

dovetailed Shoulder Plane

Make an heirloom tool and learn the secret to creating double dovetails in metal — it's easier than you think.

■ I've always been fascinated by old, metal hand planes. Especially ones that were made using dovetails to join the sides of the plane with the sole, like the shoulder plane in the photo above. If you look carefully, you'll see that they're really "double" dovetails. Both the sides and the sole have flared "tails." Now this seems like it would be impossible to put together. But these dovetails are cut almost the same way as regular dovetails. The tails are cut into the brass sides and the pins are cut into the steel sole. But there's a little trick to

make the pins look like tails to create the double dovetails. I'll explain more about this later.

When building your own plane, you'll need to decide how to go about locking the iron (or blade) in place. I could have used a simple wedge to do this. But I wanted to be able to easily and accurately fine-tune the depth of cut. The solution is really pretty simple. I used just a few commonly available hardware items. This allows you to adjust this plane to make paper-thin shavings for tight-fitting joints.

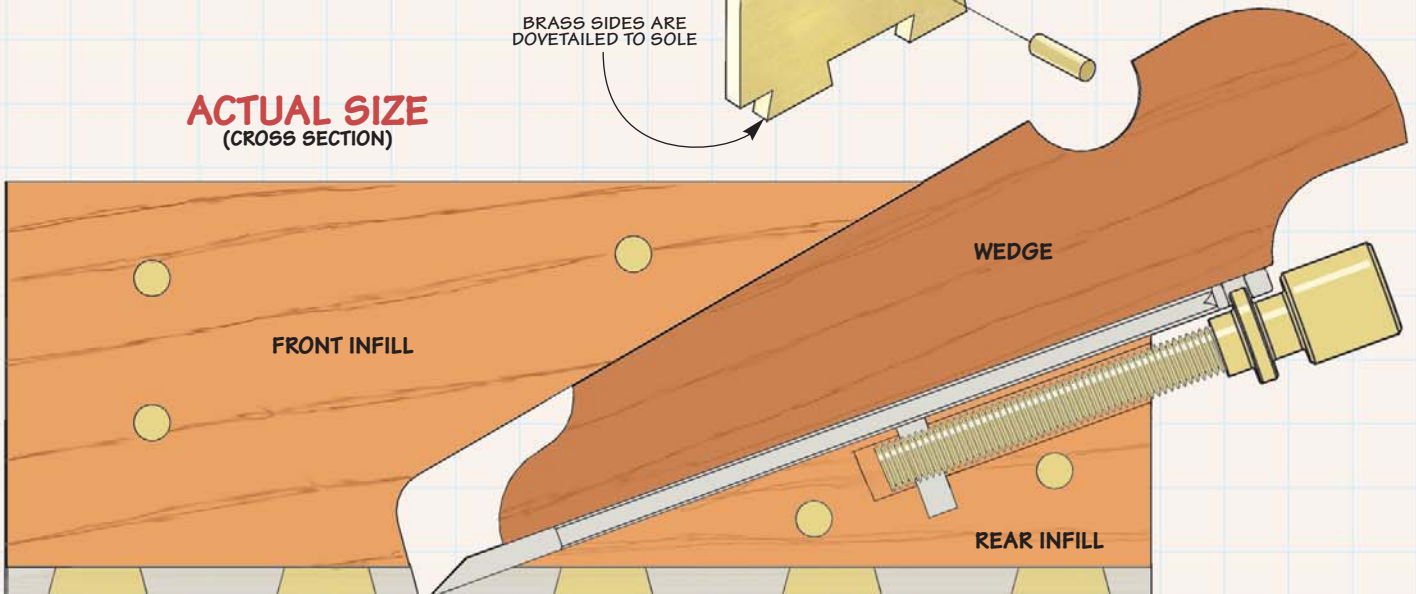
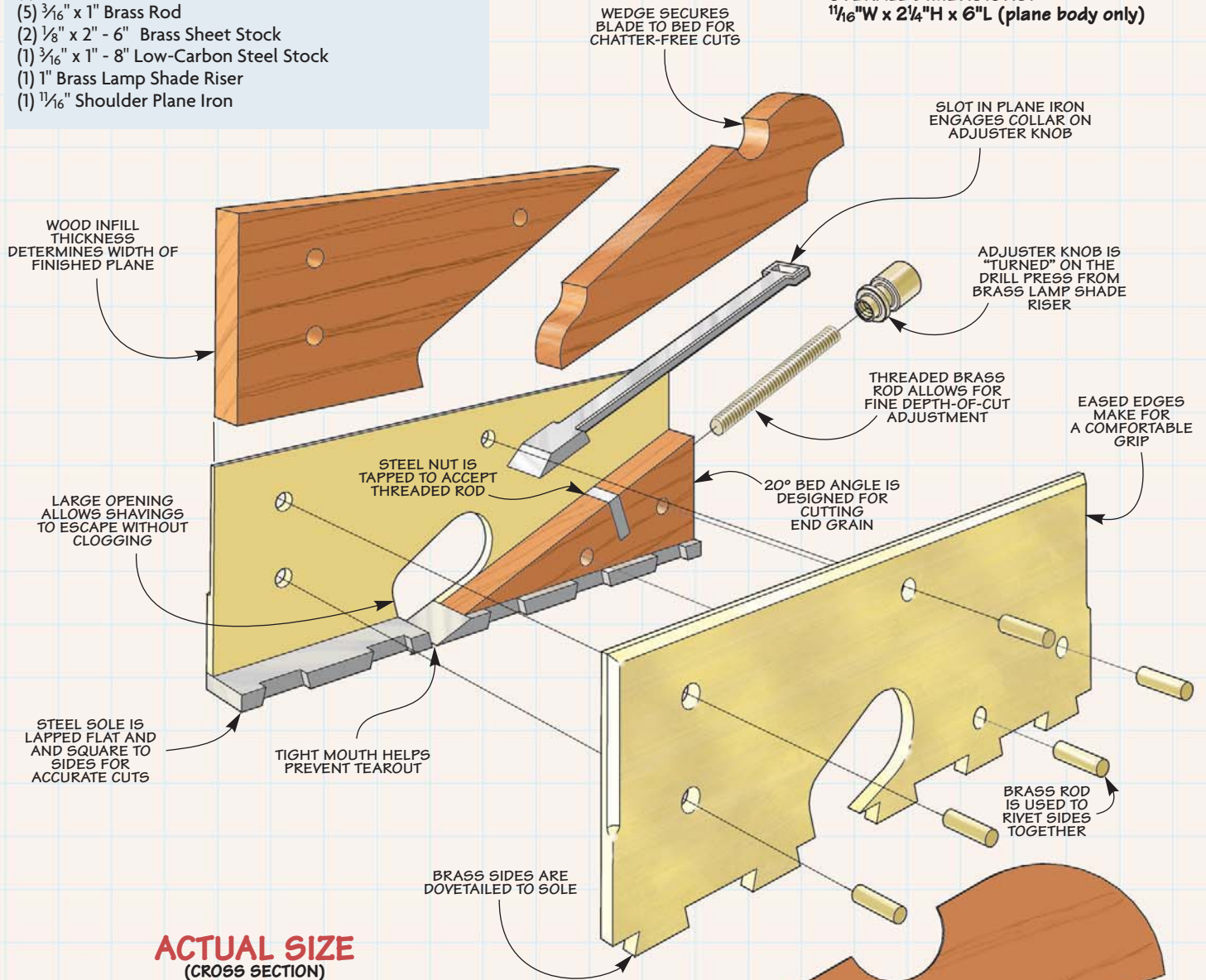
Materials & Hardware

Infill and Wedge (cut from same piece) 1/2 x 4 - 8 (Rgh.)

- (1) 1/4"-28 x 6" Threaded Brass Rod
- (5) 3/16" x 1" Brass Rod
- (2) 1/8" x 2" - 6" Brass Sheet Stock
- (1) 3/16" x 1" - 8" Low-Carbon Steel Stock
- (1) 1" Brass Lamp Shade Riser
- (1) 1/16" Shoulder Plane Iron

Exploded View Details

OVERALL DIMENSIONS:
1 1/16"W x 2 1/4"H x 6"L (plane body only)



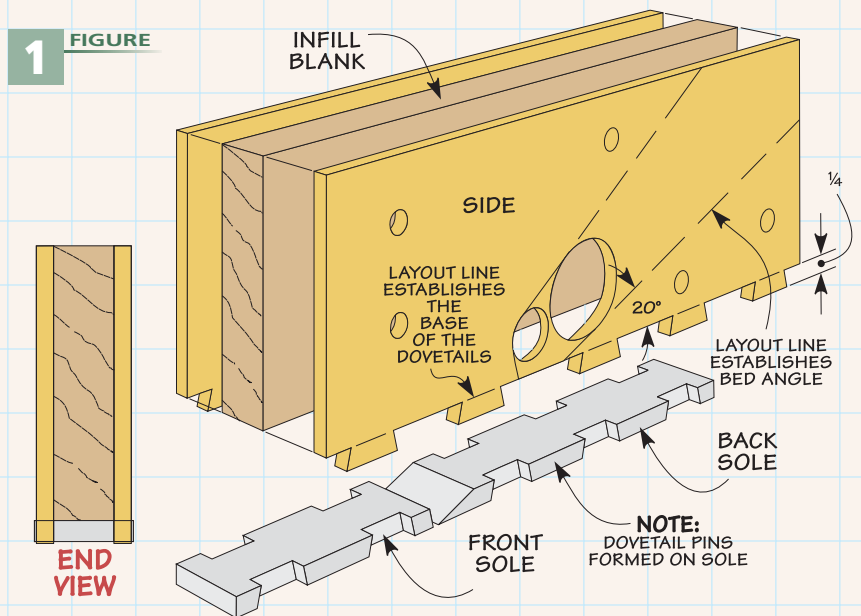
building the Plane Body

The shoulder plane is made from a pair of brass sides and two steel sole pieces that wrap around the wood infill pieces and wedge. You can see what I'm talking about in Figure 1.

The box below shows the step-by-step process to layout and cut the dovetails. But there are a few other things I want to mention.

Making the Sides. The first thing to do is make the brass sides since all the other pieces are made to fit them. You can turn to page 40 for an overview of the tools and techniques for working with metal.

Since the sides are identical, you can file and drill both at the same time, as shown in the box below. Using carpet tape to fasten them together, make sure to align one long edge and one short edge of each blank flush with the other. Now you can begin to make accu-



rate layout lines using layout dye and a sharp scribe.

Laying it Out. The first important layout line you'll need is the one to mark the bottom of the dovetails. I made this line $\frac{1}{4}$ " from the bottom edge as you can see in Figure 1. Since the sole is $\frac{3}{16}$ " thick,

that'll leave about $\frac{1}{16}$ " of brass to be peened over later when you lock the sides to the two sole pieces.

The next step establishes a reference line for the bed angle (Figure 1). The purpose of the bed is to provide support for the plane iron when it's wedged in place.

Step-by-Step: Filing Dovetails

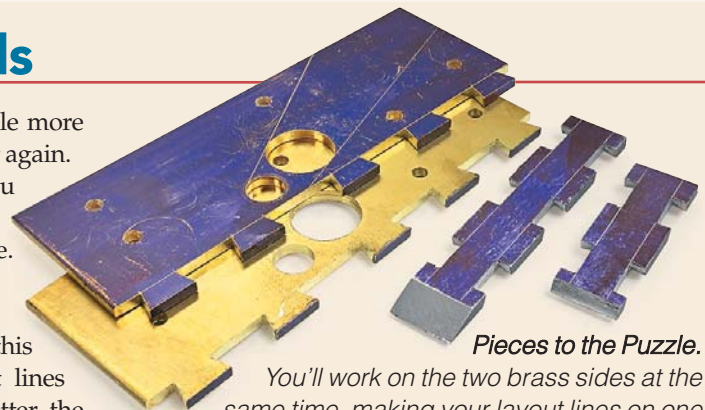
Filing the double dovetails isn't as hard as you might think. It'll take some time and patience to get everything to fit right, though. They start out like ordinary dovetails. But later on you'll turn them into double dovetails. Here is what you need to know to get started and get great-looking double dovetail joints.

Clean Layout Lines. Just like you do in woodworking, you'll be "working to a line." This means you'll need sharp layout lines for the best results. Layout dye and a sharp scribe make it easy to mark your lines in one pass (Step 1). This will guarantee a thin, precise line you can work to while filing.

Use Guide Blocks. When you're filing, the file can skate across the metal, especially as you start the cut. To help guide my file, I clamp some scrap wood blocks along my layout lines (Step 2). And if you do happen to accidentally remove a

layout line, just daub a little more layout fluid on and scribe it again.

Take Your Time. As you file closer to your layout line, take a little more care. And you might want to switch to a finer file. The more time you take at this point to get nice, straight lines and sharp corners, the better the dovetail joints will look in the end.



Pieces to the Puzzle.

You'll work on the two brass sides at the same time, making your layout lines on one side. The two steel sole pieces form the mouth.



1 Use a protractor and scribe to lay out the tails on the brass sides. I used an angle of 15° for looks and strength.



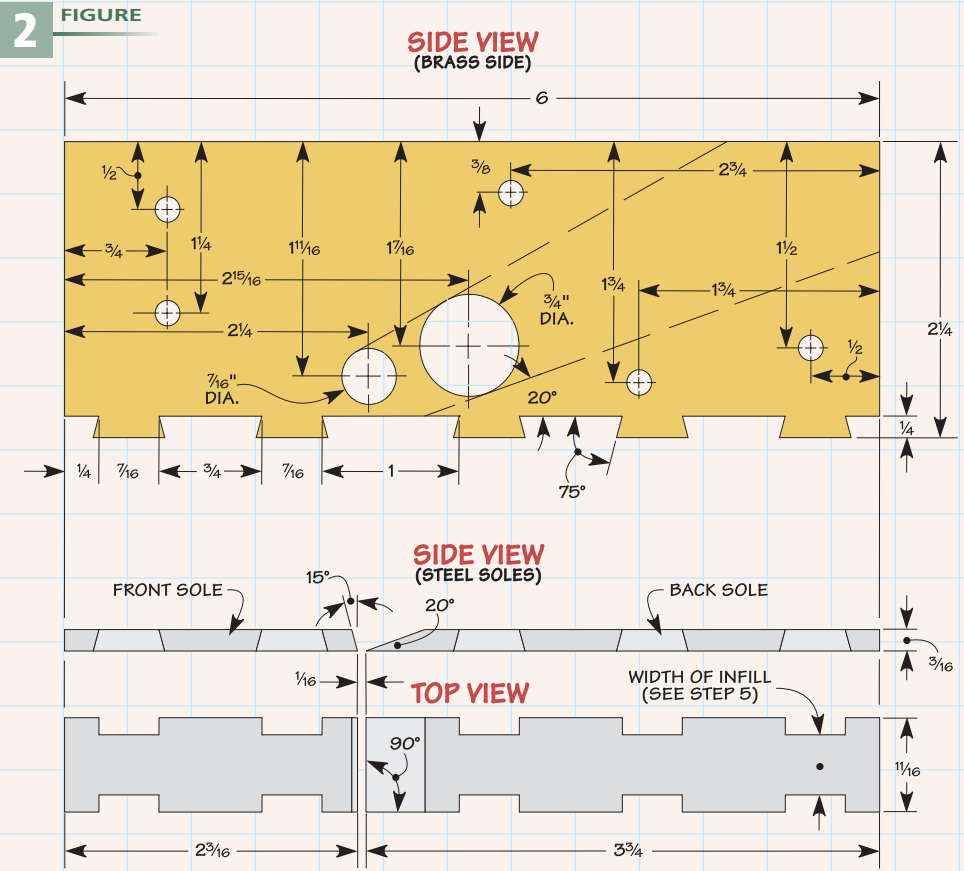
2 A square file quickly removes most of the waste. Then finish up the dovetails with triangular and needle files (inset).

You'll use the layout line when you position the sole piece on the brass sides. The bed angle on the sole should line up with this layout line.

Tight, Square Mouth. There's one thing to point out when it comes time to cut and assemble the two blanks for the sole. To take a nice, clean shaving from end grain, the mouth opening needs to be pretty narrow. I shoot for about $\frac{1}{16}$ " (or a bit less) for the mouth (Fig. 2). If it's too narrow, you can always open it up as I'll show you later.

Infill Blank. Before making the sole, I chose a nice piece of hardwood for the infill. (I used padauk.) Step 4 below shows you how to use your plane iron to determine the final thickness of the infill.

Filing for Tight Joints. With the layout lines in place and the infill blank in hand, you can follow the steps below to complete the sides and make the two sole pieces. I found it helpful to stop filing occasionally and test-fit the pieces until I got a nice, tight fit between them.



3 I used a $\frac{3}{4}$ "-dia. hole saw and $\frac{7}{16}$ "-dia. bit to rough out the mouth opening. Then drill $\frac{3}{16}$ "-dia. holes for the rivets.



4 Using the plane iron as a gauge, plane the infill stock down until the plane iron matches the width of the iron.



5 After centering the infill blank on the sole piece, you can scribe the baselines for the dovetails.



6 Use a wood guide, cut to match the bed angle, to file the 20° bevel on one end of the long sole blank.



7 With a spacer block, hold the two sole blanks between the sides. Then scribe the pin profile on the sole blanks.



8 Once you rough out the waste to form the pins (like you did on the tails), finish up with fine needle files for a tight fit.

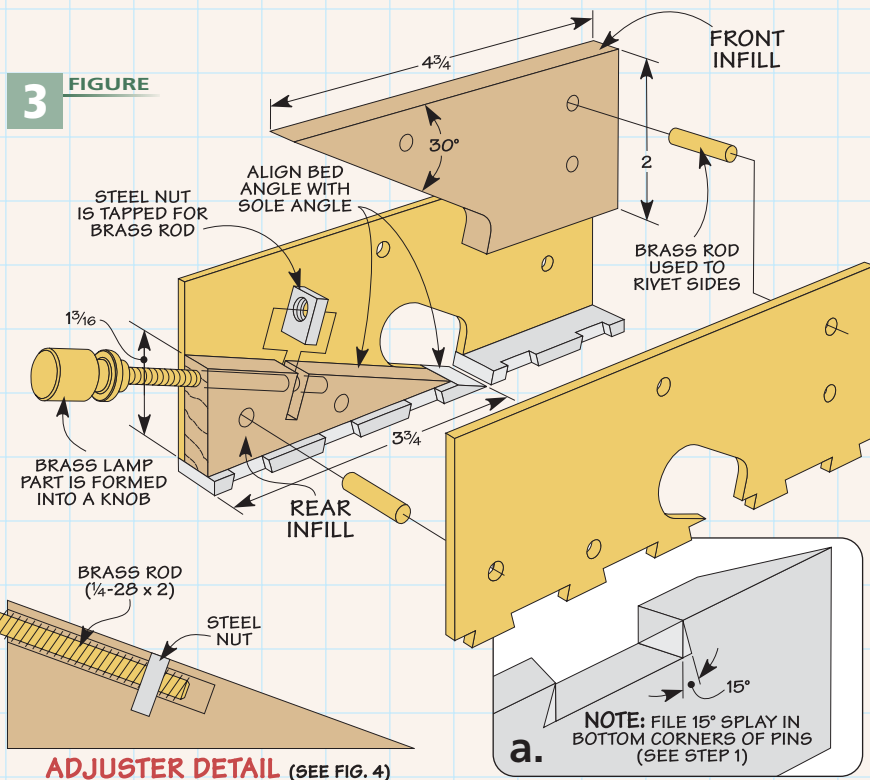
assembling the Body & Infill



▲ **Double Dovetails.** The simple trick to getting great-looking double dovetails is some careful filing.

At this point, the two sides and sole pieces should fit together nicely. But there's one more small step. To create the double dovetail look, you need to file a "splay" in each bottom corner of the pins on the sole pieces. This leaves a gap or pocket between the pins and the tails on the sides (detail 'a'). Then, when youpeen the brass sides to the sole, the brass fills in these little pockets, creating a locked joint. The box below shows you how to do this, along with the other steps you will need to do to complete the body.

Adjuster. Now that you have the "shell" of the plane done, you can move on to the infill and adjuster mechanism. The adjuster is made from three pieces. There's a knob, a



short length of threaded brass rod, and a shop-made, steel nut.

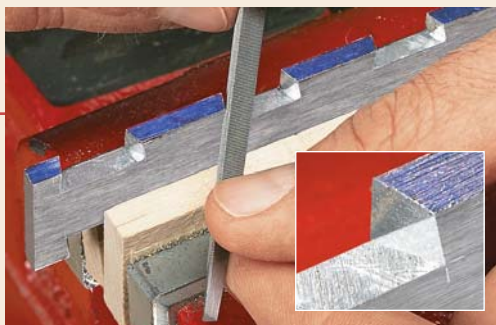
The knob is made from a lamp part called a lamp shade riser (margin photo on opposite page).

One end has a threaded hole that you'll use for the threaded brass rod. The other end has a stud that you can cut off. The top photo on the next page shows how I shaped

Step-by-Step: Peening

Peening the brass tails into the steel sole pins is what holds the plane body together. You actually "flow" the brass into the joints. The trick to making the double dovetail, though, is in filing the "splays" in the sole pieces, as shown in Step 1. All you're doing here is removing a small triangular section of material from the bottom corner of the pin.

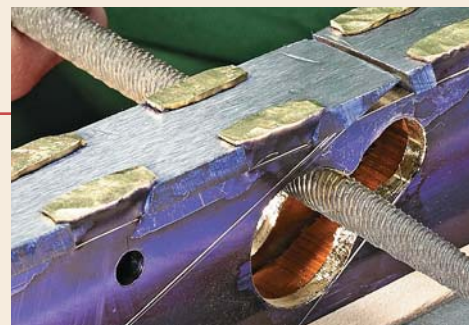
Peening Tips. Once that's done, it's time to peen the pieces together. There are some tricks to getting the best results. One is to have a solid surface to work on. I ended up using the peening buck (next page) on the concrete floor in my shop. Another trick is to make carefully directed hammer blows. It doesn't take a lot of force to move the brass into the joints. It'll look like a mess, but don't worry. You can take care of that when you file it smooth.



1 A triangular file is used to create the 15° "pockets" on the sole pins. This will make them look like tails after peening.



2 The object is to force the brass into the gaps in the sole. Work on a solid surface and take your time.



3 Use files to finish forming the mouth to its final shape. But don't file below the layout line for the bed angle.



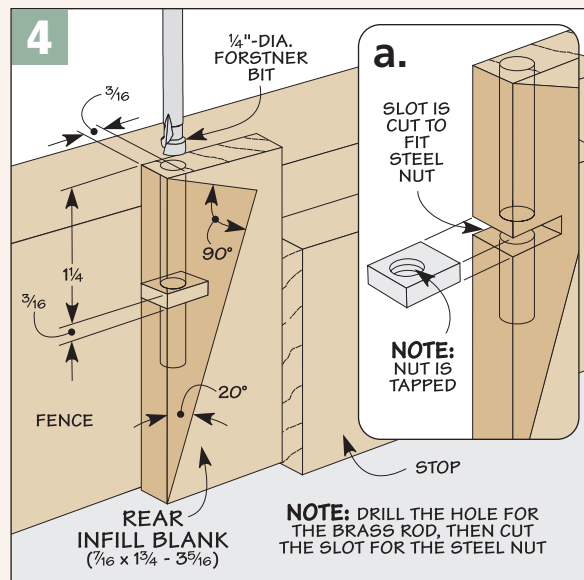
4 Mark and cut the infill pieces and drill the rivet holes. The rear infill should line up with the bed angle on the sole.

the knob on the drill press. The important thing is for the “collar” on the knob to fit into the adjustment slot on the plane iron. For fine adjustments, it should have a close fit without being too loose.

The shaft is a short length of 1/4"-28 threaded brass rod. The knob is threaded onto one end and the other end of the rod engages a shop-made steel nut in the infill. The drawing on the previous page shows how it goes together.

I made the nut for the adjuster from a piece of leftover steel I used for the sole. It's drilled and tapped with a 1/4"-28 thread.

Rear Infill. The rear infill is a triangular piece that houses the adjuster and forms the bed for the plane iron. You need to drill a hole for the adjustment rod and cut a slot for the nut. I found it was easier to do all this before cutting the infill piece to shape (Figure 4). After that, you can cut the 20° bed angle to match the sole and insert the infill into the body. Just make

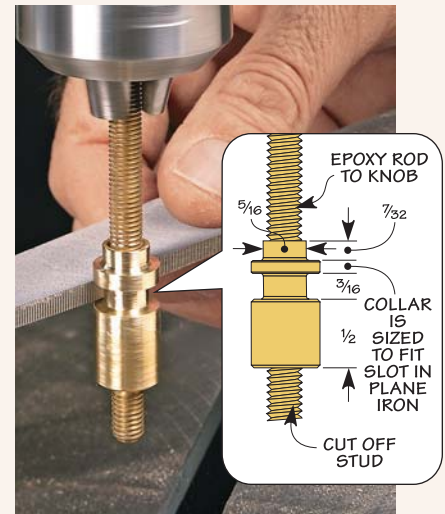


sure it lines up with the bed angle on the sole. Then you can trim the end flush with the brass sides.

Front Infill. The front infill is angled to match the shape of the wedge and hold it in place. (You'll make the wedge later). I roughed out the shape of the infill piece but didn't do any final work until I had

the mouth of the plane complete, as detailed in the box below.

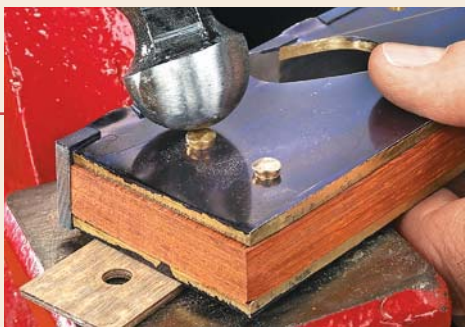
Rivets. The final step is to add the rivets that lock the sides and infill in place. I used a dab of epoxy to hold the infill pieces in place then drilled the rivet holes. After peening the rivets in place, they can be filed flush with the sides.



▲ “Turning” the Knob. Chuck the knob into the drill press and use files to shape it. The collar should fit the slot in the plane iron.



▲ Shade Riser. A brass lamp part is “turned” into the adjuster knob.



5 Scrap laminate with holes allows the rivets to “mushroom” on the bottom. Remove it when peening the other side.



6 A flat file smooths the sides and sole. Just be careful not to round over the edges of the plane body.

Peening Buck

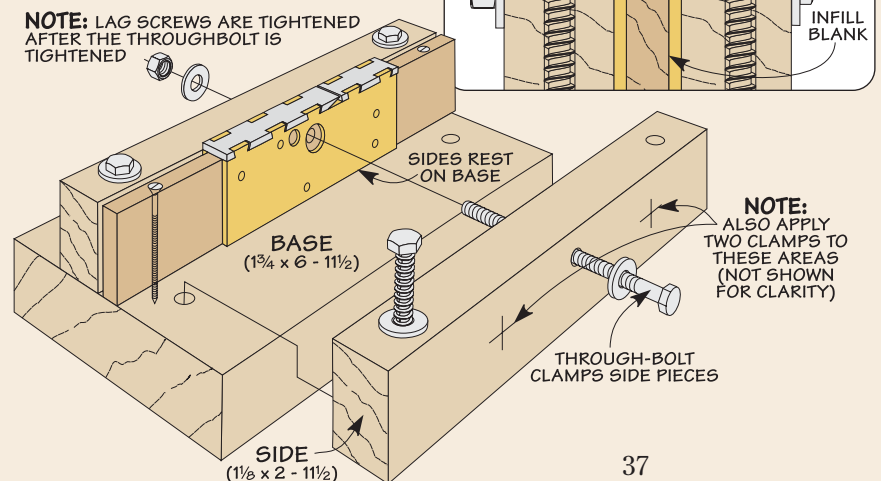
When peening the sides to the sole, I had trouble with the pieces shifting. So I came up with this “peening buck” to help hold the pieces securely.

The base and two side pieces are made from 1 1/2"-thick hardwood. The center support is planed to the same thickness as the infill and is glued and screwed securely to the base.

To hold the plane body in place while you're peening, the two side

pieces have oversized holes for a pair of lag screws. A bolt clamps the side pieces of the plane tight. Then you can tighten the lag screws down. Finally, place the assembly on a firm surface and start peening using firm, direct blows.

NOTE: LAG SCREWS ARE TIGHTENED AFTER THE THROUGH-BOLT IS TIGHTENED



adding the final Details

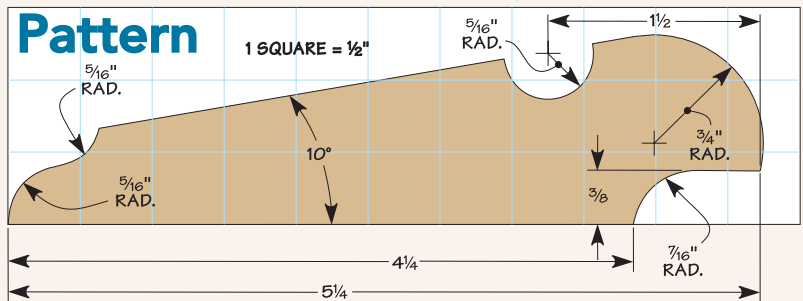
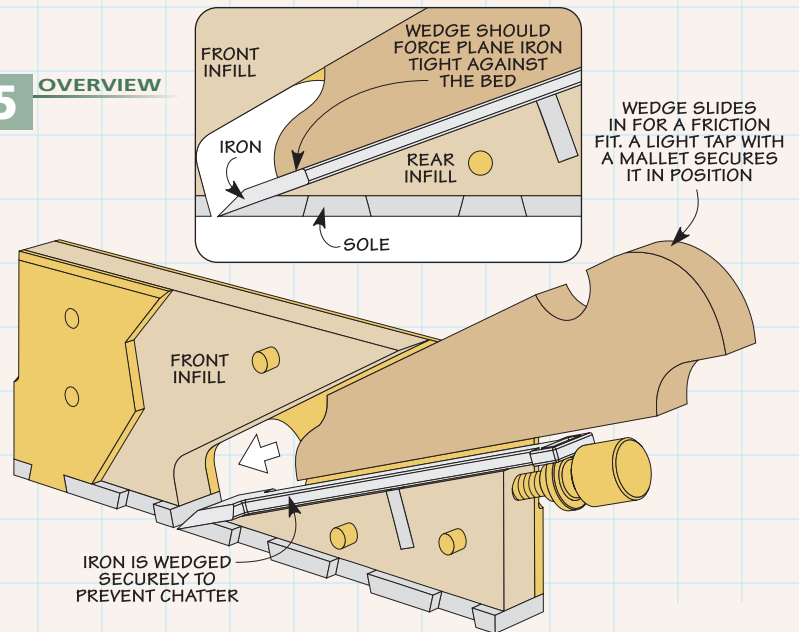
Now that you've got the body of the plane assembled, you can make the wedge and add a few last details.

Wedge. The wedge holds the plane iron securely in the plane. I made mine from the same stock as the infill. But you could use a different or contrasting hardwood for a "custom" look.

What's important is to shape the wedge so that it forces the plane iron tight against the bed, especially at the mouth. So some careful fitting is in order here.

You can use the drawings at right to rough out the shape of the wedge. Then it's just a matter of fine-tuning the fit as you go. The goal here is that the "nose" of the wedge should end up just slightly behind the bevel on the plane iron (see photo below). If the wedge is too tight to move that far forward, you can remove a little material at a time from the bottom edge, checking the fit as you work. Then you can sand the finger notches smooth and ease the edges.

5 OVERVIEW



Tuning. At this point your plane is almost functional. But there are a few details to take care of before giving it a workout (see box below). For starters, you need to

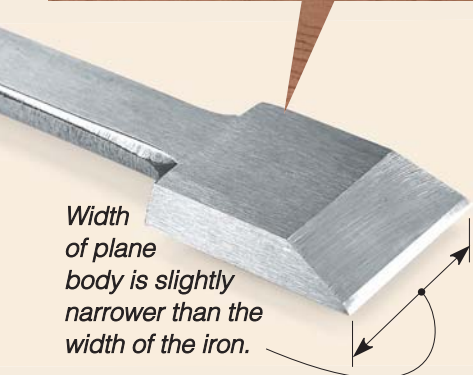
fine-tune the width of the plane body so that the iron projects a little from each side. This lets the plane remove shavings all the way into the corner of a joint.

Tuning Your Shoulder Plane

Now is the time to double check the width of the sole against the plane iron. You can use fine-cutting flat files and sandpaper to lap the sides of the plane to a smooth finish. The goal, besides a great appearance, is to have the edges of the plane iron projecting past the sides of the plane body just a hair. This helps the plane cut right into corners.

At the same time, you want to lap the sides and sole so they're square. Put some adhesive-backed sandpaper on your table saw and run the plane along the rip fence to keep the sides square with the sole.

Finally, check that the mouth is square to the sides and the bed is flat. The iron should sit tight against the bed without any gaps.



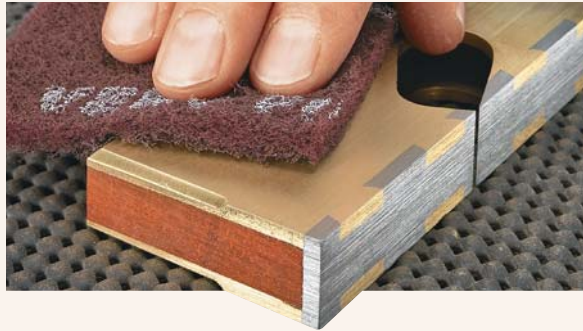
Chamfer and Polish. Traditional shoulder planes had a small chamfer on the edges. Besides adding a nice detail, it makes the plane more comfortable to use. A file makes quick work of adding the chamfers (upper right photo).

To finish up, I used some abrasive pads to polish the brass (lower right photo). A little oil gives a nice finish on the infill and wedge.

Once you've done this, you're ready to give the plane a try. The box below shows how to use your shoulder plane. After taking some time to get it set up just right, you'll be amazed at the results. 🛠️



◀ **Stopped Chamfers.** Use a flat file to form the chamfers on the edges of the plane.



◀ **Final Polish.** Use abrasive pads and wet/dry sandpaper to give the plane a polished look.

Using the Plane

Shoulder planes get their name from their ability to slice the end grain on a tenon shoulder (Figure 1). They're designed for fine-tuning joinery. Since the plane iron is a hair wider than the plane, it can get "into a corner" for professional results.

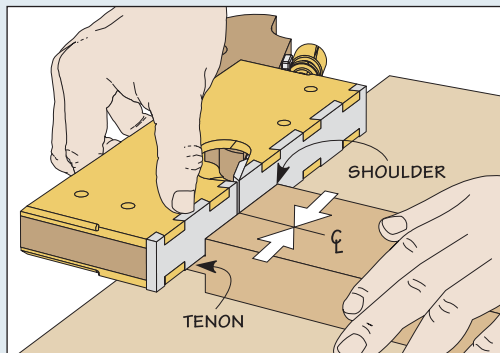
Tenons. When I want a perfect fit with mortise and tenon joinery, a shoulder plane can't be beat. I use it all the time to trim the cheeks of a tenon to get a snug fit in the mortise. And a couple of cuts on the tenon shoulders gives me nice, tight-fitting joints.

Rabbets and Dadoes. As you can see in Figures 2 and 3, a shoulder plane is also ideal for fine-tuning rabbets and dadoes. You can fine-tune the thickness of a rabbet by sneaking up on the fit. And it works just as well for cleaning up the shoulder.

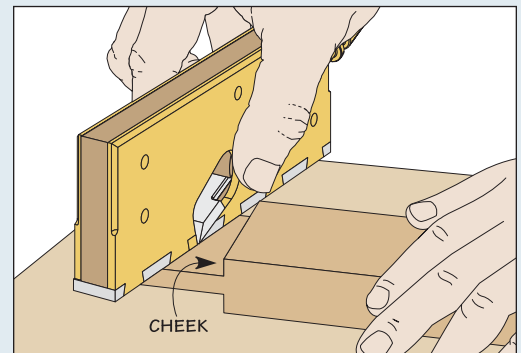
A dado blade is a great way to cut grooves and dadoes. But there's a problem. The bottom of a dado or groove can be rough. But a shoulder plane makes it easy to clean up the bottom of the dado.

Since the shoulder plane excels at working into corners, it works great on lap joints, too.

1. Tenons

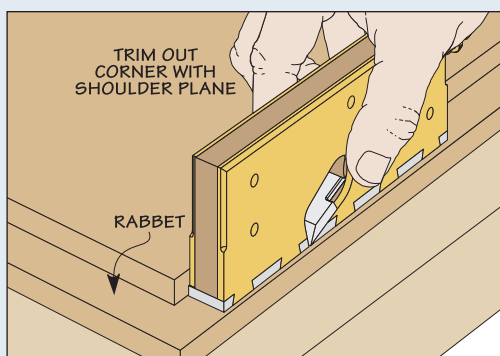


▲ **Shoulder Work.** The shoulder plane excels at slicing the end grain of a tenon shoulder. For best results and to prevent tearout, work from both sides toward the center.



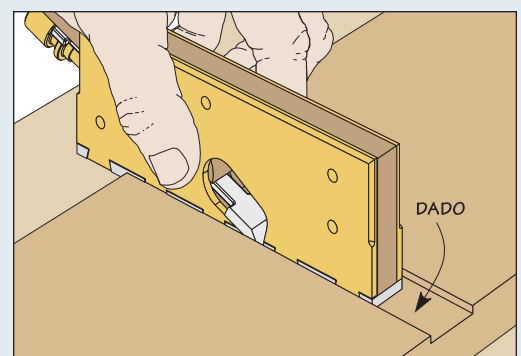
▲ **Smooth Cheeks.** Remove saw marks and sneak up on a snug fit using the shoulder plane. Shave equal amounts from both cheeks to keep the tenon centered on the workpiece.

2. Rabbets



▲ **Width and Depth.** Clean up the face of a rabbet and fine-tune the depth using the shoulder plane as shown. Flip it on its side to dress up the shoulder of the rabbet.

3. Dadoes & Grooves



▲ **Clean Bottoms.** A pass or two with a shoulder plane is all it takes to get rid of saw marks and create a smooth bottom in dadoes, grooves, and lap joints.