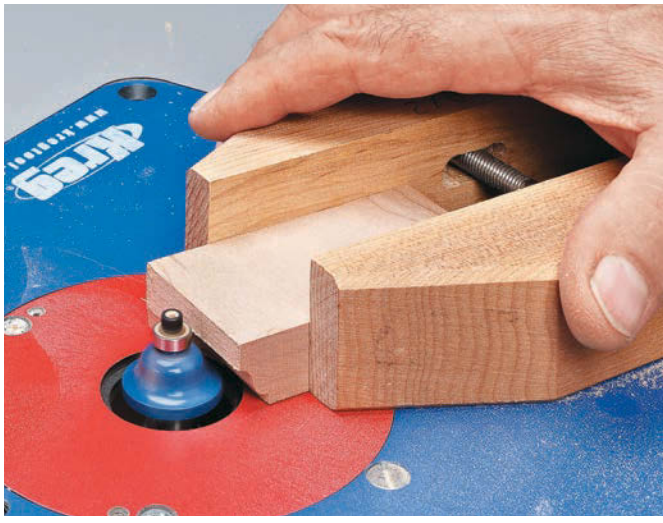
ONE-PIECE STOP BLOCK. I can think of many instances when I've cut a wood block from scrap and then clamped it to a

fence for use a stop block. But with the wide, square jaws of a handscrew, you get both the clamp and the stop block in one handy unit. This is perfect for drilling repetitive holes at the drill press or cutting parts to identical size at the table saw, as you can see in the lower left photo on the opposite page.

ADJUSTABILITY. Both bar and pipe clamps are great if the pieces you're clamping together have square faces. But what do you do if the faces of the pieces aren't parallel with one another? Only the handscrew lets you skew the jaws to account for these situations. So if you ever need to clamp tapered or beveled pieces, handscrews deliver direct clamping pressure easily (see the frame in the lower right photo on the opposite page).

Stand. A handscrew provides support to hold cabinet sides upright while putting together a complicated assembly.

SMALL PART HOLDER. I've covered several of the unique features of the jaws of a handscrew, but another one that's easy to see is that they're made from wood. This makes them soft enough to prevent marring your work, but it also serves another advantage: They won't do any major damage if you get them too close to a spinning bit or blade. For this reason, I like to use a handscrew for holding small parts while machining them. Routing an ogee profile on the edge of a small molding piece, as shown at right, is just one of many examples that comes to mind.



Helpful Holder. Handscrews are great for holding small parts while machining them. The wood jaws won't damage bits, and they keep your hands safe.

CABINET ASSEMBLY HELPER. I still use a lot of bar and pipe clamps for assembling cabinets, but I find that handscrews often come in handy in some unconventional ways. For example, there's nothing more frustrating than trying to hold case sides upright while bringing in the divider pieces for assembly. A handscrew can act as a broad "foot" to hold the side upright while you work on putting it together (like you see in the photo at left).

Wide cabinets are another good example. If the cabinet stretches beyond the reach of your bar clamps, you don't need to buy longer ones. Instead, clamp a couple of handscrews to the divider panels, and then use bar clamps to pull the dividers and case sides together, as shown in the lower left photo.

ALIGNMENT TOOL. The wide jaws of a handscrew are also great for aligning pieces from top to bottom. When I'm attaching edging to plywood shelves, for example, I use handscrews to align the edging, and then use pipe clamps to draw the edging tight to the panel for glueup (below right).

AND SO MUCH MORE. These are just a handful of the many tasks that handscrew clamps can handle. So if you have some handscrews, it's time to dust them off and put them back to work. You'll be amazed at all the ways these age-old shop tools will help out in your modern shop.

Auxiliary Clamp Blocks. For a wide assembly where your clamps don't have enough reach, attach handscrews to the dividers. Then clamp across the sides and the handscrews to draw the assembly together.

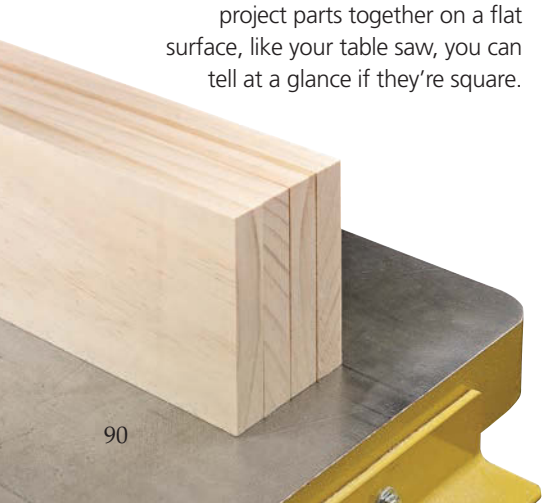
Edging Alignment. Handscrews are adept at aligning solid-wood edging with a panel when gluing it to the edge of a plywood shelf.

secrets to building Square Assemblies

Clamps alone are not an assurance that the parts you're putting together will be square, but a few handy tips and tricks will get you the rest of the way there.

Most woodworking projects require square construction. Even the ones with curved parts usually have a few 90° corners. So keeping your right angles "right" is an essential part of the building process. Here are a few techniques that I make a habit of using to help keep things square from start to finish.

Gang Them Up. By grouping your project parts together on a flat surface, like your table saw, you can tell at a glance if they're square.



STOCK. It's hard to build a square project if you don't start with square parts. That's why I like to take a few minutes to carefully look over all the stock for the project. What I'm looking for at this point is warp, cupping, and twist in the boards. Each of these conditions can be dealt with, but I want to make sure I keep track of the problem areas so I can correct them if necessary.

MILLING. After inspecting the stock, you're ready to start milling. Even if you hand picked pieces of kiln-dried lumber at the lumberyard, you'll still need to mill them to make them square and flat. For instance, if a long piece of stock is warped, you can often salvage it by cutting it into smaller pieces and jointing and planing each piece flat.

This is why it pays to inspect each piece of stock early. Fortunately, well-tuned power tools and a routine for using them properly will take you most of the way. Jointing one face and one edge gets you off on the right foot. Using those surfaces as references, you can then plane the opposite face parallel. Then head to the table saw and rip the opposite edge of the workpiece to guarantee a parallel edge, as well.

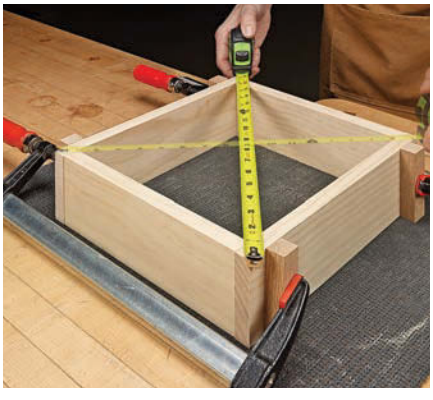
Square. An engineer's square is an inexpensive but accurate tool for checking the corners for square during assembly.

With properly milled stock, cutting parts to final size is pretty straightforward. Nevertheless, I like to keep checking them as I go. A simple way to do that is to line similar parts up on a flat surface, like your table saw, and see if they sit side-by-side with no gaps between the pieces. The photo at the bottom left of the opposite page shows what I mean.

JOINERY. Another plus of taking the time to carefully prepare parts is that cutting the joinery is easier. Whether you're using mortise and tenon joints, miters, or any other types of joinery, square stock ensures things fit together better.

ASSEMBLY

When you're ready to move on from cutting parts and joinery to assembling your project, there are a few more things to keep in mind to make sure things stay square. The best first step in creating a square assembly is a flat surface for the dry fit and final glueup.

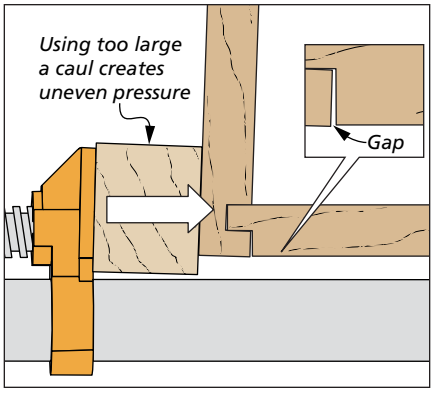


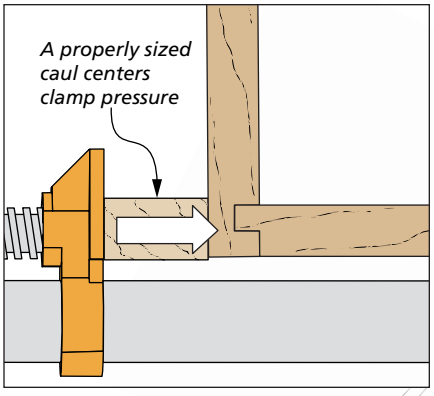
Measure. After applying clamps, use a tape to check between the corners. A square assembly has equal measurements.

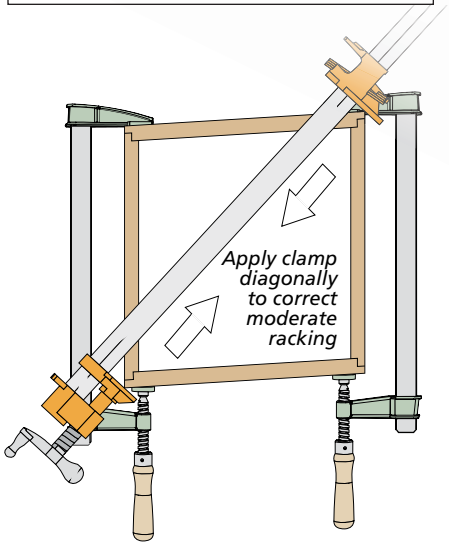
ASSEMBLY TABLE. A surface with dips or mounds can throw your assembly out of square. If your bench isn't up to the task, you can still find a flat surface just by covering your benchtop with an auxiliary surface made of MDF or melamine-covered particle board. A single piece sized to fit over your benchtop should be sufficient for most assemblies.

The box below shows another option — a shop-made jig for gluing up panels. It features a square corner formed by two fixed fences on one end and one edge. A sliding fence on the opposite end allows you to square up the assembly before adding clamps.

PROCESS. I use a simple assembly routine. Start by laying out the clamps required to hold the pieces together. At this point, you should prepare any cauls you need. I also make sure to have an engineer's square handy to check the joints, as shown in the right photo on the opposite page.







CAULS. Cauls are assembly aids that protect the surfaces of your project and distribute clamping pressure evenly. They can be made from just about any material you have in the shop. The important thing to remember when adding a caul is that the force of the clamp must be aligned with the joint, as shown in the drawings at the top of the page.

AFTER CLAMPING. Even after you've applied the clamps, you can still check and adjust the assembly. I use a tape to check for square (photo above, left). By measuring from corner to corner on opposite sides, you should get an identical measurement. If not, you can tweak the assembly using a clamp as shown in the drawing above.

OTHER TIPS. For cabinets and casework, I often use assembly squares, like the ones shown in the main photo on the opposite page. A clamp on each leg of the square holds two workpieces in place while you add the clamping pressure to the joints.

Using these techniques, you can make sure your projects turn out as expected. And that means fewer last-minute "fixes" down the road.

Handy Panel Squaring Jig

Handy Jig. An easy-to-make assembly jig will help you keep your projects square. The key is the square corner formed by the fixed fences on one edge and end.

GO 2 Online Extras

For details on building this squaring jig, visit our website at:
WoodsmithSpecials.com

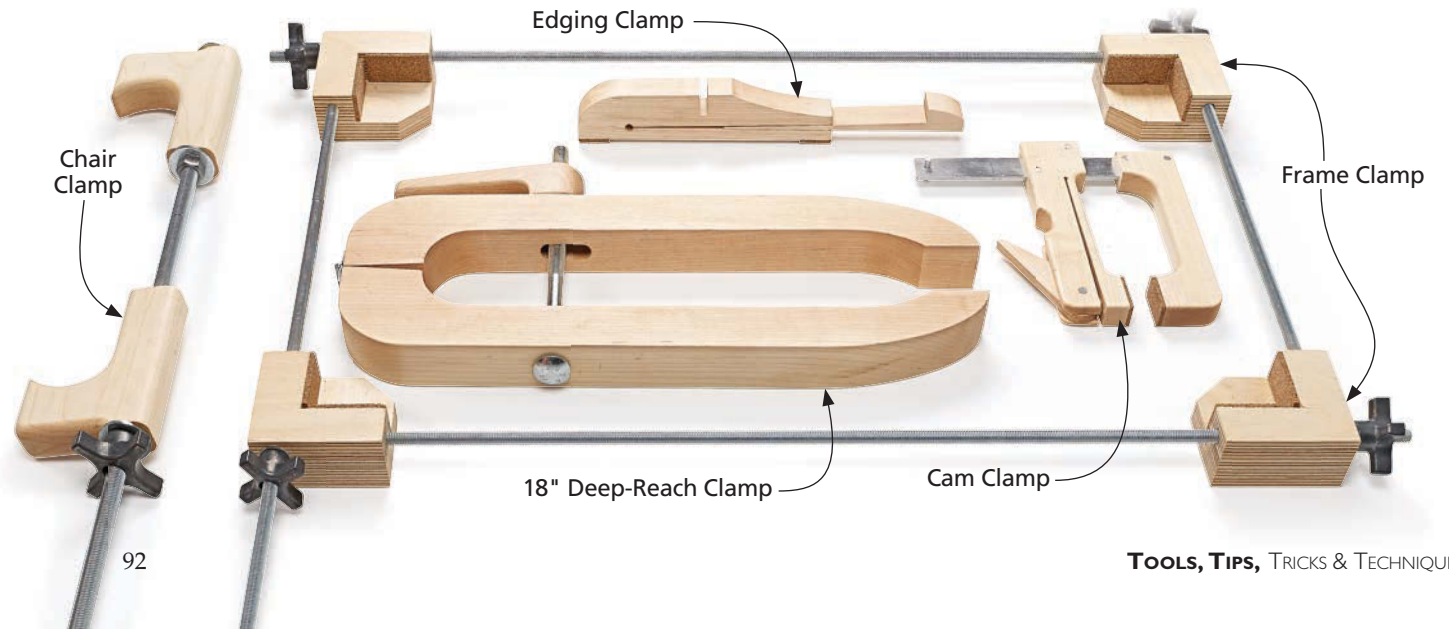
5 shop-made Clamps

Save money and solve unique clamping challenges by building your own clamps.

A good selection of bar clamps is an essential part of your tool kit for assembling projects. You'll inevitably find situations, however, where ordinary bar clamps just can't get the job done.

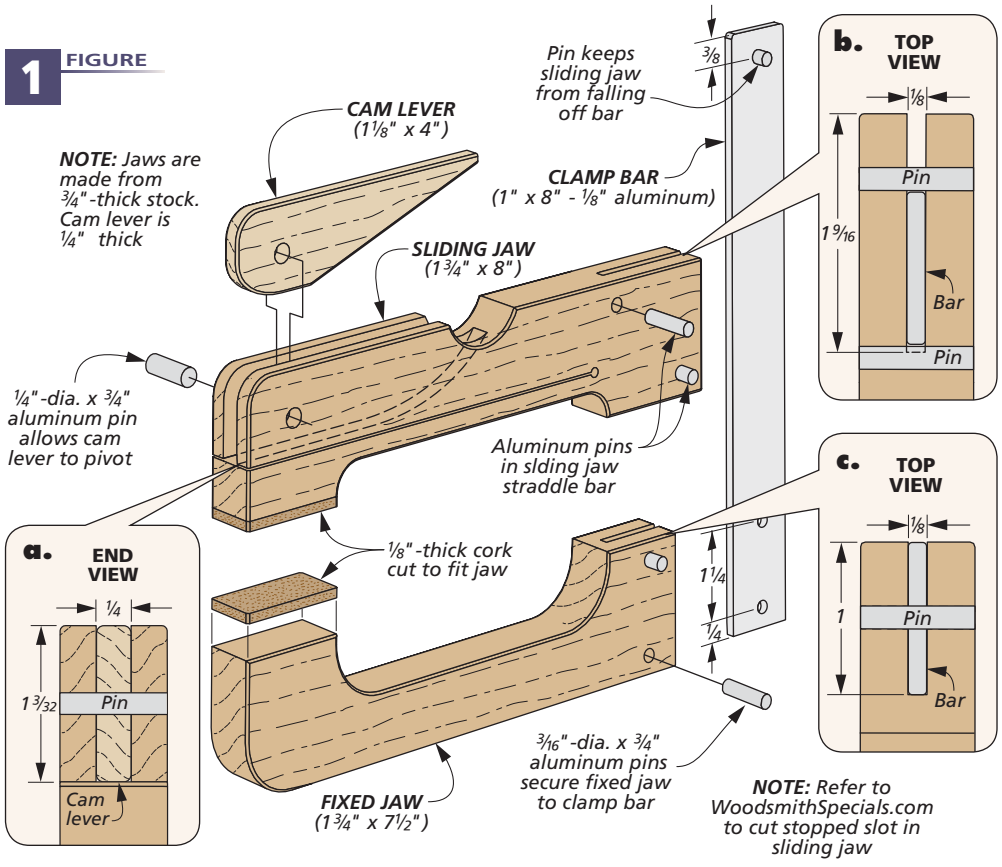
Woodworking catalogs feature a variety of specialty clamps to tackle these uncommon needs. Given their prices, it's hard for me justify purchasing the clamps for occasional use. On the other hand, with just a few, small pieces of wood and some inexpensive hardware you can make your own special-purpose clamps. We've included plans for five styles: cam clamp, edging clamp, frame clamp, deep-reach clamp, and chair clamp.

Any one of these designs can be built in an easy evening in the shop. And they're inexpensive enough that you can make a whole set of clamps without breaking the bank. What's certain is that you're sure to find one or two of these clamps that you can put to use right away in an upcoming project.



cam Clamp

FIGURE 1



The cam clamp you see here isn't new. In fact, I've admired the simple design for years. The big advantages of this design is that it's lightweight and doesn't apply a lot of pressure. That sounds like the exact opposite of the qualities of a good clamp, I know. However, for some tasks, like assembling small boxes, too much pressure (and a heavy clamp) can distort the project parts.

The clamp consists of two jaws and an aluminum bar, as shown in Figure 1. One jaw is fixed to the end of the bar, and the other slides along the bar to match the size of the workpiece. A cam lever in the adjustable jaw pivots against a flexible tongue to apply the clamping pressure.

The sliding jaw captures the aluminum bar between a pair of pins. To move it, you cock the jaw slightly to release it and slide it along the bar. The jaw wedges itself in place when clamping pressure is applied.

FIXED JAW. Both jaws are fairly small. So it's a good idea to work with oversize blanks for the initial steps. I started by making the much simpler fixed jaw. You can use the patterns at right to guide you through the steps.

The first thing that you need to do is cut a slot across the back edge (refer to Figure 1c). The width of the slot is sized to accept the aluminum bar.

From there, you can create the notch on the inside edge, as shown in the pattern. Use a Forstner bit in the drill press to make the curved corners then remove the waste at the band saw.

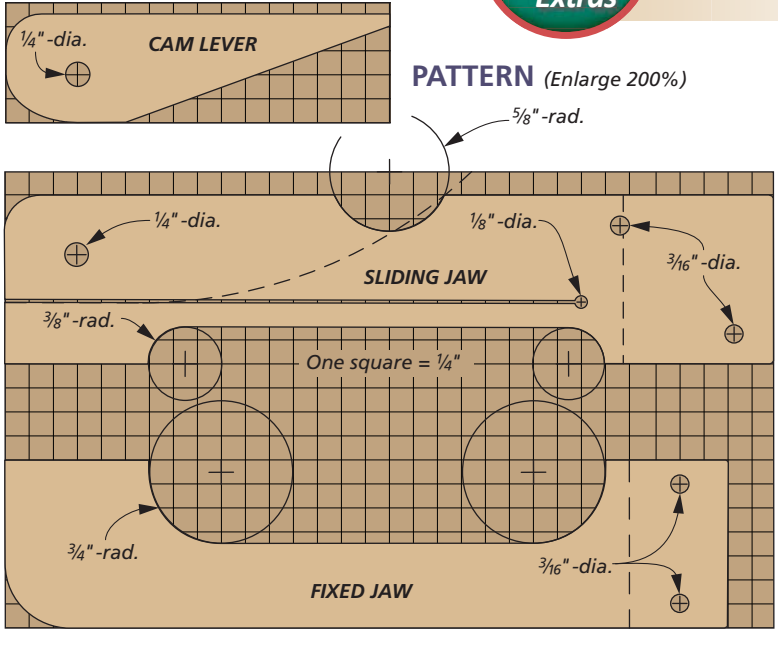
SLIDING JAW. The sliding jaw has a few other details that deserve some mention. The first of these is a stopped slot that creates a pocket for the cam lever. I made this cut at the table saw with a dado blade (refer to *WoodsmithSpecials.com* for more).

Another detail to note is the slot for the clamp bar along the back of the jaw. It's deeper than the slot in the fixed jaw to account for aluminum pins that trap the bar. The space between them matches the width of the bar.

The final unique detail is the narrow kerf that allows the clamp pad to flex as pressure from the lever is applied. I drilled a stop hole at the end of the slot. After that, the narrow kerf can be cut over at the band saw.

The final piece to make is the cam lever. I cut it to match the width of the stopped slot, then cut it to shape at the band saw.

MAKING MULTIPLES. Chances are you'll want several of these clamps in your shop. So I've come up with some simple tips for making multiples. You can find these online at *WoodsmithSpecials.com*.



deep-reach **Clamp**

The reach of most bar clamps is limited to just a few inches. So when a clamping task comes along that's beyond this, you're usually left scratching your head. The solution is to have a set of these deep-reach clamps hanging on your clamp rack.

Think of it as a cross between a C-clamp and an old-fashioned handscrew. Long, stout, jaws apply clamping force nearly a foot away from the edge. I chose straight-grained hard maple for the jaws for the most strength.

Long-Distance Clamping. Long, thick jaws and a shop-made handle apply pressure well away from the edge of an assembly. This works great for projects like this veneered panel.

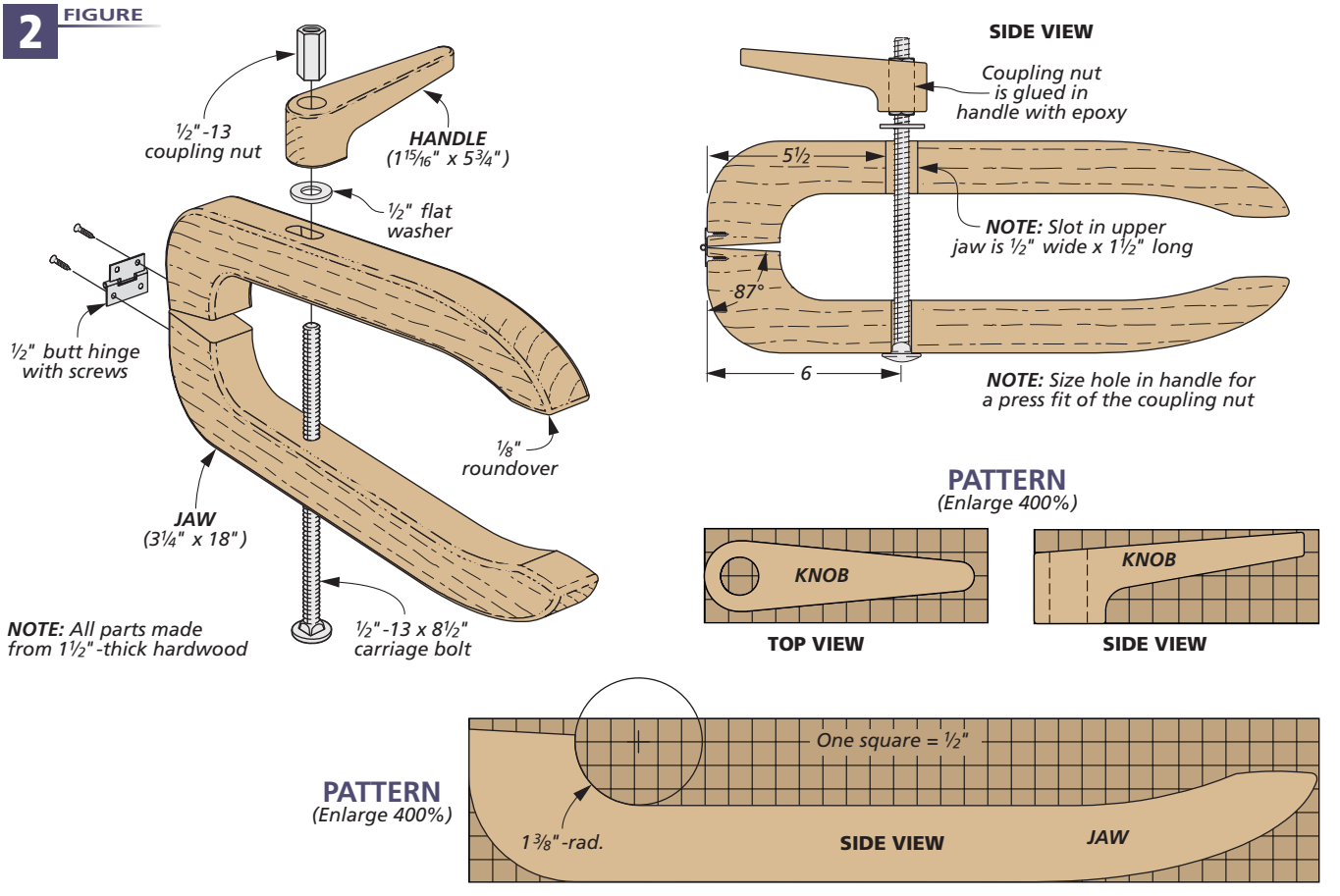
HARDWARE. The mechanism consists of hardware-store items: a carriage bolt, washer, and coupling nut. I used ½" hardware to stand up to heavy use.

JAWS. The jaws are linked at the back end by a surface-mounted hinge. In use, the back end of the jaws are pressed together, so there isn't much stress placed on the hinge or its screws.

The two jaws of the clamp are nearly identical. The only difference is the upper jaw has a slot (rather than a hole) to accept the carriage bolt. Drill the hole and create the slot before cutting the jaws to final shape.

HANDLE. I opted for a maple handle and coupling nut to keep the cost down and match the jaws. The pattern below makes shaping the handle pretty simple.

FIGURE 2



chair **Clamp**

If you're like me, you often get called on to repair chairs with loose joints. If that's the case, then this is the clamp that you're looking for.

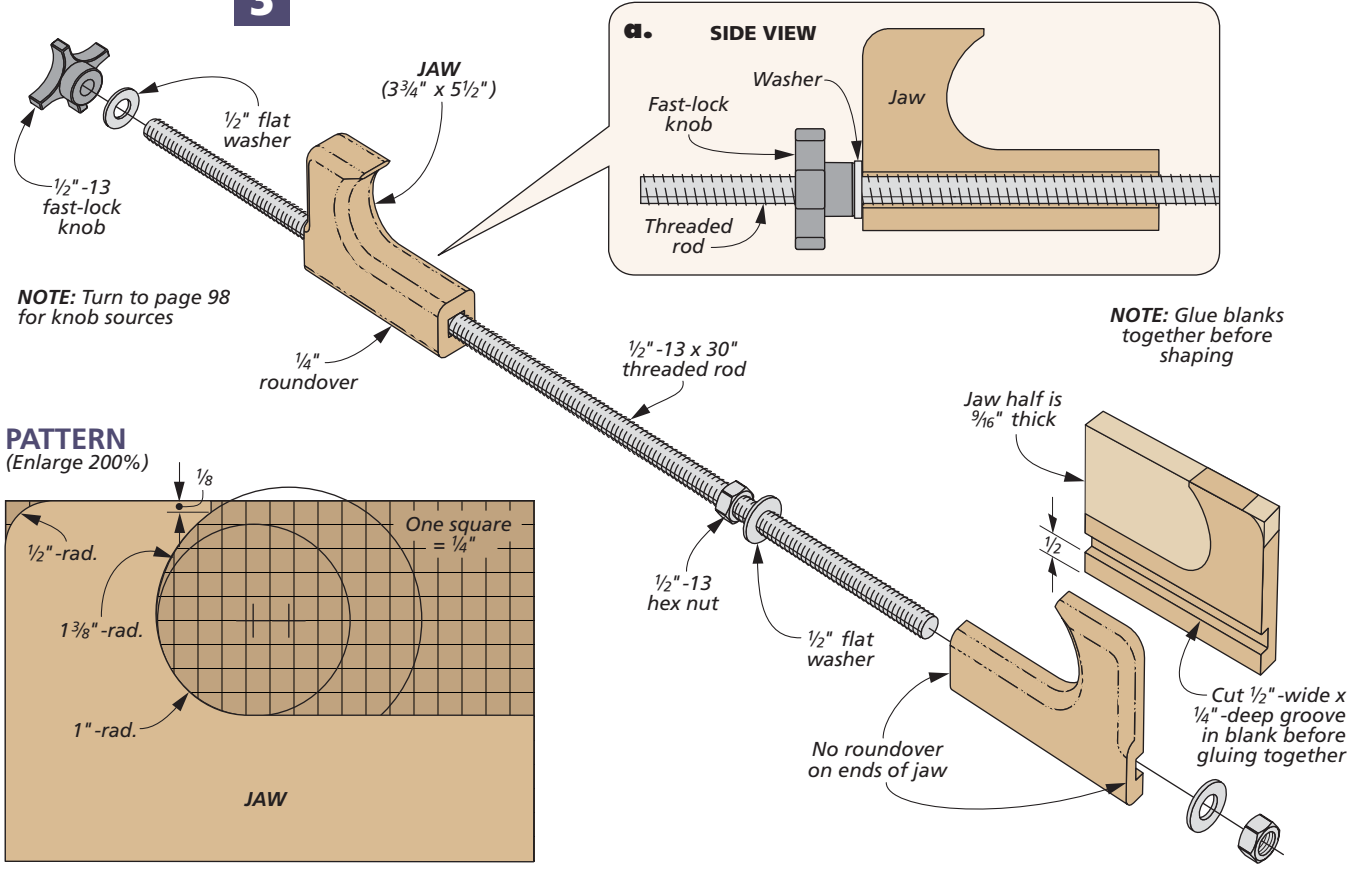
The secret is the hooked shape of the jaws that lets them get a good grip on angled surfaces. Ordinary threaded rod serves as the bar. A knob and washer apply the clamping pressure. But this isn't your typical star knob. It's called a fast-lock knob and has a quick-release feature built in that ends the tedium of winding the knob along the threaded rod.

GLUE UP JAWS. The thick jaws are glued up from thinner stock (Figure 3). Before gluing the blanks together, cut a groove in each piece. This creates a channel for the rod to pass through.

The blanks can be cut to shape at the band saw by using the pattern shown in the drawing below. Sand the curves completely smooth after cutting, then head over to the router table to ease the edges to prevent the jaws from leaving dents on the workpiece.

Dual Purpose. The hook jaws of this clamp can grip round and angled edges for gluing up chairs (above). Flip the jaws around to spread joints apart (right photo).

FIGURE 3



edging **Clamp**

Attaching hardwood edging to a plywood panel isn't a difficult task. The trouble is spreading out the clamping pressure on such long joint lines without using every clamp in the shop.

The solution is the bar clamp accessory shown in the photo at right. It doubles the number of clamping points.

The shaped hardwood block and wedge works on the same principle as the cam clamp. The thin wedge replaces the cam lever to apply the pressure. When tapped into the slot, the wedge forces the two cork-faced pads against the edging.

A notch cut on the back edge of the block accepts the bar of the clamp and serves as a fulcrum to distribute the clamping pressure between both cork pads evenly — like a seesaw.

Edging Clamp.
Tap a wedge into the slot of this unique clamp to attach hardwood edging to a plywood panel.

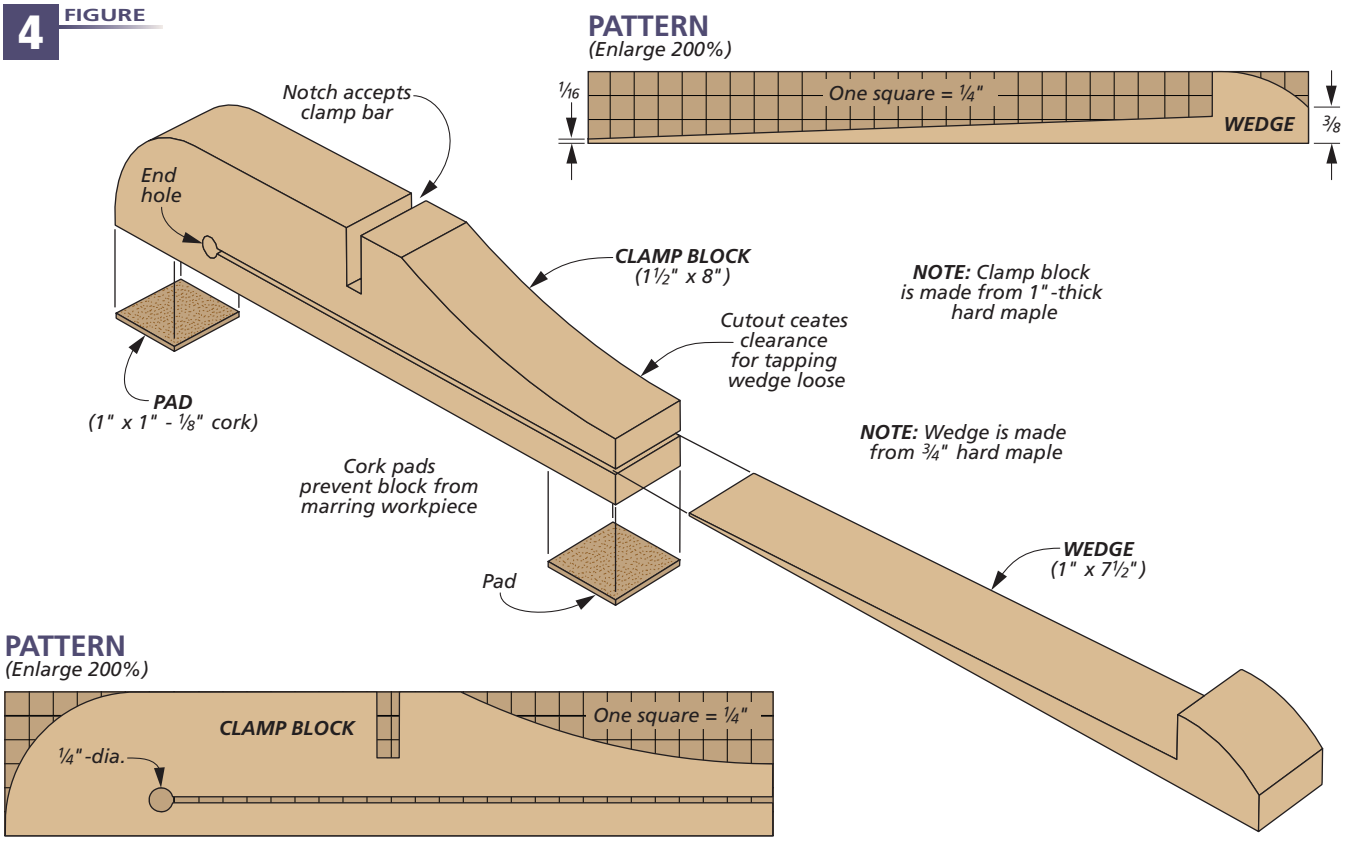
THE BLOCK. Building the edging clamp is about as straightforward as it looks, as shown in Figure 4. I cut the notch along the back edge at the table saw using a dado blade. It's a good idea to do this before shaping the block. This way the block remains stable during the cut.

There's nothing critical about the shape, so feel free to modify it to something that suits you.

The next step is to cut the kerf. Drill the end hole then cut the kerf at the band saw. I used a rip fence to keep the cut straight. Now glue a pair of clamp pads on the flat edge of the block to prevent the clamp from marring workpieces.

THE WEDGE. The band saw is the tool of choice for making the wedge, too. Photocopy the pattern below and attach it to the blank to guide your cuts.

FIGURE 4



frame **Clamp**

Easy Frame Assembly. Simple plywood corner blocks, threaded rod, and tip nuts combine to create a great way to glue up mitered frames.

Mitered frames have a clean look and a timeless appeal. But as a woodworker, they can sometimes be a pain in the neck. The biggest hassle? Gluing the corners together. The miter joint faces slide out of position if you try to use ordinary clamps.

The answer to my frustrations came in the form of the frame clamp you see here. Plywood corner blocks capture and draw all the joints together at once.

The blocks are joined with lengths of threaded rod you can get at the hardware store. Here again, I used tip nuts to speed up the process of adjusting the knobs and blocks.

MAKING THE BLOCKS. Figure 5 shows the makeup of the blocks. Each one consists of three layers of plywood. The lower layer serves as a platform that's used for holding the corner of the mitered frame. I clipped the inside corner of the platform to ease the edge.

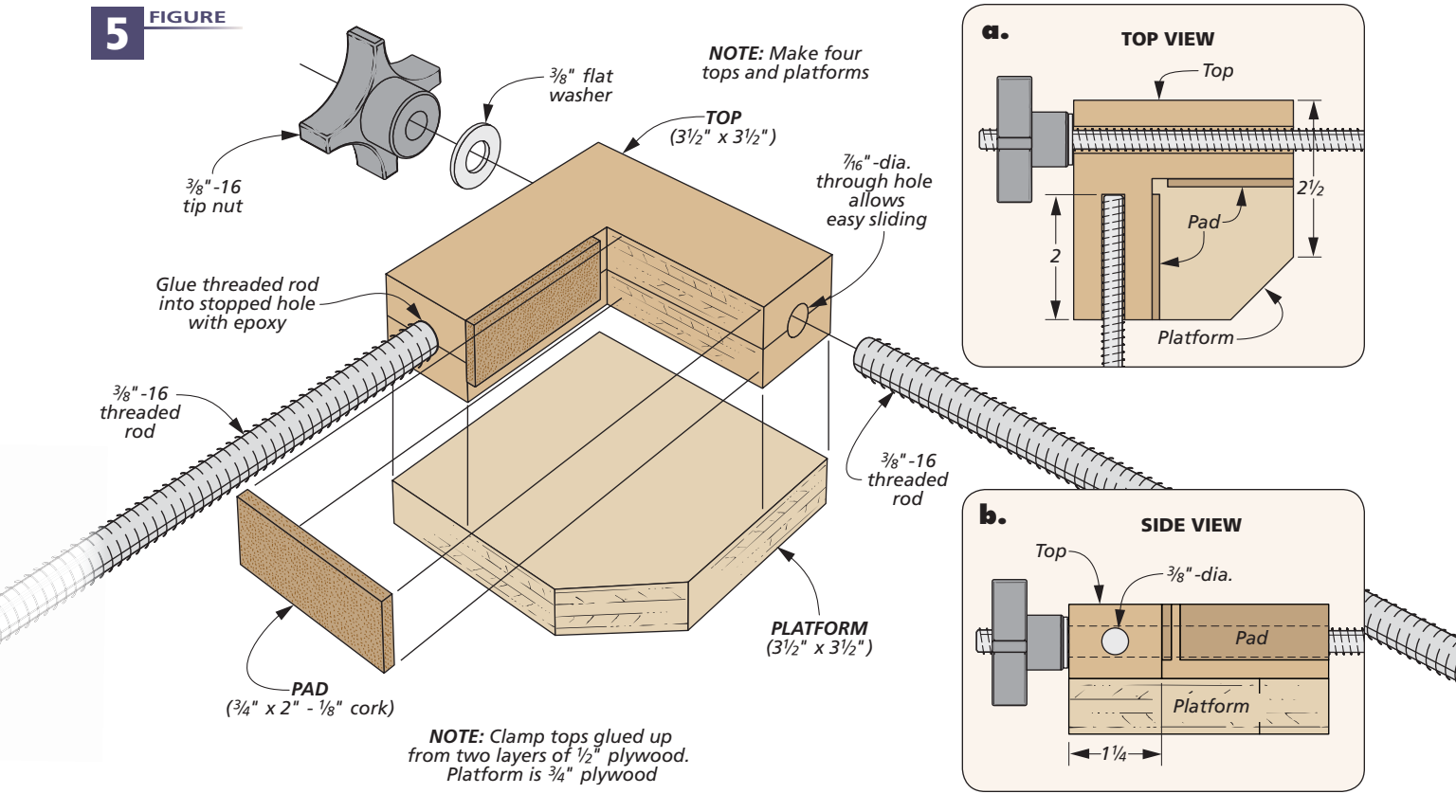
The top is glued up from two layers of plywood and cut into an L-shape. It accepts a pair of threaded rods. The key is making sure the inside corner is 90°.

The holes in the top aren't identical, as you can see in Figure 5a. One is stopped, and the other is a through hole. When drilling these holes, be consistent. The blind hole in one block should align with the through hole in the adjoining block.

After gluing the layers together, you can apply cork pads to the inside face. This keeps the clamp from marring the frame and provides a relief in the corner.

Finally, be sure to wax the platform before use, so the frame isn't glued to the clamp blocks.

FIGURE 5



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Sources

MAIL ORDER SOURCES

Alabama Damascus Steel
256-310-4619
alabamadamascussteel.com

amazon.com

Essentra Components
800-847-0486
essentracomponents.com

Highland Woodworking
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highlandwoodworking.com

Holbren Cutting Tools
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rockler.com

Traditional Woodworker
800-509-0081
traditionalwoodworker.com

Woodcraft
800-225-1153
woodcraft.com

Most of the supplies you'll need for projects in this book are available at hardware stores or home centers. For specific products or hard-to-find items, take a look at the sources listed here.

Retailers will periodically discontinue some items, so gather all the hardware that you need before you get started on your project. You can always adjust dimensions or drill different-sized holes to suit your hardware.

MARKING KNIVES (P. 8)

- **Lee Valley**

Wheel Gauges 05N33.21

MARKING GAUGES (P. 10)

- **Traditional Woodworker**

Cutting Gauge 680-5200

TRY SQUARES (P. 12)

- **McMaster-Carr**

1¼" Brass 8954K231
¾" Brass 8954K237
1/16" Brass 8954K44
3/16"-dia. Rivets 96082A100
5/16"-dia. Rivets 96082A200

HEIRLOOM COMPASS (P. 16)

- **McMaster-Carr**

3/16" x 1" - 24" Brass 8954K174
3/16" x 2" - 6" Brass 8954K177
O1 Tool Steel 9018K13
¼"-20 Thumbscrew 92421A535
#8-32 Thumbscrew 92421A192
Bronze Bearing 6381K102
¼"-dia. Rivet 97500A180
3/16"-dia. Rivet 97500A150

- **Rio Grande Jewelry Supply**

Brass Wire Solder 132201
Grifflux #1 Flux 504089

LAYOUT GAUGES (P. 20)

- **McMaster-Carr**

Brass Thumbscrews 92421A194
Threaded Inserts 90016A009
⅛" Brass Bar 9122K212

MORTISE & TENON JOINTS (P. 26)

- **Lie-Nielsen**

Medium Shoulder Plane.....042

SHOOTING BOARD (P. 34)

- **Essentra Components**

¼"-20 x 1¼" Knob RST-101
¼"-20 T-Nuts WN-120
¼"-20 Knob (1¾") DK-54
¼"-20 Knob (1¼") DK-81

WOOD MALLETS (P. 38)

- **Holbren Cutting Tools**

Bowl and Tray Bit 1376

SANDPAPER SHARPENING (P. 50)

- **Rio Grande Jewelry Supply**

Microfinishing Film ..... varies

CUSTOM CHISELS (P. 56)

- **McMaster-Carr**

¾" x ⅛" O1 Steel 9018K82
¾" x 0.064" Brass 8859K89
5/32" Brass Rod 8859K54
3/32" Brass Rod 8859K52
Flared Tube Fitting 50635K544
Buffing Wheel 4818A12
Tripoli Compound 4786A3

RASPS & FILES (P. 68)

- **Japan Woodworker**

9" Shinto Rasp 151297
10" Shinto Rasp 153778

- **Woodcraft**

#49 Nicholson Rasp..... 06B01
#50 Nicholson Rasp..... 06B02

BLOCK PLANES (P. 70)

For the steel-sided plane, we purchased a 3" x 17" billet of Damascus steel from *Alabama Damascus Steel*. The thickness of the billet should be between .14" - .175". On the company's website, you can select the specific pattern you like for your plane.

- **McMaster-Carr**

3/16" Steel 9517K415
3/16" 360 Brass 8954K177
½" Naval Brass Rod 9105K23
⅜" 360 Brass 8954K18

- **Lee Valley**

Wooden Plane Kit..... 05P40.42

- **Jantz Supply**

Ferric Chloride BS110

SPOKESHAVES (P. 78)

- **Highland Woodworking**

Spokeshave Blade.....433906

- **McMaster-Carr**

Studded Knob 6079K14
Washer 91434A115
⅝"-dia. Steel Rod 8279T28

HANDSCREWS (P. 88)

- **Amazon.com**

Handscrews ..... varies

SQUARE ASSEMBLIES (P. 90)

- **Rockler**

Assembly Square 29190
Mini Assembly Square 27767

5 SHOP-MADE CLAMPS (P. 92)

- **McMaster-Carr**

⅜"-16 Knob 6032K13
½"-13 Knob 6032K14

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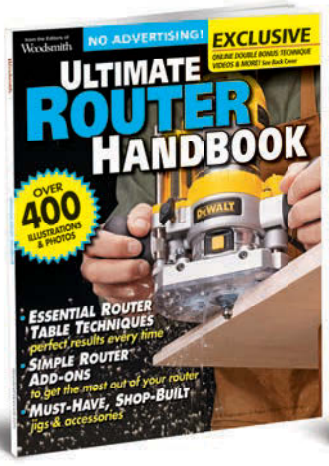

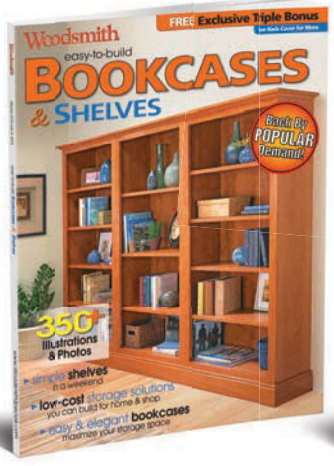

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